A METHOD FOR THE DESIGN OF GAMIFIED TRAININGS

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Abstract

The use of game elements in non-game contexts (gamification) -has previously been widely explored in contexts such as healthcare and marketing but less extensively in education and training. In this paper we explore the use of gamification in education and training. Traditional training methods often fail to engage or motivate students, especially Digital Natives raised from a young age with apps and games. This paper explores how class- or computer-based trainings can be (re)designed using gamification to increase student engagement and motivation. The paper first develops a taxonomy of game elements, based on a literature review. It then provides an Educational Game Element Database (EGEDB) that includes the taxonomy and that represents the effect of each game element on learning. Following a Design Science Research approach, the paper proposes a method for the design of ''gamified'' training. The method extends the instructional design model ADDIE (Analyze, Design, Develop, Implement, Evaluate) and uses the EGEDB to select game elements. We evaluate the method using a case study of gamified training design for a customer service contact team at Dutch Railways. The resulting gamified training design is evaluated by trainers from the same company.

Keywords: Gamification, Game Element, Instructional Design, Learning, Training.

1 INTRODUCTION

The widespread use of information technology in everyday life is changing expectations, requirements and opportunities for learning processes (Pivec et al. 2004). Traditional approaches to the delivery of training and education, such as face-to-face classes, do not always adequately engage or motivate trainees and learners (Gegenfurtner 2011). There is a need for innovative learning processes based on information technologies, seeking to develop and sustain learner engagement and motivation. A significant first move in that direction has been the development of electronic learning (e-learning) and computer-based training (CBT) (Prensky 2005): the transformation of traditional learning processes into an electronic environment, making them time- and place-independent and thus accessible, among other benefits. However, e-learning does not necessarily increase learner engagement or motivation (Muntean, 2011). A recent and promising innovation in training and learning, stemming from the extraordinary popularity and acceptance of computer games globally, is the use of games. Recent research suggests that games can help increase learner engagement and motivation (Prensky 2005; Garris et al. 2002; Squire 2008). However simplistic learning solutions based on games, such as developing a separate game for each learning task, are costly or otherwise disadvantageous. New innovative solutions for the use of games to support engagement and motivation in training and education are needed.

A promising potential solution is offered by gamification, a relatively new concept (Werbach and Hunter 2012) defined as *the use of game elements in non-game contexts* (Deterding et al. 2011). Gamification has become pervasive in public life: points, badges, and leaderboards have been introduced in several domains such as healthcare, fitness and marketing (Werbach and Hunter 2012). An example is Healthmonth (healthmonth.com), a web application that encourages users to adopt a healthier lifestyle. Rather than traditional web applications that provide diets and advice, Healthmonth motivates users by embedding game elements such as goal setting, progression indicators and rewards in a web application. Gamification has also received significant interest and application from businesses. Because game elements could be added to trainings to make them more engaging and motivating people to learn. For example, badges and leaderboards can be used in training new sales skills. Badges are rewarded when new skills are mastered and the leaderboard shows how far colleagues are in mastering new skills. However, many existing gamification initiatives have failed to achieve their intended objectives due to poor design (Gartner 2012). In particular and of interest to this paper, game elements may be selected without an adequate study of gamification objectives (Werbach and Hunter 2012) or application context (Hamari et al. 2014).

In this paper various game elements are investigated to assess their suitability for motivating learners in a business training context. While the use of games for education has been previously explored (cf. Squire (2008); Prensky (2005); Hwang and Wu (2012)), to date the selection of adequate individual game elements to boost the effectiveness of existing training has not been systematically studied. Existing frameworks for selecting game elements are limited or have not been developed from rigorous research (Simões et al. 2012; Werbach and Hunter 2012; Nah et al. 2013; Charles et al. 2009). This paper reports research that develops an Educational Game Element Database (EGEDB) combining game elements and their learning effects, integrating this database within a method to design 'gamified' training.

This paper makes several contributions to theory and practice. First, it adds to the growing literature concerning the use of gamification for education and training. In particular, the paper develops a comprehensive taxonomy of game elements for gamification, relating the game elements to research on learning effects. Second, its holistic viewpoint may be beneficial to the development of gamified tutorials (Li et al. 2014; Li et al. 2012). Third, it provides a foundational, top-down perspective that complements the many case-driven, bottom-up studies that use gamification for e-learning (Domínguez, Saenz-De-Navarrete et al. 2013) and apply game elements to higher education (e.g., see Barata et al.

(2013) and O'Donovan et al. (2013)). Fourth, it significantly extends early efforts to provide frameworks for the use of gamification in education (Nah et al. 2014; Dicheva et al. 2015).

The remainder of this paper is structured as follows. Section 2 describes the research method employed to develop the method to design gamified training. Section 3 presents a taxonomy of game elements identified during the literature review. Section 4 relates the game elements to research on learning effects. Section 5 details a method for designing gamified trainings. Section 6 presents an evaluation of the method at Dutch Railways. Finally, section 7 discusses conclusions, limitations and future research.

2 RESEARCH METHOD

A design science research approach was chosen for this research (Peffers et al. 2006; Vaishnavi and Kuechler, 2007). Design science research aims to develop knowledge by designing, creating and evaluating an artifact. In this research the artifact is a method for developing gamified training. The design science research process followed for this study is based on the cycle of Peffers et al. (2006), briefly described below. The cycle commences by identifying and defining a problem for which a solution in the form of an artifact, is needed. Next, alternative solutions are proposed . One alternative is selected as having the greatest potential and developed into a first draft artifact. This artifact is evaluated by testing or applying it in a laboratory environment or in practice. Based on the feedback and knowledge gained from the evaluation process, a refined version of the artifact is developed. Further iterations of evaluation and refinement are then performed until an evaluation is sufficiently positive. Finally, conclusions are drawn from the design experience and the artefact and conclusions are shared with researchers and other interested parties.

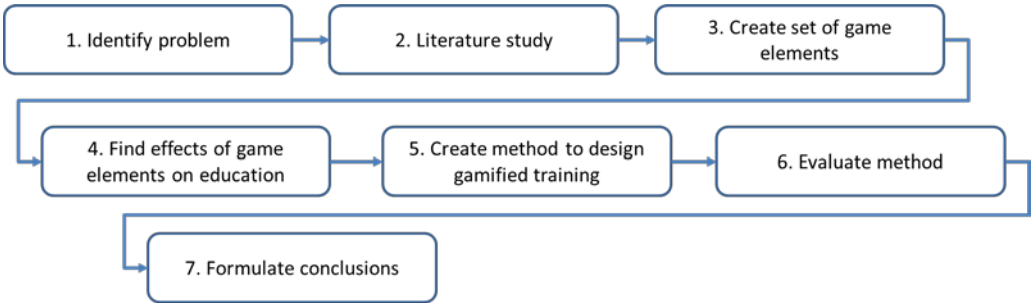

Figure 1 Applied design science research approach

We incorporated the design science research process of Peffers et al. (2006) within a broader research design as shown in Figure 1. The problem identified was that traditional, classroom-based training and education may fail to engage or motivate the learner. As discussed earlier, applying gamification when designing training and education may help increase engagement and motivation by making training more interesting and appealing. A literature review was performed to assess the current state of the field of gamification. Key concepts were analyzed and synthesized, resulting in a set of game elements that can be used for gamification (section 3). In addition, the effects of the various game elements on education were identified from the literature review (section 4). The set of game elements was integrated with the set of effects to underpin a newly developed method to design gamified training (section 5). To evaluate the new method, the method was applied at the Dutch Railways as now summarized (section 6). At the time of study the organization was in the process of discontinuing the paper train ticketing system and moving to a new electronic system. Seeking to address anticipated customer concerns about the discontinuation and forthcoming new system through its customer service contact team, Dutch Railways sought to team members on likely customer questions and appropriate respons-

es. By applying the newly developed method, a gamified training program was developed. The program was subsequently evaluated by trainers at the Dutch Railways.

3 GAME ELEMENTS FOR GAMIFICATION

A first step in the process to develop a method for gamified trainings is to gain a better understanding of the available game elements for gamification. To this end a literature review was conducted to identify game elements and develop a taxonomy. The starting point for the literature search was the paper by Deterding et al. (2011), one of the first papers to define gamification. In their paper, the authors provide a number of examples of game elements, including, for example: levels, points, and a story line. Searching the citations for this article and searching for 'game elements', 'game design', 'learning', 'education' and 'employee training' via Google Scholar, we identified sources that described game elements and sources that described games from which the elements could be derived.

The search and refinement of the search results led to 11 articles that specifically address game elements. When studying the articles, potential game elements and descriptions of game elements were coded. All codes were collected in a table and duplicates removed. Identical elements were renamed. This process resulted in the set of game elements shown in the second column of Table 1. The third column of the table identifies the sources in which the game elements were mentioned. In some cases a game element was mentioned in only one source while in other cases a game element was found in several sources. Although the aim was to be as complete as possible. The literature on game elements is still sparse and therefore a particular game element might not have been documented yet and not added to Table 1. Hence, it is assumed that the set of game elements needs to be revised as the field matures.

Once the set of game elements was finalized, we reviewed the elements for common characteristics with the aim of grouping the elements into a taxonomy of game elements. Various possible groupings were considered and the best option selected that had the least overlap between the categories (Table 1). Nevertheless, categories can be related and strengthen each other when applied together in games. The first column of Table 1 shows seven game element categories: *Progression*, *Rewards*, *Rules*, *Social*, *Competition*, *Communication* and *General*. The General category denotes game elements for which no category could be defined and which do not fit into other categories.

The *Progression* category (Adams 2013) includes game elements that can be used to assess the progress of a player. Typical examples of game elements in this category are *levels* and *objectives/goals*. A level is typically achieved when a specified number of tasks have been completed or when a player has proven to have mastered certain skills. Objectives are predefined goals that need to be completed in order to progress in a game. Another, less straightforward element in this category is *curiosity*, a game mechanic in which a player receives new information by progressing in a game. Curiosity motivates a player to persist and solve the problem at hand or master a specific skill, step by step.

The *Rewards* category (Salen and Zimmerman 2004; Deterding et al. 2011) includes game elements that stimulate extrinsic motivation. *Points* and *badges* are examples of rewards commonly employed in games. Points are awarded when certain actions are completed and provide important feedback to players that they are on the right track. *Badges* mark specific achievements that players have accomplished. They are similar to points but typically mark a major achievement that can be related to progressing to the next level or mastering a skill. Another reward is gaining access to certain (virtual) *resources* or *goods*; in games, such rewards or goods often serve as strategic tools that empower a player. Resources and goods are also awarded based on various achievements.

The *Rules* category (Salen and Zimmerman 2004) concerns the rules that constrain player behavior within a game. Without rules a game might be perceived as informal fun (Fullerton 2014). From a game design perspective, rules are formal game design schemas that focus on the essential logical and mathematical structures of a game. In addition to rules that define how to play a game, *time* and

chance are considered rules. Time constrains a player and indicates the time available to complete a task or action. Chance introduces randomness in a game and ensures that an action does not always yield the same result. It makes games less predictable and more interesting.

The *Social* category (Simões et al. 2012) stresses the social aspects in games and mainly involves communication and interaction between players. Working in *teams* is a good example of a social aspect. Collaboration enables players to exploit synergies in a game and increases enjoyment due to collaboration with live people rather than fictional characters. *Social graphs* is another game element that connects a player to friends playing the same game. A player observes friends' achievements or can chat about the game.

The *Competition* category (Werbach and Hunter 2012) concerns game elements associated with players competing with other players. A well-known game element used for this purpose are *leaderboards* which compare the score or achievements of game players. Observing the scores of other players motivates players to outperform competitors. The other element in this category is conflict/competition which concerns direct competition between players in a game where each player strives for the same objective - for example, crossing a finish line or winning a medal, with only one player able to win.

The *Communication* category (Kapp 2012) concerns player communication with a game (rather than with other players , which is the *Social* category). One game element is *feedback* about player performance. Certain other game elements, including points, rewards and leaderboards, can also be used for this purpose. The remaining game element in this category is *interaction*, which involves, for example, communication with game objects in order to acquire information.

The final game element category is the *General* category which includes elements not fitting into other categories. *Control* is experienced by players making certain choices which influence the direction in which a game unfolds. Another element in this category is *Fun*, a rather abstract and broad concept but an important reason why people enjoy games.

The game element taxonomy presented in Table 1 forms the basis for the Educational Game Element Database discussed in the next section.

Category	**Game Element**	**Source(s)**
Progression	Levels	(Hunicke et al. 2004; Deterding et al. 2011; Werbach and Hunter 2012; Kapp 2012)
	Quests	(Werbach and Hunter 2012)
	Story line	(Apperley 2006; Salen and Zimmerman 2004; Kapp 2012; Werbach and Hunter 2012; Deterding et al. 2011)
	Objective/goal	(Werbach and Hunter 2012; Kapp 2012; Salen & Zimmerman 2004; Prensky 2005; Deterding et al. 2011)
	Discovery	(Hunicke et al. 2004)
	Problem solving	(Prensky 2005)
	Characters	(Fullerton 2014; Aarseth 2003)
	Curiosity	(Pivec et al. 2004; Deterding et al. 2011)
Rewards	Points	(Salen and Zimmerman 2004; Deterding et al. 2011; Werbach and Hunter 2012; Kapp 2012)
	Badges	(Werbach amd Hunter 2012; Kapp 2012)
	Resources	(Werbach and Hunter 2012; Deterding et al. 2011)
	Win states	(Prensky 2005; Werbach and Hunter 2012)

Rules	General rules	(Prensky 2005; Deterding et al. 2011; Salen and Zimmerman 2004; Kapp 2012)
	Time constraints	(Kapp 2012; Salen and Zimmerman 2004; Hunicke et al. 2004; Deterding et al. 2011)
	Chance	(Werbach and Hunter 2012; Salen and Zimmerman 2004)
Social	Fellowship	(Hunicke et al. 2004; Deterding et al. 2011)
	Fantasy	(Pivec et al. 2004; Prensky 2005; Hunicke et al. 2004; Deterding et al. 2011)
	Avatars	(Bessière et al. 2007; Deterding et al. 2011; Werbach and Hunter 2012)
	Social Graph	(Werbach and Hunter 2012)
Competition	Leaderboards	(Werbach and Hunter 2012; Kapp 2012; Deterding et al. 2011)
	Competition	(Prensky 2005; Werbach and Hunter 2012; Kapp 2012; Deterding et al. 2011)
	Boss fights	(Werbach and Hunter 2012)
	Challenge	(Pivec et al. 2004; Hunicke et al. 2004; Deterding et al. 2011)
Communication	Feedback	(Kapp 2012; Werbach and Hunter 2012; Hunicke et al. 2004; Salen and Zimmerman 2004; Deterding et al. 2011)
	Interaction	(Prensky 2005)
General	Control	(Pivec et al. 2004)
	Fun	(Prensky 2005; Werbach and Hunter 2012; Deterding et al. 2011)
	Play	(Prensky 2005)

Table 1 Taxonomy of game elements (identified by literature review)

4 THE EDUCATIONAL GAME ELEMENT DATABASE

4.1 Effectiveness of gamification for educational purposes

Although using game elements in education is believed to increase the interactivity and engagement of the students, the effectiveness of using such elements is hard to measure (Pivec et al. 2004). This view is supported by Wilson et al. (2008) and based on an extensive literature review concerning the effects of games in education. Wilson and colleagues claim that it is unknown whether the relationship between games and learning is direct or indirect. Pivec et al. (2004) also suggest that the use of certain game elements can add to the intrinsic motivation that is present in training: the motivation to progress in a story that is part of a training program, for instance, is intrinsic, instead of the extrinsic motivation related to completing training. Przybylski et al. (2010) suggested that game rewards present some form of performance feedback and thereby show how the player got better and therefore they may promote intrinsic motivation under certain circumstances.

Hamari et al. (2014) researched the effectiveness of gamification for different contexts and implementations. The most commonly identified context was education and the outcomes were primarily positive. Their review of the literature reveals that using gamification in an educational context increases the enjoyment, the student experience, and learner motivation (intrinsic and extrinsic) and engagement. However, Hamari et al also identified some pitfalls, the most prominent being an increase in competition that results in demotivation, since not everybody enjoys competing with their peers for top places in the leaderboard (Werbach and Hunter 2012). Another drawback is that poorly designed gamified applications lead to impaired effectiveness.

The final conclusion presented in Hamari et al. (2014) is that gamification does work, but there are some pitfalls that need to be taken into account when trying to apply it. Furthermore, they conclude that the effects on learning outcomes are only partly attributable to the used game elements. Finally, they suggest that the effects of gamification depend on the characteristics of the player, as gamers exhibit different personalities.

4.2 Linking game elements with learning effects

Using games for learning has been proven effective (Blunt 2007). However, these previous studies do not differentiate the role and efficacy of the various game elements. In order to successfully apply gamification to training programs, the effects of the different game elements should be known. Otherwise the selected elements might not match the intended goals and training objectives might not be achieved. Therefore, a literature review was conducted to find learning effects for each of the game elements presented in our game element taxonomy (Table 2). The main source for the literature review was literature accessed through Google Scholar. The results of the initial search query were refined by removing the papers from before 2000 (i.e. not related to gamification), then selecting the papers that had "game" or "learning" in the title. The remaining papers were scanned for availability and relevance. Additionally, we used the snowball method in order to identify additional papers to lay the groundwork for our research. Most of the papers did not focus on one particular game element but often concerned a combination of game elements. Therefore, only when an effect on learning was found that could be subscribed to an individual game element was the element added to the Educational Game Element Database (EGEDB). The complete Educational Game Element Database is shown in Table 2.

Category	**Element**	**Effect (+ for positive, - for negative)**
Progression	Levels	+ Provide structure and reduce the risk of boredom (Werbach and Hunter 2012)
		+ Keep the game space manageable (Kapp 2012)
		+ Motivate players to continue playing (Kapp 2012)
	Quests	+ Increase motivation by providing a goal (Malone 1981)
		+ Keep outcomes measurable because progress is visible (Kapp 2012)
	Story Line	+ Adds context for the tasks in the training program and adds relevance (Kapp 2012)
		+ Makes the training more fun (Hunicke et al. 2004)
	Objective/Goal	+ Increases motivation since trainees will know what to do (Prensky 2005; Malone 1981)
		+ Makes the outcomes more measurable (Kapp 2012)
	Discovery	+ If the tasks contain either scaffolding, users explaining their own ideas or examples of success, discovery might enhance constructive learning (Alfieri and Brooks 2011)
		- Has little effect if too little guidance is provided and might even impair learning (Jong and Joolingen 1998; Alfieri and Brooks 2011)
	Problem Solving	+ Increases motivation, by challenging trainees (Prensky 2005)
		+ Sparks creativity of trainees (Prensky 2005)
	Characters (Story)	+ Adds context for the tasks in the training program and adds relevance (Kapp 2012)
	Curiosity	+ Increases trainee engagement (Eccles and Feltovich 2012)

Rewards	Points	+ Increases motivation of trainees as they receive a reward (Werbach and Hunter 2012; Kapp 2012)
		- May take away focus off training content (Kapp 2012)
	Badges	+ Increase motivation by rewarding trainees for certain achievements (Kapp 2012)
		- Decrease motivation since not everybody might appreciate them (Antin and Churchill 2011)
	Resources / Virtual Goods	+ Increase motivation since the trainees can receive them as a reward, or acquire new things in the game (Werbach and Hunter 2012)
		- Might take away the focus from the training content (Werbach and Hunter 2012)
	Win States	+ Increase motivation (by ego gratification) since people like to win (Prensky 2005; Werbach and Hunter 2012)
		- Demotivate trainees who lose (Werbach & Hunter 2012)
		- Demotivate trainees that keep winning, since they get the feeling they are done (Werbach and Hunter 2012)
Rules	General Rules	+ Limit actions of trainees (Kapp 2012)
		+ Keep the training manageable (Kapp 2012)
	Time (constraints)	+ Increase motivation, since trainees will know they have to take action (Kapp 2012)
		+ Increase tension and simulate or invoke stress (Hunicke et al. 2004)
		+ Increase performance consistency, since employees will be used to the stress (Aguinis and Kraiger 2009)
	Chance	+ Stimulates the sense of fun and curiosity with the trainees (Werbach and Hunter 2012)
		+ Increases engagement (Kapp 2012)
Social	Fellowship/Teams	+ Increases team cohesion of trainees (Hunicke et al. 2004)
		+ Stimulates sharing of information (Hunicke et al. 2004)
	Fantasy	+ Increases motivation, since trainees can identify with game characters (Lepper 1985)
		+ Increases interest of trainees and increase efficiency of learning (Pivec et al. 2004)
Competition	Leaderboard	+ Increases motivation, by making competition visible (Domínguez et al. 2013)
		- Decreases motivation of trainees if they fall behind in points (Werbach and Hunter 2012; Hunicke et al. 2004)
		+ Increases engagement, since trainees will try to rise on the leaderboard (Kapp 2012)
	Conflict/Competition	+ Increases motivation, since trainees will try to be better than their peers (Prensky 2005)
		+ Increases engagement, since trainees will keep trying to be better than their peers (Kapp 2012)
		- Decreases motivation (if a trainee falls too far behind) (Lewis & Maylor 2007; Domínguez et al. 2013)
		- Trainees that get too far ahead might fail to see improvements (Lewis and Maylor 2007)

Challenge	Challenge	+ Increases motivation as long as the challenge is feasible (Lepper 1985)
	Boss fights	+ Increase motivation, since it is a challenging goal (Prensky 2005)
		+ Increase engagement (Kapp 2012; Werbach and Hunter 2012)
Communication	Feedback	+ Increases motivation, because players directly see what their actions do (Prensky 2005; Domínguez et al. 2013)
		+ Evokes correct behaviour or thoughts (Kapp 2012)
	Interaction	+ Increases motivation, because they can better interact with the training material (Prensky 2005)
		+ Evokes correct behaviour or thoughts (Kapp 2012)
General	Control	+ Increases motivation, since trainees see that their actions evoke progress (Lepper 1985; Prensky 2005)
	Fun	+ Makes the trainees more relaxed, which decreases the effort they have to put into learning (Prensky 2005)
	Play	+ Nature's way of making learning engaging (Prensky 2005)

Table 2 The Educational Game Element Database

The most commonly identified effects of gamification on learning are an increase of engagement and motivation. However, other effects were found too. An example is a story line that adds context for the task in the training and adds relevance to the training as the trainee might recognize the specific context or situation (Kapp, 2012). From the context, as described in the source, it was determined whether the effect is positive or negative. A positive effect is prefixed with a plus symbol "+" , while a negative effect is prefixed with a minus symbol "-". It is also possible that game elements have both positive and negative effects. For example, the use of the element "Competition" would have the beneficial effect of increased motivation according to Prensky (2005), but it might also decrease motivation of employees as stated in Lewis and Maylor (2007) and Domínguez et al. (2013). The researchers found that if a player keeps losing, he or she loses motivation to keep trying. Additionally, a player that keeps winning will fail to see improvements in his/her work, since he or she is already winning.

There are also some elements for which no relevant research has been found. This does not mean that there is no effect, but rather that no research is available that empirically studied the effect. Furthermore, not all learning effects have been studied in detail and on occasion existing research is based on anecdotal evidence rather than solid scientific evidence. Additionally, the game elements that are reported in the literature are often tested in a single context and hence the generalizability of the results are not known yet. Hence, the EGEDB presented in Table 2 should be considered as a preliminary version. We believe that it should be revisited and updated when more research becomes available concerning the learning effects of each of the game elements.

5 GAMIFIED TRAINING DESIGN

This section describes the method that has been developed to design gamified training programs. The proposed method is based on the instructional design model ADDIE (Carliner 2003). ADDIE is a five-phase model consisting of the following phases: *Analysis*, *Design*, *Development*, *Implement* and *Evaluate*. The analysis phase concerns identifying the target groups and general training objectives. During the design phase, the type of training is determined, as well as the materials that will be used. Next, the development phase is about creating the actual training content. Once the content has been developed the training can be conducted, which will happen during the implementation phase. The final phase is the evaluation phase where evaluators assess whether training objectives have been met.

To effectively explain the details of the ADDIE instructional design model, the model has been documented in detail using the Process Deliverable Diagram (PDD) technique that has been developed in the domain of Method Engineering (Van de Weerd and Brinkkemper 2008). Due to paper space limitations it is not included in the paper but it is available upon request from the authors.

To transform the ADDIE model into a method for designing gamified training programs, we explored alternative ways to extend the model. Rather than adding new phases to the model, we elected to add several steps to the original phases. An important addition is the use of the EGEDB that was presented in the previous section.

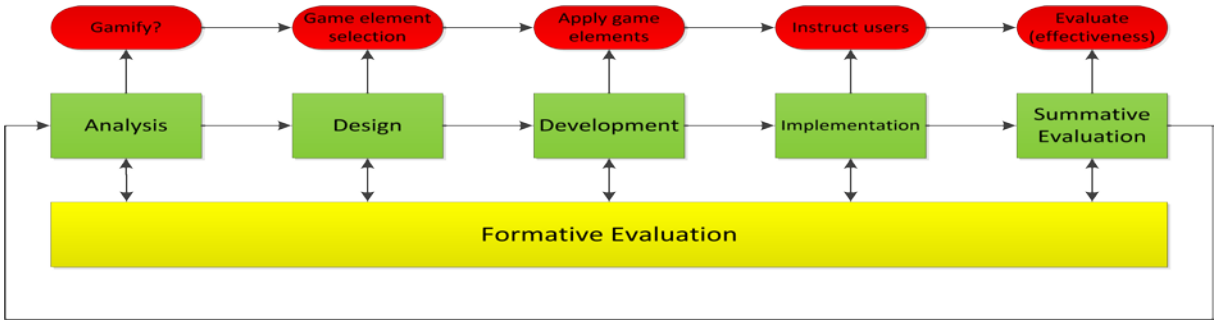

Figure 2 The modified ADDIE model

Figure 2 shows an overview of the changes that have been made to the original model. In the middle are the phases (in green) from the original model and on the top (in red) the additions that have been made to each phase are shown, and described below:

1. The analysis phase is modified by introducing a go/no-go decision: after the objectives and target group of the training have been determined, it should be decided whether or not to gamify the training. This decision depends on the budget and time available but also on previous experience with gamification and the trainees' IT proficiency. If there is no previous experience with gamification and the IT proficiency is low, gamification would be inadequate.
2. In the design phase, the most substantial addition is the introduction of the EGEDB. It concerns the selection of game elements and is driven by the chosen format and setup of the training which, in turn, should be in line with the objectives. Designers can select game elements from the EGEDB based on the intended learning effects they want to achieve. In the current state of the EGEDB, domain knowledge in gamification and instructional design is required for the analyst to select the game elements.
3. During the development phase, an application is created that supports the training and includes the game elements. Two main options exist: building a gamified application from scratch, or using gamification tools. The latter is a good choice if there is already an existing computer-based training application that can be gamified. Several gamification tools are available, including UserInfuser (code.google.com/p /userinfuser) and Openbadges (openbadges.org).
4. In the implementation phase, employees are trained using the gamified training application. This requires that the trainees are properly instructed about the use of the gamified training application and the role of the game elements in the training.
5. Finally, summative evaluation is enriched with a further evaluation activity concerning the effectiveness of the gamified training. Here, the trainees are asked about their experience. The outcome is used to reflect on the original decision to gamify, the choice of the game elements, and their implementation in the gamified training application.

This section described the ADDI model, which has been developed based on instructional design literature. In the next section an application of the extended ADDIE method at the Dutch Railways is described to test its applicability.

6 EVALUATING THE METHOD

The method described in the previous section has been tested and evaluated by experts. The following subsections discuss the case study and its limitations.

6.1 Case Study

The extended ADDIE method was used in a case study at the Dutch Railways (in Dutch: Nederlandse Spoorwegen, or in short: NS). The subject of the case was customer service training required for the planned discontinuation of the paper train ticket at NS from July 9, 2014. For the millions of customers of NS the discontinuation represented a significant change because as of this date they could only travel using an electronic card. NS predicted an increase in workload for the customer service contact team since many customers would likely have questions about the new situation. Therefore the customer service contact team needed to be trained so that they would be equipped to answer all possible questions from customers. Although a regular class-based training could have been developed for training the customer service contact team. They choose to experiment with a gamified training to investigate the added value of such a training. This provided an excellent opportunity to test the ADDI model. Since ADDI is based on a generic model for instructional design, it can be applied to this case.

6.2 Proposed solution

In order to elicit the requirements for the training program, semi-structured interviews were conducted with the trainers from customer service. During the interviews, the target groups, timing and detailed objectives for the training program were decided. The target group consisted of the contact team of the customer service department who would be responsible for handling customer questions. The contact team consists of more than 300 people, all of whom needed to undertake the training. The existing knowledge about the subject was already extensive, since all employees had been working for customer service for over a year and the majority already for several years. Therefore, the training did not contain any new content. Previous training of the target group consisted of traditional lectures, and thus there was no experience with gamification by the participants or the organization.

The content of the training was provided by NS, since the training should be designed specifically for the purpose of the discontinuation of the paper train ticket. The case study focused purely on the design of the training and the content of NS was used in order to complete the design. One of the main requirements was to employ gamification. The reason was that NS wanted to test a new style of training, since previously only lecture based training was used. In order to design the training program, the extended ADDIE method was used. Another requirement was that the knowledge of the trainees should be refreshed. Therefore, a quiz-type training was chosen (as presented in Prensky (2005)), in order to both test the current knowledge of the trainees and to make it more engaging by using game elements. The selection of the training type also aided in the selection of game elements, since a quiz generally contains points and time constraints. The training used several other game elements, such as chance, feedback and interaction. In order to make sure the focus remained on the content of the training, it was decided to award points only to every third question (as an experiment). Also this would help to avoid that people would be disappointed if they fall back to much in points (Werbach and Hunter 2012).

Figure 3 shows a wireframe of the final design. It features the leaderboard on the right side, the progression bar on the bottom, the question (with the multiple choice answers) on the left side and the clock (time constraint) in the top right corner of the question field. The frame depicts the state of the application where the contestant just chose the wrong answer, which is colored red. The correct answer is shown in green, to give the trainee immediate feedback on what is the correct answer. The application was designed to be used in groups of ten to fifteen people, guided by a trainer to explain the application and the questions that might arise during the training. The questions needed to be answered in turns by the trainees. Each participant of the groups would either have a screen that showed

the application, or the application would be shown on a beamer with the trainer acting like the quiz-master of the training program.

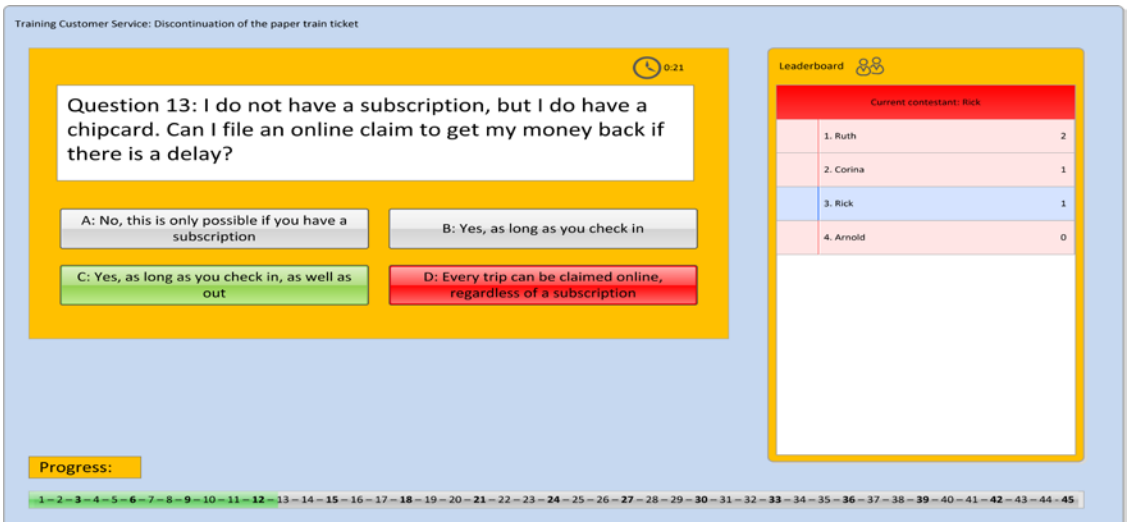

Figure 3 Wireframe of the designed training

6.3 Evaluating the design

Evaluation of the modified ADDIE method comprised two steps: evaluating the process and the training design. The evaluation took place in two sessions, during which the complete training design was discussed with internal training experts at NS. The evaluation commenced with experts evaluating the design document and all its elements. Finally, the prototype was shown and explained, after which three experts provided verbal feedback. Additionally, experts were given a feedback document by which they provided written evaluations of the gamified training design and the method itself. The baseline to which the experts compared the ADDI method, was their experience in designing traditional face-to-face class-based trainings.

The experts concluded that the design was well-structured and sound, and that the use of the different game elements was carefully considered. Additionally, the fact that the design was focused on training content was positively evaluated, and it was thought that the used game elements would not be distracting for trainees. Furthermore, the experts agreed with the choice for a quiz-type format as it matches the learning task. The experts suggested two improvements for the training method, the most important being that the current design was unclear on whether and when the trainer who supervised the training had time to explain any sources of confusion or answer questions. The other suggested improvement concerned the use of audio fragments in addition to the text based questions. The first improvement is considered particularly important as it provides feedback to the trainees resulting in a better understanding of the subject.

The second part of the evaluation assessed the method itself – that is, the steps in the process and the deliverables. During the evaluation it was explained that their current approach to designing training programs was not formally structured in a protocol. Typically, a new training program is based on a previous one. Therefore, the method presented in this study was an improvement as it shows how to design a gamified training according to a systematic approach. Such a method could result in training designs that could be used for other purposes than the original one. It was also observed by the internal experts that the resulting gamified training design was better documented than those that trainers would normally develop. The method was therefore beneficial as it provided an overview of all design choices.. Overall the experts agreed with the steps and deliverables which were considered clear, complete and useful. In particular, the addition of the game elements and the EGEDB to the design process were positively evaluated.

7 CONCLUSIONS

In this research, we focused on improving traditional training by adding game elements using gamification. To make gamification an integral part of the design process of trainings, we proposed a method to design gamified training. The method is based on the tested model for instructional design model, entitled ADDIE. Several steps have been added to the original model to account for gamification during the design process. A key ingredient of the proposed method is the Educational Game Element Database (EGEDB), which represents a newly developed taxonomy for game elements, and helps in assessing the function of the different game elements, by depicting the effect, either positive or negative, of each of the game elements on learning. Our EGEDB complements and extends recent theoretical frameworks concerning game elements in education; for example, it provides a more detailed analysis than Dicheva et al. (2015) concerning the effect of game elements, by providing a bigger set of elements, and by characterizing not only positive effects, but also negative ones. As such, the EGEDB provides a comprehensive evidence-grounded framework for researchers to analyze the strengths and weaknesses of game elements, and for practitioners to inform their design of gamified trainings. In the method, the EGEDB guides the designer in the selection of the game elements that best fit the objectives of the training. The method was applied to a case study at the Dutch Railways where the method was used to gamify a training program for the members of their customer service contact team. In addition the developed training program was evaluated by trainers of the Dutch Railways, resulting in several modifications to the method.

An important first insight gained from studying the design process and development of the method is that gamification can be used to create a different kind of training experience for employees. For one thing, it can increase intrinsic motivation and engagement. For another, as became clear in this study and as shown in the EGEDB, there are several possibilities for applying game elements to a training design and their effects on learning may vary. A second insight is that the gamification of training is a design process that extends well beyond merely adding leaderboards and points to an existing training program. To fully exploit the benefits of gamification for training design, the use of game elements in a training program should be considered early in the design process. The learning effects of each of the game elements should be weighed against one another and only those elements should be selected which contribute to the objectives of the training. Thirdly, designers should not only focus on the positive effects of gamification but also on possible side effects. An example of a potential negative side effect of gamification is demotivation of employees due to lagging behind in a leaderboard. Clearly the designer should take care to avoid this pitfall.

There are limitations to this research. First, as gamification is a relatively young field, prior research on game elements and the effect of game elements on learning is limited. Therefore, the taxonomy and the EGEDB should be considered as a beta release that requires further development when more research on gamification becomes available. Another direction for further research is to review a wide range of (serious) games and to distill game elements from them. Literature on game elements is typically lagging behind commercial game development. Therefore, studying games will provide the latest insights in the use of game elements. Moreover, the method for designing gamified trainings was only applied by the researchers in a single case. Although the ADDI model was not designed for the specific context of the case study, because it was derived from the literature. Further evaluation is required to test its generalizability. Furthermore, follow-up studies should focus on measuring whether gamified trainings are indeed delivering the benefits suggested by literature.

Acknowledgements

The authors like to thank Dr. Sharman Lichtenstein for proofreading the final version of the manuscript and making many valuable suggestions for language corrections.

References

Aarseth, E. (2003). Playing Research: Methodological approaches to game analysis. Proceedings of the Digital Arts and Culture Conference. May 19-23, Melbourne, Australia.

Adams, E. (2013). Fundamentals of game design. Pearson Education.

Aguinis, H. and Kraiger, K. (2009). Benefits of training and development for individuals and teams, organizations, and society. Annual review of psychology, 60, 451–74.

Alfieri, L. and Brooks, P. (2011). Does discovery-based instruction enhance learning? Journal of Educational Psychology, 103(1), 1-18.

Antin, J. and Churchill, E. (2011). Badges in social media: A social psychological perspective. CHI 2011 Gamification Workshop Proceedings. May 7-12, Vancouver, BC, Canada, p.1–4.

Apperley, T.H. (2006). Genre and game studies: Toward a critical approach to video game genres. Simulation & Gaming, 37(1), 6–23.

Barata, G., Gama, S., Jorge, J. and Gonçalves, D. (2013). So Fun It Hurts – Gamifying an Engineering Course. Proceedings of the International Conference on Augmented Cognition (AC), p. 639-648

Bessière, K., Seay, A. F. and Kiesler, S. (2007). The ideal elf: identity exploration in World of Warcraft. Cyber psychology & behavior, 10(4), 530–535.

Blunt, R. (2007). Does game-based learning work? Results from three recent studies. Proceedings of the Interservice/Industry Training, Simulation & Education Conference, p. 1–11.

Carliner, S. (2003). Training design basics. USA: American Society for Training and Development.

Charles, M., Bustard, D. and Black, M. (2009). Game inspired tool support for e-learning processes. Electronic Journal of e-Learning, 7(2), 101–110.

Deterding, S., Dixon, D. , Khaled, R. and Nacke, L. (2011). From game design elements to gamefulness: defining gamification. Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments. September 28-30, Tampere, Finland. New York, NY: ACM Press, p. 9–15.

Dicheva, D., Dichev, C., Agre, G. and Angelova, G. (2015). Gamification in Education: A Systematic Mapping Study. Educational Technology & Society, 18(3), 1–14.

Domínguez, A., Saenz-de-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagés, C., and Martínez-Herráiz, J. J.. (2013). Gamifying learning experiences: Practical implications and outcomes. Computers & Education, 63, 380–392.

Eccles, D.W. and Feltovich, P.J. (2012). Implications of Domain-General "Psychological Support Skills" for Transfer of Skill and Acquisition of Expertise. Performance Improvement Quarterly, 29(2), 43–60.

Fullerton, T. (2014). Game design workshop: a play centric approach to creating innovative games. Burlington, MA: Morgan Kaufmann (Elsevier).

Garris, R., Ahlers, R. and Driskell, J.E. (2002). Games, Motivation, and Learning: A Research and Practice Model. Simulation & Gaming, 33, 441–467.

Gegenfurtner, A. (2011). Motivation and transfer in professional training: A meta-analysis of the moderating effects of knowledge type, instruction, and assessment conditions. Educational Research Review, 6, 153–168.

Hamari, J., Koivisto, J. and Sarsa, H. (2014). Does Gamification Work? A Literature Review of Empirical Studies on Gamification. Proceedings of the 47th Hawaii International Conference on System Sciences (HICSS), p. 3025–3034.

Hunicke, R., LeBlanc, M. and Zubek, R. (2004). MDA: A formal approach to game design and game research. Proceedings of the AAAI Workshop on Challenges in Game AI. July 25-26, San Jose, CA.

Hwang, G.J. and Wu, P.H. (2012). Advancements and trends in digital game-based learning research: A review of publications in selected journals from 2001 to 2010. British Journal of Educational Technology, 43 (1).

Jong, T. de and Joolingen, W. Van (1998). Scientific discovery learning with computer simulations of conceptual domains. Review of educational research, 2(68), 179–201.

Kapp, K.M. (2012). The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education. San Francisco, CA: Pfeiffer (Wiley).

Lepper, M. (1985). Microcomputers in education: Motivational and social issues. American Psychologist, 40(1), 1-18.

Lewis, M. and Maylor, H. (2007). Game playing and operations management education. International Journal of Production Economics, 105(1), 134–149.

Li, W., Grossman, T. & Fitzmaurice, G. (2014). CADament: a gamified multiplayer software tutorial system. Proceedings of the Annual ACM Conference on Human Factors in Computing Systems (CHI), p. 3369–3378.

Li, W., Grossman, T. and Fitzmaurice, G. (2012). GamiCAD: A gamified tutorial system for first time AutoCAD users. Proceedings of the Annual ACM Symposium on User Interface Software and Technology (UIST), p. 103–112.

Malone, T. (1981). Toward a theory of intrinsically motivating instruction. Cognitive science, 4, pp. 333-369.

Muntean, C.I. (2011). Raising engagement in e-learning through gamification. Proceedings of the International Conference on Virtual Learning (ICVL), p. 323–329.

Nah, F. F.-H., Telaprolu, V. R., Rallapalli, S. and Venkata, P.R. (2013). Gamification of Education Using Computer Games. Proceedings of the International Conference on Human-Computer Interaction (HCI), p. 99-107.

Nah, F. F.-H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P. and Eschenbrenner, B. (2014). Gamification of Education: A Review of Literature. Proceedings of the International Conference on Human-Computer Interaction (HCI), p. 401-409.

O'Donovan, S., Gain, J. and Marais, P. (2013). A case study in the gamification of a university-level games development course. Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference (SAICSIT), p. 242–251.

Peffers, K., Tuunanen, T. and Gengler, C. (2006). The design science research process: a model for producing and presenting information systems research. Proceedings of the first international conference on design science research in information systems and technology (DESRIST 2006). February 24-25, Claremont, CA.

Pivec, M., Dziabenko, O. and Schinnerl, I. (2004). Game-based learning in universities and lifelong learning: “UniGame: Social Skills and Knowledge Training” game concept. Journal of Universal Computer Science, 10(1), 14–26.

Prensky, M. (2005). Computer games and learning: Digital game-based learning. Handbook of computer game studies. Cambridge, CA: MIT Press.

Przybylski, A., Rigby, C., and Ryan, R. (2010). A motivational model of video game engagement. Review of General Psychology, 14, 154–166.

Salen, K. and Zimmerman, E. (2004). Rules of Play: Game Design Fundamentals. Cambridge, CA:MIT Press.

Simões, J., Redondo, R.D. and Vilas, A.F. (2012). A social gamification framework for a K-6 learning platform. Computers in Human Behavior, 29(2), 345-353.

Squire, K. (2008). Video game–based learning: An emerging paradigm for instruction. Performance Improvement Quarterly, 21(2), 7–36.

Vaishnavi, V.K. and Kuechler, W. (2008). Design science research methods and patterns: innovating information and communication technology. New York, NY: Auerbach Publications (Taylor & Francis Group).

Werbach, K. and Hunter, D. (2012). For the win: How game thinking can revolutionize your business. Philadelphia, PA: Wharton Digital Press.

Wilson, K. A., Bedwell, W.L., Lazarra, E.H., Salas, E., Burke, C.S., Estock, J.L., Orivs, K.L. and Conkey, C. (2008). Relationships Between Game Attributes and Learning Outcomes: Review and Research Proposals. Simulation & Gaming, 40(2), 217–266.