IS IT ALL ABOUT HAVING FUN? – DEVELOPING A TAXONOMY TO GAMIFY INFORMATION SYSTEMS

Research paper

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Abstract

Gamification is a well-known approach that refers to the use of game design elements in information systems to make monotonous and tedious tasks more enjoyable. However, research and practice show that game design elements are oftentimes chosen and integrated in information systems randomly, therefore impeding the outcomes of such systems. In this regard, taxonomies can guide system developers, i.e., in selecting and combining game design elements to gamify their information system. Nonetheless, existing taxonomies do not provide such guidance for gamifying information systems. Therefore, the goal of our research is to consolidate the state of the art of gamification research and rigorously develop a gamification taxonomy. To achieve our goal, we conducted a systematic literature review and developed a taxonomy based on a rigorous taxonomy development process. We evaluate our theory by providing evidence of its feasibility with two practical cases: First, we show how the taxonomy helps to analyze existing gamification approaches, and, second, how the taxonomy guides to gamify information systems. Overall, we enrich theory by introducing a new taxonomy to better explain the meaning and characteristics of game design elements. Likewise, practitioners will be guided in selecting and combining game design elements for their gamification approaches.

Keywords: Gamification, Taxonomy, Game Design Elements, Categorization.

1 Introduction

As early as 1949, Johan Huizinga (1949) stated that the life of people evolves around playing. However, there is a difference between playing and games (Salen and Zimmerman 2004). Huizinga´s Homo Ludens is absorbed in games that are described as a free activity, independent from ordinary life. Since then this phenomenon has not changed. In fact, the use of games has increased at an astounding pace and has led to inspiring trends, one being gamification which counts among the most prominent developments during the last years (Hamari et al. 2016). Gamification is defined as the use and combination of game design elements in non-game contexts (Deterding et al. 2011) and involves the incorporation of gaming elements into monotonous and tedious tasks to make them more enjoyable (Thiebes et al. 2014), thereby increasing user activity (Deterding et al. 2011). Gamification can therefore be seen as the next stage of game development, broadening this very concept to areas in which games have not been part of until now, such as the workplace. As the concept of gamification gains popularity, research concerning the use of gamification in different fields such as education, health or crowdsourcing grows (Hamari et al. 2014; Suh et al. 2015). The broad concept of gamification offers many more research possibilities. The most important features of a gamification approach constitute its game design elements. Game design elements are oftentimes chosen randomly and integrated in information systems (IS) (Hanus and Fox 2015). Furthermore, in most cases it is not clear what game design elements represent (Liu et al. 2017). Some researchers merely describe game design elements by examples such as “levels and points” (Filsecker and Hickey 2014), whereas others introduce taxonomies (da Rocha Seixas et al. 2016). The most common taxonomy is MDA (mechanics, dynamics, and aesthetics) (Hunicke et al. 2004). However, although the MDA taxonomy is well-known, there are many in-

consistencies about what mechanics, dynamics, and aesthetics are. Faghihi et al. (2014) classify the game design element challenges as a game mechanic that is used as a building block to gamify a core offer, while Blohm and Leimeister (2013) define a challenge as an effect of mechanics on the subjective user experience. Finally, Hunicke (2004) classifies challenges as aesthetics, because a challenge represents the emotional response evoked in users when they interact with a game mechanic such as a level. Hence, current taxonomies, such as the MDA taxonomy, do not provide a clear understanding about the meaning of game design elements, and though, do not offer guidance in gamifying IS (Scheiner and Witt 2013). Without a guiding taxonomy, it becomes difficult to adapt gamification approaches to a certain context and therefore to the needs of a target group (Cheng et al. 2015). This can be seen in the different results of research studies that use the same game design elements. Haaranen et al. (2014) and Hamari et al. (2014) both implemented badges in an IS. Unlike Hamari et al. (2014), the authors Haaranen et al. (2014) could not prove positive effects on the user's motivation and behavior. These results can be traced back to the different understandings about the meaning of game design elements which can harm users motivation in the long term (Hanus and Fox 2015). According to Bui and Veit (2015), existing taxonomies lack rigor and need to be developed to provide more guidance in gamifying IS. Seaborn and Fels (2015) explain that there is a lack of consensus on proposed taxonomies. More precisely, the authors point out that gamification taxonomies have not yet been explored in detail. Therefore, research is necessary that consolidates and develops existing taxonomies (Seaborn and Fels 2015). Hence, the goal of our research is to enrich the body of knowledge in the field of gamification by presenting a taxonomy that supports practitioners and researchers to decide which game design elements to use and to combine. Furthermore, the taxonomy will be used to specify the meaning and connection of each game design element in contrast to others. This will help us to explain already gamified IS. Referring to this, our research paper will answer the following research question:

*RQ: How can the **meaning** and **construction** of game design elements be **represented in a taxonomy**?*

To achieve our goal, we follow the principles of Nickerson et al. (2013). This development includes the detailed analysis of several research papers. Our research contributes as a type I theory (Gregor 2006) to important streams of IS research and practice by aiding the analysis and design of gamified IS. First, we provide a novel taxonomy explaining already gamified IS and helping system designers to select, combine, and adapt game design elements to gamify IS. For this purpose, we will use the results of a literature review and the insights from existing taxonomies. This will be useful to provide guidance in gamifying IS. Furthermore, we bridge the gap between game design and development, as we provide insights about how the game design elements build up on each other which will provide implications about the selection and combination of game design elements to practitioners. The remainder of the paper proceeds as follows: in the next section, we will provide insights into the theoretical background. Afterwards, we will describe the methodology we applied in our paper, before we then introduce our developed taxonomy as well as the application of our taxonomy. Our paper closes with a discussion of our results and suggestions for future research, limitations and implications.

2 Theoretical Background and Related Work

In their work, Schlagenhaufer and Amberg (2015) claim that the first gamification system was introduced by Bunchball (2010). After that, companies started to use gamification for marketing purposes before expanding to other areas. Even though a limited number of definitions of the term gamification are available, two of the most common definitions are outlined by Deterding et al. (2011) and Hamari et al. (2014). Deterding et al. (2011) define gamification as "an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience and user engagement". On the other hand, Hamari et al. (2014) define the term as "a process of enhancing IS with (motivational) affordances to invoke gameful experiences and provoke behavioral outcomes such as continuous use". Additionally, Hamari et al. (2014) suggest that gamification contains three parts, namely the implemented motivational affordances, the directly induced psychological outcomes and the consecutive behavioral outcomes. Other descriptions of the term gamification, for instance by Thiebes et al.

(2014), also characterize gamification as the application of game principles to existing organizational real-world problems, situations, or processes. To combine the definitions of previous works, we define gamification as the use and combination of game design elements in non-entertainment-based contexts (Deterding et al. 2011), which induces positive psychological outcomes (Hamari et al. 2014) by addressing the motives of specific users and, thus, provokes behavioral outcomes. The goal of our research is to develop a taxonomy that explains gamified IS and that helps researchers and designers to gamify IS.

To develop our taxonomy, we conducted a systematic literature review, which will be presented in the following section. We used the results of our literature review to analyze existing taxonomies and by doing so identified three different taxonomies. The mechanics, dynamics, aesthetics (MDA) framework is the taxonomy most prominently used to gamify IS and it was developed by Hunicke et al. (2004). Mechanics are particular components of the game at the level of data representation and algorithms such as levels. Dynamics describe the run-time behavior of the mechanics acting on an individual's input and its output over time such as competition. Finally, aesthetics describe the emotional responses evoked in the individual when he or she interacts with the game system and for example faces challenges. Alcivar et al. (2016) and Cavavo et al. (2016) define a mechanics, dynamics and components (MDC) taxonomy. Mechanics are defined as mechanisms used to reward users, dynamics are defined as the most abstract game elements and components as the least abstract ones. Finally, the authors Weiser et al. (2015) define a taxonomy of motivational affordances (TMA) which includes design principles, mechanics, and elements. Design principles are guidelines for the design process such as a meaningful story. Mechanics are possible means of interaction between users and a system, and elements are building blocks to gamify an IS. To the best of our knowledge and according to our subsequently presented literature review, the MDC and TMA taxonomy were not yet applied by other research studies. Therefore, we focussed on analysing the application of MDA which was used by nearly all studies, and we are able to identify five problem clusters that arise from the application of MDA in different research studies. The problem clusters and the resulting problems can be seen in Table 1.

The table presents five problem clusters. The first observation of the studies that applied MDA indicates that there are *differences in the meaning and characteristics* of game design elements. This makes it more difficult for other researchers and designer to apply MDA to gamify an IS due to incompleteness of used taxonomies, different definitions of mechanics, dynamics, and aesthetics, and different categorizations of game design elements. The second problem cluster summarizes the *incomplete application of all three characteristics of the taxonomy*. Dynamics and aesthetic, for example, indicate which kind of emotions and motives are triggered by specific game design elements. This is necessary because most gamification approaches are developed as a one-size-fits-all approach, without considering the idiosyncratic needs and motives of users, which can then lead to negative effects in a user's motivation (Hanus and Fox 2015; Santhanam et al. 2016). Since several research studies have a different understanding of the meaning of game design elements, it gets more difficult to adapt gamification approaches to the needs of users. Hence, it is not clear how and which emotions are going to be evoked in a user. Referring to the *different understandings about the three characteristics*, we were able to observe that some game design elements merely summarize other game design elements such as rewards and achievements. Again, problems arise regarding the missing guidance for designers and researchers as well as the unavailable explanation of the effects on a user's motivation and behavior. Another problem cluster is the *missing representation of connections between game design elements*. Many studies merely summarize which game design elements have been categorized as mechanics, dynamics or aesthetics. Hunicke et al. (2004) explain that dynamics describe the run-time behavior of the mechanics which lead to emotions. A leaderboard addresses the dynamic competition which can lead to social recognition (Blohm and Leimeister 2013). In this case, the effects caused by game design elements are unknown. Again, this makes it difficult for designers to transfer a gamification approach to other ISs. Finally, there are different degrees of details concerning the definition of mechanics, dynamics and aesthetics. For example, Suh et al. (2015) define mechanics as tools, techniques or

widgets. However, it is not specified which mechanics are tools, which ones are techniques, and which are widgets. This can also lead to unexplained effects and a missing guidance in gamify IS.

Problem Cluster	Description	Resulting Barriers
Inconsistent assignments of game design elements	Bista (2014) assigned game design elements such as points or badges to dynamics, whereas Toda et al. (2014) assign them to mechanics.	• Not applicable for other designers or researchers due to inconsistent assignment of elements.
Incomplete application of all mechanics, dynamics, and aesthetics	Seixas et al. (2016) and Simoes et al. (2013) do not define aesthetics. Hence, it is not clear which emotional response should be evoked in users. Bista et al. (2014) merely specify dynamics and aesthetics. Because mechanics are the components to gamify an IS, it is not outlined which components were integrated in their IS.	• Unpredictable outcomes because it is unknown which elements cause motivating effects and whether and how emotions are evoked. • No consideration of user needs such as motives or aesthetics.
Encapsulation of elements that are assigned to mechanics, dynamics or aesthetics	Simoes et al. (2013) define rewards as dynamics. Bista (2014) defines them as aesthetics. However, game design elements such as badges, a leaderboard or points can all be used as a reward (Thiebes et al. 2014).	• Unpredictable outcomes because it is unknown which elements cause motivating effects and whether and how emotions are evoked. • Not applicable for other designers or researchers due to inconsistent categorization of elements.
Missing representation of connections between game design elements that are assigned to mechanics, dynamics, and aesthetics	Ibanez et al. (2014) assign different game design elements to mechanics, dynamics, and aesthetics. However, they do not outline the connections between the assigned game design elements. It is not clear which mechanic leads to which dynamic and which emotions are addressed.	• Unpredictable outcomes because it is unknown which elements cause motivating effects and whether and how emotions are evoked. • Not applicable for other designers or researchers due to unknown relations between elements.
Different degrees of details of definitions of mechanics, dynamics, and aesthetics	Ibanez et al. (2014) define dynamics and claim that they drive users into a state of flow. On the other hand, Bista (2014) defines that dynamics are used to cause fun. Toda et al (2014) explain that mechanics are the utilized mechanisms within a system. Suh et al.(2015) define them as tools, techniques, and widgets.	• Unpredictable outcomes because it is unknown which elements cause motivating effects and whether and how emotions are evoked. • Not applicable for other designers or researchers due to different understandings about meaning of categories.

Table 1. Problem Cluster of MDA Application

Overall, these problems arise because of ambivalent meanings of game design elements and the lack of conceptual clarity regarding their categories. Furthermore, there are various understandings about the meaning of individual game design elements such as rewards. Different problems with the application of MDA can be drawn back to several issues. First, the original definitions of mechanics, dynamics and aesthetics are not precise enough. Second, definitions of mechanics, dynamics and aesthetics are ambiguous. Third, the MDA taxonomy does not specify which elements are assigned to mechanics, dynamics, and aesthetics. Summarizing these insights, we can say that there are some inconsistencies regarding the meaning of already defined gamification taxonomies. To bridge this gap, our research provides a novel taxonomy that clarifies the meaning of each game design element and that, therefore, provides guidance in selecting and combining game design elements for gamification approaches.

3 Method

A fundamental problem in gamification research is the classification of game design elements into clear and meaningful categories. Therefore, a taxonomy can be used that allows a classification of objects of interest (Nickerson et al. 2013). Nickerson et al. (2013) point out that taxonomies play an important role in research and management because the classification of objects helps researchers and practitioners to understand and analyze complex domains. They provide a structure and an organization to the knowledge of a field which enables researchers and designers to study the relationships among different objects, and in our case, among game design elements (Glass and Vessey I. 1995; Nickerson et al. 2013). Furthermore, Iivari (2007) explains that taxonomies aim at identifying essences within the research territory and their relationships. They also explain that conceptual knowledge, including taxonomies, does not have a truth value but is a relevant input for the development of theories representing forms of descriptive knowledge which do have a truth value (Iivari 2007). A taxonomy is a form of classification, and, as mentioned above, the terms typology and framework are also used to describe a taxonomy (Nickerson et al. 2013).

Keywords	**Databases and Amount of Identified Paper**					
	ACM	AIS	EBSCO	Emerald	IEEE	JSTOR
Gamification	337	118	547	118	347	5
Game Design Elements	23	50	2	50	16	4
Total amount:	***1617 papers***					

Table 2. Results of Literature Survey

To develop a taxonomy, literature is needed that is the basis for the systematic and stepwise development of a taxonomy. According to Nickerson et al. (2013), many papers do not base their developed taxonomy on a theoretical foundation. More precisely, the authors explain, that although authors review the literature in their field on interest, their taxonomy is often not based on a systematic literature review but instead is ad hoc (Nickerson et al. 2013). However, to develop a taxonomy, researchers should consider the most important insights from previous research studies. Therefore, we first conducted a systematic literature review according to Webster and Watson (2002) and vom Brocke (2009). Table 2 provides an overview of the results. The goal of our systematic literature was twofold. First, we wanted to analyze how taxonomies were used in previous research studies. Second, we wanted to identify how research studies define and design game mechanics, which helped us to derive the meaning and structure of each game mechanic in detail. To cover a broad set of publications, we used the keywords "gamification" and "game design elements" in six different databases. As seen in Table 2, the search displayed numerous publications by using the keywords represented above, so certain criteria had to be used to limit the number of publications. The papers had to focus on either gamification in terms of definition or game design elements, or on game design. As a great amount of papers fit the criteria presented above, the second step of the search process was to exclude the papers that were not relevant for the analysis as they did not present an outline of the game design elements that they used. On the other hand, in this stage of the process a lot of papers were found through cross-referencing. Out of the papers found by using the keywords "gamification" and "game design elements", 89 papers remained as relevant for the analysis. These papers are marked with an asterisk in references. To develop our taxonomy based on the identified papers, we followed the recommendations of Nickerson et al. (2013). An overview of the different steps is provided in Figure 1.

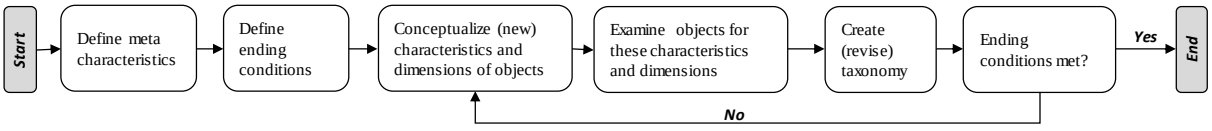


Figure 1. Process Steps of Taxonomy Development according to Nickerson et al. (2013)

Nickerson et al. (2013) point out that a taxonomy should fulfil certain qualitative attributes. First, a taxonomy should be concise and contain a limited number of dimensions and characteristics for each dimension. Second, it should be robust but still contain enough dimensions and characteristics to allow a clear separation of the objects that are being compared. Third, the taxonomy should be comprehensive which means that it can classify all known objects within a domain and include all dimensions of the objects of interest. Fourth, it should be explanatory, allowing the taxonomy to be used to identify where an object is found in the taxonomy. Finally, a taxonomy should be extendible which means that it should allow the inclusion of additional dimension and characteristics if new objects appear. When starting to develop a taxonomy, the first step is the definition of meta-characteristics that depend on the purpose of the taxonomy. As a second step, Nickerson et al. (2013) recommend determining ending conditions such as the examination of all objects or representative samples of objects or the fact that at least one object is classified under each characteristic of every dimension. Referring to our gamification taxonomy, we decided to stop when each game design element is classified under every characteristic of every dimension. As a next step, the taxonomy development method includes the iterative conduction of steps, beginning with either an empirical-to-conceptual or a conceptual-to-empirical approach and exchange between them. They recommend beginning with the conceptual-to-empirical approach if little data are available but the researcher has a good understanding of the domain and to start with the empirical-to-conceptual approach if the researcher has little understanding of the domain but a lot of available data about the objects. We used a conceptual-to-empirical approach for our case. The steps just described are repeated until the ending conditions are fulfilled and the taxonomy is completed.

4 Results

In the following, we are going to present our taxonomy as a first step. As a second step, we will use our taxonomy to explain an already gamified IS. Finally, we will use our taxonomy to gamify an IS.

4.1 Taxonomy

Referring to our literature review, we used the identified papers to analyze which game design elements were used in previous studies and how they were structured, categorized and defined. Furthermore, we analyzed which taxonomies current studies have used.

Term	Alternatives	Term	Alternatives	Term	Alternatives
Collection System	• Scoring System	Leaderboard	• Ranking • Score Board	Tasks	• Missions • Quests • Assignments • Goals
Points	• Experience Points • Scores	Level	• User Level • Progression		
Badges	• Trophies • Medals • Stamps • Awards	Progress Bar	• Progress • Performance Graph • Performance Stars	Narratives	• Meaningful Stories • Stories
		Feedback	• Audible Feedback	Reminder	• History
Virtual Goods	• Gifts	Avatar	• Roles • Virtual Character • Character	Time Pressure	• Time Limit • Deadline • Time Banking

Figure 2. Alternative Terms of Game Design Elements

Our taxonomy will be based on game mechanics that constitute the initial components of the game within an IS. However, game mechanics often correlated and had similar names. To avoid confusion, terms will be used as outlined in Figure 2. For instance, “badges” and “trophies” are both visual icons that represent milestones a user has reached. A “ranking” or a “leaderboard” is used to show a user’s progress in collecting “points” or “scores”. In all cases, game design elements have the same definition and meaning but are used with different names. According to Nickerson et al. (2013), we derived the structure and features of game mechanics as our meta characteristic and derived it’s characteristics

for our taxonomy in an iterative process. In total, we identified 10 different characteristics. The final taxonomy is presented in Table 3.

	Characteristics																			
	1		2		3		4		5		6		7		8		9		10	
Game Mechanics	Rewarding	Not Rewarding	Punishing	Not Punishing	Bonus	No Bonus	Independent	Dependent	Developing	Static	Partial Involvement	No User Involvement	Competitive	No Competitive	Cooperation possible	Individual	Intrinsically	Not Intrinsically	Extrinsically	Not Extrinsically
Collection System		x		x		x		x	x			x		x		x	x			x
Points	x		x		x		x			x		x	x		x			x	x	
Badges	x		x		x		x			x	x		x		x			x	x	
Virtual Goods	x		x		x			x		x	x		x		x			x	x	
Leaderboard		x		x		x		x	x			x	x			x	x			x
Level		x		x		x		x	x			x		x		x	x			x
Progress Bar		x		x		x		x	x			x		x		x	x			x
Feedback		x		x		x	x			x		x		x		x	x			x
Representing Avatar		x		x		x	x			x	x			x		x	x			x
Interacting Avatar		x		x		x	x			x		x		x		x	x			x
Tasks		x		x		x	x			x	x		x		x		x		x	
Narratives		x		x		x	x			x		x		x		x	x			x
Reminder		x		x		x	x		x			x		x		x	x			x
Time Pressure		x		x		*x*	x			x		x	x			x	x			x
Legend: 1=Reward, 2=Punishment, 3=Bonus, 4=Interdependency, 5=Development, 6=User Design, 7=Competition, 8=Cooperation, 9=Intrinsic Motivation, 10=Extrinsic Motivation																				

Table 3. Taxonomy for Game Mechanics

In the following, we provide an overview about the characteristics presented in our taxonomy:

- **Reward**: We classify game mechanics as rewards when a tangible and desirable item (Seaborn and Fels 2015) is given to a user for successfully committing an activity or task (Weiser et al. 2015).
- **Punishment:** If a tangible and desirable item is taken away from a user, because they failed committing an activity, we refer to it as punishment (Thiebes et al. 2014).
- **Bonus:** Some game mechanics act as bonuses and can therefore be characterized as tangible and desirable elements that are given to users (Mollick and Rothbard 2014) for successfully completing a series of activities (Melero et al. 2015).
- **Interdependency:** Specifies if game mechanics are dependent or independent to other mechanics. Hence, stand alone and need no other game mechanics to work. Dependent game mechanics should be combined with other mechanics. Independent game mechanics are alone standing but can also be combined with other game mechanics.
- **Development:** Points out, whether game mechanics are static or develop over time. Hence, they show the overall development of users working on activities or tasks.

- **User Design:** Includes game mechanics that allow an active design and integration of users and give him the chance to organize their own work and to express themselves within a system (Mora et al. 2016).
- **Competition:** Summarizes game mechanics used to encourage a competitive behavior such as being better (Hanus and Fox 2015; Sousa Barreto et al. 2016) or faster than others (Liu et al. 2013).
- **Cooperation:** All game mechanics that can be used to increase cooperation between users. Cooperation between users is used to motivate them to work together (Arai et al. 2014) and share a common goal (Perry 2015). Besides encouraging cooperation with game mechanics, they can be focussed on the activities of individual users.
- **Intrinsic motivation:** Includes mechanics that are derived from one's inherent pleasure and interest in an activity (Noels 2001) meaning that the intrinsically motivated user feels enjoyment while performing an activity which, in turn, leads to the achievement of a predetermined goal.
- **Extrinsic motivation:** Refers to reasons that are instrumental to some consequence apart from inherent interest in the activity (Noels 2001). Hence, a user is not doing an activity on account of the activity itself. Sources of extrinsic motivation could be getting a badge.

Besides using characteristics such as cooperation or competition, many studies refer to characteristics such as collection, challenges or acquisition of status. We already addressed them with some of our characteristics. First, collecting can be displayed by the category of interdependency. A leaderboard is a public display based on the collection of other game mechanics (Weiser et al. 2015). Furthermore, a level is based on the collection of other game mechanics (Hanus and Fox 2015). In addition, points, badges, and virtual goods can be a part of a collection system, but they can also be used standing alone. This is why we integrated a collection system as additional game mechanic. Challenges appeal to our psychological need for competence, because they can act as a benchmark against which we judge our performance. (Weiser et al. 2015). More precisely, a challenge is something that is difficult to do. For example, users are faced with a challenge when they try to reach a higher level or a leaderboard position (da Rocha Seixas et al. 2016; Hamari et al. 2016). A point, badge or virtual goods system is considered to build up a foundation to measure a user's progress or his performance on activities or tasks (Gnauk et al. 2012). Developing mechanics are based on challenges too: for example, by reaching a higher level, ranking or progress bar position or even by collecting more badges in a badge system. Hence, challenges are included in the characteristic development. Finally, a user can acquire status by being better than others or by successfully helping others (Bandura and Jourden 1991; Christy and Fox 2014). Hence, the acquisition of status is displayed in the characteristic involvement of other users. After presenting our developed taxonomy, we are now aware of the different characteristics of each game mechanic. This enables us to better understand the meaning of each game mechanic and its relation to other mechanics. As a next step, we would like to apply our taxonomy.

4.2 Application of Taxonomy

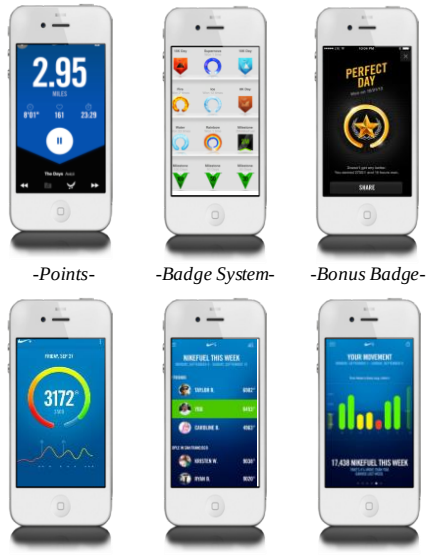
Our developed taxonomy serves two different purposes. First, by referring to the game mechanics and their characteristics, we are able to explain gamified ISs. By explaining the structure and constitution of already developed gamification approaches, researchers and practitioners will be able to better adapt such approaches to their own applications or ISs. Second, the defined characteristics can be used to systematically gamify an IS. More precisely, due to pre-defined characteristics, our taxonomy can be used to identify which game mechanics fit the best for a specific context or target group.

4.2.1 Explanation of Existing Gamification Approaches in Relation to Used Game Mechanics

One goal of our research study was to use our new developed taxonomy to explain gamified IS. To do so, we used the Nike+ mobile application (Nike 2017). This application supports individuals in their running activities by tracking their running distance, duration and much more. To promote their appli-

cation, Nike claims that it will help individuals to reach their goals and have more fun while getting there (Nike 2017). To make their application more fun, they integrated some game mechanics. As mentioned before, our taxonomy can be used to better explain already gamified applications. Such an explanation is useful to practitioners and researchers to better understand the overall gamification approach and to apply it to other systems or research endeavours. To better explain an already developed gamification approach, we have to identify the used game mechanics in a first step. Afterwards, we can use our taxonomy to explain the intentions of the overall gamification approach. Nike+ uses six different game mechanics: *points, badge system, bonus badges, progress bar, leaderboard, reminder*. Referring to our taxonomy, we can see how different game mechanics were used with regard to the characteristics we defined. An overview about the used game mechanics and the characteristics that are addressed with these mechanics is provided in Figure 3:

Identification of used Game Mechanics



Explanation of Gamification Approach

Game Mechanics	Characteristics																			
	1		2		3		4		5		6		7		8		9		10	
	Rewarding	Not Rewarding	Punishing	Not Punishing	Bonus	No Bonus	Independent	Dependent	Developing	Static	Partial Involvement	No User Involvement	Competitive	No Competitive	Cooperation possible	Individual	Intrinsically	Not Intrinsically	Extrinsically	Not Extrinsically
Collection System		x		x		x		x	x			x		x		x	x			x
Points	x		x		x		x			x		x	x		x			x	x	
Badges	x		x		x		x			x	x		x		x			x	x	
Virtual Goods	x		x		x			x		x	x		x		x			x	x	
Leaderboard		x		x		x		x	x			x	x			x	x			x
Level		x		x		x		x	x			x		x		x	x			x
Progress Bar		x		x		x		x	x			x		x		x	x			x
Feedback		x		x		x	x			x		x		x		x	x			x
Representing Avatar		x		x		x	x			x	x			x		x	x			x
Interacting Avatar		x		x		x	x			x		x		x		x	x			x
Tasks		x		x		x	x			x	x		x		x		x		x	
Narratives		x		x		x	x			x		x		x		x	x			x
Reminder		x		x		x	x		x			x		x		x	x			x
Time Pressure		x		x		x	x			x		x	x			x	x			x

Legend: 1=Reward, 2=Punishment, 3=Bonus, 4=Interdependency, 5=Development, 6=User Design, 7=Competition, 8=Cooperation, 9=Intrinsic Motivation, 10=Extrinsic Motivation

Figure 3. Game Mechanics in Nike+

Everything is based on rewarding users for their success in running. Therefore, miles are used as *points* to reward different activities of users. A *badge system* is used to reward users to fulfil specific activities and also as bonuses. The *points* are used in combination with a *progress bar* that indicates a user's daily running progress. A *leaderboard* is used to compare the own results with the results of other users. Finally, a *reminder* is used to visualize a user's progress over a period of seven days. Referring to the motivational components of the application, we can see that the gamification concept of Nike+ involves intrinsic and extrinsic motivating game mechanics. Users can collect *badges* and miles (*points*) which address their extrinsic motivation. Comparing with others in a *leaderboard* or seeing the own progress in a progress bar addresses a user's intrinsic motivation. In sports, both intrinsic and extrinsic motivating components are very important to maintain a user's general motivation (Vallerand and Losier 1999). The system developers used a *leaderboard* and specific *badges* to increase competition between users. In sports it is very important to visualize an individual's progress as well as his progress compared to others (Vallerand and Losier 1999). The *progress bar* addresses an individuals' need for autonomy without cooperating with others. The *leaderboard* addresses an individuals' need for competence, by taking part in a competition (Deci et al. 2001). Furthermore, the developers of Nike+ used a *reminder* as developing game mechanic to visualize the user's individual development a specific period. Overall, we can see that miles were used as basic game mechanics that reward users. They visualize a user's development in running.

4.2.2 Development of New Gamification Approach by Referring to Characteristics

In a second step, we want to use our taxonomy to develop a gamification concept for an IS (Ernst et al. 2016; Janson et al. 2016). Therefore, we used a mobile learning application we constructed for vocational students of the automotive area. When starting the mobile learning application, a user can choose between different tasks of learning modules. While working on a task, a user can see a short task description as well as his progress. In reference to this, a possible task could be to find specific parts of a car such as the wheel or a battery as in scavenger hunts (Ceipidor et al. 2009). Regarding tasks to train procedural knowledge, a problem is presented to the students, for instance: "The street is not illuminated enough. What do you do to fix this problem?". Users are now supposed to select QR codes on the parts of a car in the right order. After they selected a QR Code, an explanation about the different parts of the car is presented in the mobile learning application. To make the application more meaningful to the students, we developed a gamification concept. We used our taxonomy, to identify the most suitable game mechanics for our mobile learning application. The characteristics we address and the game mechanics we used in our application are presented in Figure 4:

Selection of Game Mechanics due to Characteristics

Game Mechanics	Characteristics																			
	1		2		3		4		5		6		7		8		9		10	
	Rewarding	Not Rewarding	Punishing	Not Punishing	Bonus	No Bonus	Independent	Dependent	Developing	Static	Partial Involvement	No User Involvement	Competitive	No Competitive	Cooperation possible	Individual	Intrinsically	Not Intrinsically	Extrinsically	Not Extrinsically
Collection System		x		x		x		x	x			x		x		x	x			x
Points	x		x		x		x			x	x	x	x		x			x	x	
Badges	x		x		x		x			x	x		x		x			x	x	
Virtual Goods	x		x		x			x		x	x		x		x			x	x	
Leaderboard		x		x		x		x	x			x	x			x	x			x
Level		x		x		x		x	x			x		x		x	x			x
Progress Bar		x		x		x		x	x			x		x		x	x			x
Feedback		x		x		x	x			x		x		x		x	x			x
Representing Avatar		x		x		x	x			x	x			x		x	x			x
Interacting Avatar		x		x		x	x			x		x		x		x	x			x
Tasks		x		x		x	x			x	x		x		x		x		x	
Narratives		x		x		x	x			x		x		x		x	x			x
Reminder		x		x		x	x		x			x		x		x	x			x
Time Pressure		x		x		x	x			x		x	x			x	x			x

Legend: 1=Reward, 2=Punishment, 3=Bonus, 4=Interdependency, 5=Development, 6=User Design, 7=Competition, 8=Cooperation, 9=Intrinsic Motivation, 10=Extrinsic Motivation

Implemented Game Mechanics

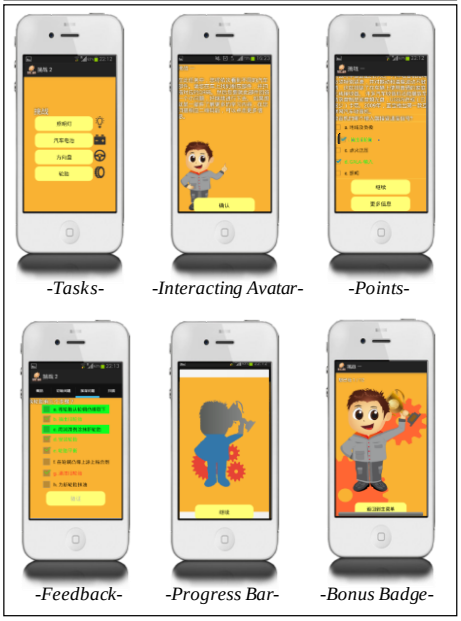


Figure 4. Game Mechanics for Mobile Learning Application

To address a student's feeling of autonomy (Deci and Ryan 2000), we decided to select game mechanics whose design allows a *partial involvement of users*. Referring to this, we could select between badges, virtual goods, a representing avatar and tasks. We decided not to use a representing avatar, because Redding and Ng (1983) point out that overseas Chinese tend to lose face when feeling ashamed (Ernst et al. 2016). Hence, we decided to integrate tasks and badges into our mobile learning application. As such, users can decide which task to work on. Because, we operate in a learning scenario, we visualized the learners individual progress which is necessary to give them a feeling of being guided in the learning process (Janson et al. 2017, Söllner et al. 2017). Another important characteristic, that should be adapted in mobile learning applications is the documentation of a *user's development* (Hakulinen and Auvinen 2014). Similar to a representing avatar, we decided against using a leaderboard, because students could feel ashamed (Redding and Michael 1983) when being worse in comparison to other students or being too slow in reaching higher levels. Hence, we decided not to use a leaderboard or a level for our mobile learning application. To visualize the students learning *development*, we used a progress bar (Janson and Thiele de Gafenco 2015). Because a progress bar can be used in different forms, and because of the importance of teachers in Chinese schools, we decided to use the shape of our avatar.

Since we have several different learning modules, we needed game mechanics, that were *independent* from others (Schöbel et al. 2017). At the same time, in China, the teacher plays an important role in a students' learning process, because, he guides the them through different teaching cases and represents a person the students look up to (Ernst et al. 2016). Thus, we decided to integrate an interacting avatar. The avatar appears in our mobile learning application whenever a teacher in a learning scenario would interact with the learner. The avatar has the appearance of a motor mechanic to help the students identify with him. Furthermore, to allow for *independent* improvement, feedback is given to students in the task sections, directly after each question. The feedback that users receive is *independent* of other game mechanics. Because learners get easily frustrated when they are punished, we used a *reward* based gamification approach (Hattie and Timperley 2007). Several questions to test a user's knowledge are integrated in our mobile learning application. Therefore, we combined our questions with points. Points are numeric values that are given to students for giving a right answer in a knowledge test (Thiebes et al. 2014). Thus, they are more useful than badges or virtual goods, in helping them to judge over their current level of knowledge (Hanus and Fox 2015). Finally, to keep students motivated, and to additionally reward them, we decided to use a *bonus*. Because we already use points for rewarding students, we decided to focus on special badges as additional *bonus* mechanics. This is why, users can win either a golden or a silver badge for a series of correct answers in the knowledge tests. Overall, *intrinsic* motivating components have more positive effects on the quality of a student's learning outcomes than extrinsic motivating components. Thus, we decided to ground our gamification concept on *intrinsic* motivating game mechanics. Besides using points and badges, all of our game mechanics are designed to intrinsically motivate our students.

5 Discussion and Contributions

This paper has proposed a taxonomy to classify game mechanics. Many of the ideas about classifying game mechanics are not new and have been taken from extant literature. Nevertheless, the detailed classification of game mechanics leads to a taxonomy that differs considerably, in specifying the characteristics and connections between game mechanics. By developing a new taxonomy, we aimed to explain and understand already gamified IS. Furthermore, we wanted to use our taxonomy to provide guidance in developing new gamification approaches. To this end, discussion follows under the headings of questions that encourage opinions and judgements about our taxonomy.

Do some game mechanics address specific kinds of users which make it necessary to adapt gamification to context characteristics and the needs of users?

According to Seaborn and Fels (Seaborn and Fels 2015), there is a lack of consensus on proposed gamification-specific taxonomies. Furthermore, the authors indicate that game mechanics in particular contexts for particular types of end-users should be specified, which is only possible with a considerable theoretical embedding (Seaborn and Fels 2015). More precisely, the context in which a gamified IS should be used must be defined for the construction of a model. This is of primary importance as not all game design elements are usable in every context (Hamari 2013). Therefore, the main purpose of a gamification approach should be defined and the objectives of the target group should be identified. As a first step, our taxonomy can be used to better adapt gamification approaches to IS and the users' needs. For example, several approaches focus on gamifying learning management systems (de-Marcos et al. 2014; Domínguez et al. 2013; Faghihi et al. 2014). However, most approaches do not adapt their gamification approaches to different needs of learners. Hakulinen et al. (2014) explain that there are three different kinds of learners. Learners with a mastery goal performance, for instance, invest in tasks only for achieving individual learning outcomes (Hattie and Timperley 2007). They refer to their individual prior performance instead of comparing their performance to other learners. Contrary, learners with a performance goal orientation prefer to demonstrate their abilities and are interested in gaining social recognition (Hattie and Timperley 2007). Social goal performance are attracted by working with others. They have the desire of social facilitation (Hattie and Timperley 2007). Each group of learners prefer another kind of gamification approach. Performance-oriented learners, for ex-

ample, need competitive game mechanics, whereas mastery-oriented learners are more motivated by developing game mechanics that show their individual progress. Finally, social-oriented learners need cooperative game mechanics. By using our taxonomy, we would be able to consider such issues to adapt gamification to the needs of a target group.

Does a systematic development of gamification approaches by using a taxonomy help to better predict and explain the impacts of gamification on users' motivation?

Seaborn and Fels (2015) explain that it is still difficult to isolate what effect gamification has on end-users. More precisely, despite its theoretical grounding in human motivation, only few studies have investigated the effects of extrinsic and intrinsic motivating mechanics in gamified IS. Furthermore, the relation between intrinsic and extrinsic motivating game mechanics is unclear (Ryan and Deci 2000; Seaborn and Fels 2015). As such, our taxonomy separates points from point systems. Points reward extrinsically reward users, whereas a point system is based on intrinsic motivation because users like to collect as many points as they can. However, most studies that use a point system do not analyze its effects on the users motivation (Gnauk et al. 2012; Liu et al. 2011). This can be observed in mixed results of previous research studies that evaluated the effects of gamification on a user's motivation. Seixas et al. (2016) and Hamari et al. (2014), for example, combined the elements points, badges, levels and goals. Both studies could prove positive effects on the users' motivation. However, Hanus and Fox (2015) analyzed the same elements but instead of using levels and goals, they used a leaderboard to leverage competition between users. Contrary to Seixas et al. (2016) and Hamari et al. (2013), the results were negative. Hence, changing the combination of game mechanics can influence the effects on a user's motivation. Therefore, research is necessary that reveals whether and how particular game mechanics or a combination of them are intrinsically or extrinsically motivating alone or together (Seaborn and Fels 2015). Hence, it is necessary to better understand the meaning and characteristics of each game mechanic that can be used to gamify IS. By introducing our taxonomy, we made a first step towards a better understanding about how gamification can influence a user's motivation.

Can a taxonomy inform about a good gamification design?

Although, there is a considerable amount of research that has studied gamification designs, there is a lack of research on how gamification influences user motivation (Fogel 2015; Gartner 2012). For example, many research studies implement a leaderboard in their ISs to increase competition between users. However, Santhanam et al. (2016) suggest that not all competitions are the same and that there is no one-size-fits-all design. They recommend that gamification designs should be adapted to make them more meaningful to users. Liu et al. (2017) present a list of less successful gamification examples. Omnicare has developed a gamification approach to improve long helpdesk waiting times, by using the game mechanics time pressure, leaderboard and point system (Hein 2013). The employees felt like being watched, which lead to more pressure and dissatisfaction (Liu et al. 2017). The JetBlue badge program was used in combination with a leaderboard to engage the airline's customers and motivate spending (Liu et al. 2017). This concept failed to take off, because the customers felt that it asked too much personal information (Meermann 2013). Thus, we can predict that gamification designs can be decisive when it comes to the success of gamification approaches. Our taxonomy points out that a gamification approach can be either rewarding or punishing. To make a gamification design more meaningful, designers should first consider which kind of motivational concept is the best choice for individuals. True to the saying "less is more", gamification designs should not focus on implementing as many game mechanics as possible in an IS (Schöbel et al. 2016), but rather focus on a sophisticated gamification design concept.

Our taxonomy will not eliminate all existing problems in gamification research. However, it presents one solution to better understand the meaning and characteristics of game mechanics, which is one important step toward to improve gamification designs. Our research provides several theoretical as well as practical contributions. First, our developed taxonomy helps system designers as well as researchers to design their gamification approaches more sophisticated by considering the characteristics of each game mechanic. Second, our systematic literature review provides an overview about current

research gaps regarding the use of taxonomies to gamify their ISs. It outlines that there are still some inconsistencies about the meaning of each game design element, which makes it difficult to understand how gamification can influence a user's motivation. Third, our findings contribute to the body of knowledge of gamification, as our developed categories in our taxonomy specify the meaning of each individual game mechanic. Finally, our developed taxonomy provides guidance in the selection and combination of game mechanics, which will be helpful to avoid a random selection and combination of elements. This might be useful when context or user characteristics should be considered. Therefore, we can explain the concepts behind already developed gamification approaches and will also guide researchers to develop new approaches. From a practical perspective, our developed taxonomy offers system designers a practical solution for solving a real-world problem, which is the process of selecting, combining and designing customized game mechanics for IS. Our taxonomy can be used by practitioners as a guideline for constructing an own gamification approach. By specifying the meaning of each game mechanic, practitioners will be able to adapt their approaches to the needs and interest of users and context characteristics.

6 Limitations, Future Research and Conclusion

Our research has some limitations which are useful in identifying subjects for future research. First, we did not include an empirical analysis of our taxonomy in our research paper. In a next step, we first plan to conduct interviews with system developers as well as researchers to improve our taxonomy. In a second step, we will use our taxonomy to gamify different IS. We will evaluate the usefulness of our taxonomy by conducting an experiment with two groups. The first group will receive a gamified version including game mechanics that are randomly selected by system analysts and designers that are not accustomed to gamifying IS. The game mechanics of the second group are selected by using our taxonomy. After the participants of our two groups will have used the gamified IS, they will have to answer a survey. We will measure the participants usage behavior (Agarwal and Karahanna 2000) and the intensity of intrinsic and extrinsic motivation as well as the participants enjoyment and engagement (Pintrich 1991; Ryan and Deci 2000; Vos et al. 2011). Second, with our taxonomy, we merely provide an overview about all game mechanics that can be used for gamification approaches. However, according to Seaborn and Fels (2015), more research has to focus on analyzing the effects of specific elements. Therefore, future research could analyze the usefulness of specific elements in a particular context for different types of users. Finally, we did not provide specific guidelines or design implications to make it easier for system developers to apply our developed taxonomy. Therefore, based on our developed taxonomy future research studies could use a design science approach to develop design principles and guidelines (Gregor and Hevner 2013; Hevner et al. 2004). With our study, we developed a gamification taxonomy to better explain the meaning of game design elements. Summarizing our results, we enrich the body of knowledge in the field of gamification by introducing a novel taxonomy that supports practitioners and researchers when deciding which game mechanics they can use in a specific context and how they can combine them. These insights can be used to better understand the meaning of each game design element. Furthermore, a systematic selection and combination of game design elements makes it easier to understand the effects of gamification on the motivation of users. On the basis of our research findings, we are able to provide precise implications for research and practice. Given the immense growth of gamification projects and the potential of motivating users by games, more research on this topic is guaranteed which needs a solid theoretical understanding such as offered by our taxonomy.

Acknowledgments

This paper presents research that was conducted in context of the projects "StaySmart" (funding number: 02L12A170, managed by the Project Management Agency Karlsruhe - PTKA) and "KoLeArn" (funding number: 01BE17008A, managed by the DLR Project Management Agency – PT-DLR), both funded by the German Federal Ministry of Education and Research (BMBF).

7 References

Agarwal, R., and Karahanna, E. 2000. “Time Flies When You're Having Fun: Cognitive Absorption and Beliefs About Information Technology Usage,” *MIS Quarterly* (24:4), pp. 665–694.

*Alcivar, I., and Abad, A. G. 2016. “Design and evaluation of a gamified system for ERP training,” *Computers in Human Behavior* (58), pp. 109–118.

*Arai, S., Sakamoto, K., Washizaki, H., and Fukazawa, Y. 2014. “A gamified tool for motivating developers to remove warnings of bug pattern tools,” *Empirical Software Engineering in Practice*, pp. 37–42.

*Ašeriškis, D., and Damaševičius, R. 2014. "Gamification patterns for gamification applications," *Procedia Computer Science* (39), pp. 83-90.

*Attali, Y., and Arieli-Attali, M. 2015. "Gamification in assessment: Do points affect test performance?," *Computers & Education* (83), pp. 57-63.

Bandura, A., and Jourden, F. J. 1991. “Self-Regulatory Mechanisms Governing the Impact of Social Comparison on Complex Decision Making,” *Journal of Personality and Social Psychology* (60:6), pp. 941–951.

*Bedwell, W. L., Pavlas, D., Heyne, K., Lazzara, E. H., and Salas, E. 2012. "Toward a taxonomy linking game attributes to learning: An empirical study," *Simulation & Gaming*, (43:6), pp. 729-760.

*Berengueres, J., Alsuwairi, F., Zaki, N., and Ng, T. 2013. "Gamification of a recycle bin with emoticons," *In Proceedings of the 8th ACM/IEEE international conference on Human-robot interaction*, pp. 83-84. IEEE Press.

*Bista, S. K., Nepal, S., Colineau, N., & Paris, C. 2012. "Using gamification in an online community," In *Collaborative Computing: Networking, Applications and Worksharing (CollaborateCom)*, 2012 8th International Conference on, pp. 611-618. IEEE.

*Bista, S. K., Nepal, S., Paris, C., and Colineau, N. 2014. “Gamification for online communities: A case study for delivering government services,” *International Journal of Cooperative Information Systems* (23:2), pp. 1–25.

*Blohm, I., and Leimeister, J. M. 2013. “Gamification: Design of IT-based enhancing services for motivational support and behavioral change,” *Business & Information Systems Engineering (BISE)* (5:4), pp. 275–278.

*Bittner, J. V., and Schipper, J. 2014. "Motivational effects and age differences of gamification in product advertising," *Journal of consumer marketing* (31:5), pp. 391-400.

*Boticki, I., Baksa, J., Seow, P., and Looi, C. K. 2015. "Usage of a mobile social learning platform with virtual badges in a primary school," *Computers & Education* (86), pp. 120-136.

*Buckley, P., and Doyle, E. 2017. "Individualising gamification: an investigation of the impact of learning styles and personality traits on the efficacy of gamification using a prediction market," *Computers & Education* (106), pp. 43-55.

*Bui, A., and Veit, D. 2015. “The Effects of Gamification on Driver Behavior: An Example from a Free Float Carsharing Service,” *Twenty-Third European Conference on Information Systems (ECIS)*, pp. 1–14.

Bunchball, I. 2010. “Gamification 101: An Introduction to the Use of Game Dynamics to Influence Behavior,” *(White Paper). Bunchball Inc*.

*Burgers, C., Eden, A., van Engelenburg, M. D., and Buningh, S. 2015. "How feedback boosts motivation and play in a brain-training game," *Computers in Human Behavior* (48), pp. 94-103.

Ceipidor, U. B., Medaglia, C. M., Perrone, A., Marsico, M. de, and Di Romano, G. (eds.). 2009. *A museum mobile game for children using QR-codes*, ACM.

*Chapman, J., and Rich, P. 2017. "Identifying Motivational Styles in Educational Gamification," In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

Cheng, M.-T., Lin, Y.-W., and She, H.-C. 2015. “Learning through playing Virtual Age: Exploring the interactions among student concept learning, gaming performance, in-game behaviors, and the use of in-game characters,” *Computers & Education* (86), pp. 18–29.

*Cheong, C., Cheong, F., and Filippou, J. 2013. "Quick Quiz: A Gamified Approach for Enhancing Learning," In *PACIS 2013 Proceedings*, 206.

*Christy, K. R., and Fox, J. 2014. "Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance," *Computers & Education* (78), pp. 66–77.

*Davis, K., and Singh, S. 2015. "Digital badges in afterschool learning: Documenting the perspectives and experiences of students and educators," *Computers & Education* (88), pp. 72-83.

*da Rocha Seixas, L., Gomes, A. S., and de Melo Filho, Ivanildo José. 2016. "Effectiveness of gamification in the engagement of students," *Computers in Human Behavior* (58), pp. 48–63.

*de Santana, S. J., Souza, H. A., Florentin, V. A., Paiva, R., Bittencourt, I. I., and Isotani, S. 2016. "A quantitative analysis of the most relevant gamification elements in an online learning environment," *In Proceedings of the 25th International Conference Companion on World Wide Web*, pp. 911-916.

*de Sousa Barreto, L., Cavaco, I. N., Monteiro, A., Rousy, D., and Silva, C. 2016. "Gamification Aspects in Detail: Collectanea of Studies to Renew Traditional Education," *Revista Eletrônica Argentina-Brasil de Tecnologias da Informação e da Comunicação* (1:4).

Deci, E. L., and Ryan, R. M. 2000. "The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior," *Psychological Inquiry* (11:4), pp. 227–268.

Deci, E. L., Ryan, R. M., Gagne, M., Leone, D. R., Usunov, J., and Kornazheva, B. P. 2001. "Need Satisfaction, Motivation, and Well-Being in the Work Organizations of a Former Eastern Bloc Country: A Cross-Cultural Study of Self-Determination," *Personality and Social Psychology Bulletin* (27:8), pp. 930–942.

*de-Marcos, L., Domínguez, A., Saenz-de-Navarrete, J., and Páges, C. 2014. "An empirical study of comparing gamification and social networking on e-learning," *Computers & Education* (75), pp. 82–91.

*Denny, P. 2013. "The effect of virtual achievements on student engagement," In *Proceedings of the SIGCHI conference on human factors in computing systems*, pp. 763-772. ACM.

*Depura, K., and Garg, M. 2012. "Application of online gamification to new hire onboarding," In *Services in Emerging Markets (ICSEM)*, 2012 Third International Conference on, pp. 153-156. IEEE.

*Deterding, S., Sicart, M., Nacke, L., O'Hara, K., and Dixon, D. 2011. "Gamification: Using Game Design Elements in Non-Gaming Contexts," *Human Factors in Computing Systems*, pp. 2425–2428.

*Dey, S., and Eden, R. 2016. "Gamification: An emerging trend," In *Pacific Asia Conference on Information Systems (PACIS 2016)*.

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

*Dong, T., Dontcheva, M., Joseph, D., Karahalios, K., Newman, M., and Ackerman, M. 2012. "Discovery-based games for learning software." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 2083-2086. ACM.

*El-Masri, M., Tarhini, A., Hassouna, M., and Elyas, T. 2015. "A Design Science Approach to Gamify Education: From Games to Platforms," In *European Conference on Information Systems* 2015.

Ernst, S.-J., Janson, A., Söllner, M., and Leimeister, J. M. 2016. "It's about Understanding Each Other's Culture – Improving the Outcomes of Mobile Learning by Avoiding Culture Conflicts," *International Conference on Information Systems (ICIS)*, Dublin, Ireland.

*Faghihi, U., Brautigam, A., Jorgenson, K., Martin, D., Brown, A., Measures, E., and Maldonado-Bouchard, S. 2014. "How Gamification Applies for Educational Purpose Specially with College Algebra," *Procedia Computer Science* (41), pp. 182–187.

*Fernandes, J., Duarte, D., Ribeiro, C., Farinha, C., Pereira, J. M., and da Silva, M. M. 2012. "iThink: A game-based approach towards improving collaboration and participation in requirement elicitation," *Procedia Computer Science* (15), pp. 66-77.

*Filsecker, M., and Hickey, D. T. 2014. "A multilevel analysis of the effects of external rewards on elementary students' motivation, engagement and learning in an educational game," *Computers & Education* (75), pp. 136–148.

*Fitz-Walter, Z., Tjondronegoro, D., and Wyeth, P. 2012. "A gamified mobile application for engaging new students at university orientation," In *Proceedings of the 24th Australian Computer-Human Interaction Conference*, pp. 138-141. ACM.

Fogel, G. 2015. *Will 80% of gamification projects fail? Giving credit to Gartner's 2012 gamification forecast*. http://www.gameffective.com/gamification-basics/will-80-of-gamification-projects-fail/. Accessed 25 April 2017.

*Garris, R., Ahlers, R., and Driskell, J. E. 2002. "Games, motivation, and learning: A research and practice model," *Simulation & gaming* (33:4), pp. 441-467.

Gartner. 2012. *Gartner Says by 2014, 80 Percent of Current Gamified Applications Will Fail to Meet Business Objectives Primarily Due to Poor Design*. http://www.gartner.com/newsroom/id/2251015. Accessed 13 November 2015.

Glass, R. L., and Vessey I. 1995. "Contemporary application-domain taxonomies," *IEEE Software* (12:4), pp. 63–76.

*Gnauk, B., Dannecker, L., and Hahmann, M. 2012. "Leveraging gamification in demand dispatch systems," *Proceedings of the 2012 Joint EDBT/ICDT Workshops*, pp. 103–110.

Gregor, S. 2006. "The nature of theory in information systems," *MIS Quarterly* (30:3), pp. 611–642.

Gregor, S., and Hevner, A. R. 2013. "Positioning and presenting design science research for maximum impact," *MIS Quarterly* (37:2), pp. 337–355.

*Haaranen, L., Ihantola, P., Hakulinen, L., and Korhonen, A. 2014. "How (not) to introduce badges to online exercises," *Proceedings of the 45th ACM technical symposium on Computer science education*, pp. 33–38.

Hakulinen, L., and Auvinen, T. (eds.). 2014. *The effect of gamification on students with different achievement goal orientations*, IEEE.

*Halan, S., Rossen, B., Cendan, J., and Lok, B. 2010. "High Score! - Motivation Strategies for User Participation in Virtual Human Development," In *IVA 2010*, pp. 482-488.

*Hamari, J. 2013. "Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service," *Electronic Commerce Research and Applications* (12), pp. 236–245.

Hamari, J., Koivisto, J., and Sarsa, H. 2014. "Does Gamification Work?: A Literature Review of Empirical Studies on Gamification," *Hawaii International Conference on System Science (HICSS)* .

*Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., and Edwards, T. 2016. "Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning," *Computers in Human Behavior* (54), pp. 170–179.

*Hamzah, W. A. F. W., Ali, N. H., Saman, M. Y. M., Yusoff, M. H., and Yacob, A. 2014. "Enhancement of the ARCS model for gamification of learning," In *User Science and Engineering (i-USEr), 2014 3rd International Conference on*, pp. 287-291. IEEE.

*Hanus, M. D., and Fox, J. 2015. "Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort and, academic performance," *Computers & Education* (80), pp. 152–161.

Hattie, J., and Timperley, H. 2007. "The power of feedback," *Review of educational research* (77:1), pp. 81–112.

Hein, R. 2013. *How to Use Gamification to Engage Employees*. https://www.cio.com/article/2453330/careers-staffing/how-to-use-gamification-to-engage-employees.html. Accessed 29 March 2018.

Hevner, A. R., March, S. T., Park, J., and Ram, S. 2004. "Design science in information systems research," *MIS Quarterly* (28:1), pp. 75–105.

*Hew, K. F., Huang, B., Chu, K. W. S., and Chiu, D. K. 2016. "Engaging Asian students through game mechanics: Findings from two experiment studies," *Computers & Education* (92), pp. 221-236.

*Hori, Y., Tokuda, Y., Miura, T., Hiyama, A., and Hirose, M. 2013. "Communication pedometer: a discussion of gamified communication focused on frequency of smiles," In *Proceedings of the 4th augmented human international conference*, pp. 206-212. ACM.

Huizinga, J. 1949. *Homo Ludens*, Boston: The Beacon Press.

*Hunicke, R., LeBlanc, M., and Zubek, R. 2004. "MDA: A formal approach to game design and game research," (4:1).

*Ibánez, M.-B., Di-Serio, Á., and Delgado-Kloos, C. 2014. "Gamification for Engaging Computer Science Students in Learning Activities: A Case Study," *IEEE Transactions on Learning Technologies* (7:3), pp. 291–300.

Iivari, J. 2007. "A paradigmativ analysis of information systems as a desing science," *Scandinavian Journal of Information Systems* (19:2).

Janson, A.; Söllner, M.; Leimeister, J. M. 2017. "Individual Appropriation of Learning Management Systems — Antecedents and Consequences," *AIS Transactions on Human-Computer Interaction*, (9:3), pp. 173-201.

Janson, A., Ernst, S.-J., and Söllner, M. 2016. "How Cultural Values Influence the Appropriation of Technology-Mediated Learning," *European Conference on Information Systems (ECIS)*, Istanbul, Turkey.

Janson, A.; Thiel de Gafenco, M. 2015. "Engaging the Appropriation of Technology-mediated Learning Services - A Theory-driven Design Approach," *European Conference on Information Systems (ECIS)*, Münster, Germany.

*Jia, Y., Xu, B., Karanam, Y., and Voida, S. 2016. "Personality-targeted gamification: a survey study on personality traits and motivational affordances," *In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, pp. 2001-2013. ACM.

*Jones, B. A., Madden, G. J., and Wengreen, H. J. 2014. The FIT Game: preliminary evaluation of a gamification approach to increasing fruit and vegetable consumption in school. *Preventive medicine*, 68, 76-79.

*Kari, T., Frank, L., Makkonen, M., and Moilanen, P. 2016. "How is Gamification Perceived in Health and Wellness Technology Companies: Views from Four Companies of Different Size," In MCIS 2016: 10th M*editerranean Conference on Information Systems*. University of Nicosia.

*Knutas, A., Ikonen, J., Nikula, U., and Porras, J. 2014. "Increasing collaborative communications in a programming course with gamification: a case study," I*n Proceedings of the 15th International Conference on Computer Systems and Technologies*, pp. 370-377. ACM.

*Koivisto, J., and Hamari, J. 2014. "Demographic differences in perceived benefits from gamification," *Computers in Human Behavior* (35), pp. 179-188.

*Landers, R. N. 2014. "Developing a theory of gamified learning: Linking serious games and gamification of learning," *Simulation & Gaming*, (45:6), pp. 752-768.

*Latulipe, C., Long, N. B., and Seminario, C. E. 2015. "Structuring flipped classes with lightweight teams and gamification," In *Proceedings of the 46th ACM Technical Symposium on Computer Science Education*, pp. 392-397. ACM.

*Lee, J. J., Ceyhan, P., Jordan-Cooley, W., and Sung, W. 2013. "GREENIFY: A real-world action game for climate change education," *Simulation & Gaming* (44:2-3), pp. 349-365.

*Li, W., Grossman, T., and Fitzmaurice, G. 2012. "GamiCAD: a gamified tutorial system for first time autocad users," In P*roceedings of the 25th annual ACM symposium on User interface software and technology*, pp. 103-112. ACM.

*Lipinski, A. V. J., Weber, H., Kölle, R., and Mandl, T. 2017. "Gamification Elements and Their Perceptionby Different Gamer Types," In P*roceedings of the 15th International Symposium of Information Science (ISI 2017)*, pp. 131-144.

*Liu, D., Li, X., and Santhanam, R. 2013. "Digital Games and Beyond: What Happens When Players Compete," *MIS Quarterly* (327:1), pp. 111–124.

Liu, D., Santhanam, R., and Webster, J. 2017. "Towards meaningful engagement: A framework for design and research of gamified information systems," *MIS Quarterly* (41:4).

*Liu, Y., Alexandrova, T., and Nakajima, T. 2011. "Gamifying intelligent environments," *Proceedings of the 2011 international ACM workshop on Ubiquitous meta user interfaces*, pp. 7–12.

*McDaniel, R., Lindgren, R., and Friskics, J. 2012. "Using badges for shaping interactions in online learning environments," In *Professional Communication Conference (IPCC), 2012 IEEE International*, pp. 1-4. IEEE.

Meermann, S. D. 2013. *JetBlue Badges gamification marketing fails to take off*. https://www.webinknow.com/2013/07/jetblue-badges-gamification-marketing-fails-to-take-off.html. Accessed 29 March 2017.

*Mekler, E. D., Brühlmann, F., Tuch, A. N., and Opwis, K. 2015. "Towards understanding the effects of individual gamification elements on intrinsic motivation and performance," *Computers in Human Behavior* (71), pp. 525-534.

*Melero, J., Hernándes-Leo, D., and Manatunga, K. 2015. "Group-based mobile learning: Do group size and sharing mobile devices matter?" *Computers in Human Behavior* (44), pp. 377–385.

*Mollick, E. R., and Rothbard, N. 2014. "Mandatory fun: Consent, gamification and the impact of games at work".

*Mora, A., Planas, E., and Arnedo-Moreno, J. 2016. "Designing game-like activities to engage adult learners in higher education," *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality*, pp. 755–762.

*Nebel, S., Beege, M., Schneider, S., and Rey, G. D. 2016. "The higher the score, the higher the learning outcome? Heterogeneous impacts of leaderboards and choice within educational videogames," *Computers in Human Behavior* (65), pp. 391-401.

*Nicholson, S. 2012. "A user-centered theoretical framework for meaningful gamification," *Games+ Learning+ Society* (8:1), pp. 223-230.

Nickerson, R. C., Varshney, U., and Muntermann, J. 2013. "A method for taxonomy development and its application in information systems," *European Journal of Information Systems* (22), pp. 336–359.

Nike. 2017. *Nike+ Run Club App*. https://www.nike.com/us/en_us/c/nike-plus/running-app-gps. Accessed 29 March 2018.

Noels, K. A. 2001. "New orientations in language learning motivation: Towards a model of intrinsic, extrinsic, and integrative orientations and motivation," *Motivation and second language acquisition* (23), pp. 43–68.

*Osipov, I. V., Nikulchev, E., Volinsky, A. A., and Prasikova, A. Y. 2015. "Study of gamification effectiveness in online e-learning systems," *International Journal of advanced computer science and applications* (6:2), pp. 71-77.

*Passos, E. B., Medeiros, D. B., Neto, P. A., and Clua, E. W. 2011. "Turning real-world software development into a game," In *Games and Digital Entertainment (SBGAMES)*, 2011 Brazilian Symposium on, pp. 260-269. IEEE.

*Pedreira, O., García, F., Brisaboa, N., and Piattini, M. 2015. "Gamification in software engineering–A systematic mapping," I*nformation and Software Technology* (57), pp. 157-168.

*Peham, M., Breitfuss, G., & Michalczuk, R. 2014. "The ecoGator app: gamification for enhanced energy efficiency in Europe," In *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality*, pp. 179-183. ACM.

*Perry, B. 2015. "Gamifying French Language Learning: a case study examining a quest-based, augmented reality mobile learning-tool," *Procedia Computer Science* (174), pp. 2308–2315.

Pintrich, P. R. 1991. "A manual for the Motivated Strategies for Learning Questionnaire (MSLQ),".

*Robson, K., Plangger, K., Kietzmann, J., McCarthy, I., and Pitt, L. 2014. "Understanding gamification of consumer experiences," *ACR North American Advances* (42), pp. 352-356.

Redding, S. G., and Michael, N. 1983. "The role of "face" in the organizational perceptions of Chinese managers," *International Studies of Management & Organization* (13:3), pp. 92–123.

Ryan, R. M., and Deci, E. L. 2000. "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being," *American Psychologist* (55:1), pp. 68–78.

*Sailer, M., Hense, J. U., Mayr, S. K., and Mandl, H. 2017. "How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction," *Computers in Human Behavior* (69), pp. 371-380.

Salen, K., and Zimmerman, E. 2004. *Rules of Play*: *Game design fundamentals*, Massachusetts: MIT Press.

*Santhanam, R., Liu, D., and Shen, Wei-Cheng, Milton. 2016. "Research Note-Gamification of Technology-Mediated Training: Not All Competitions are the Same," *Information Systems Research* (27:2), pp. 453–465.

Scheiner, C. W., and Witt, M. 2013. "The Backbone of Gamification-a Theoretical Consideration of Play and Game Mechanics," *GI-Jahrestagung*, pp. 2372–2386.

*Schlagenhaufer, C., and Amberg, M. 2015. "A Descriptive Literature Review and Classification Framework for Gamification in Information Systems," *European Conference on Information Systems (ECIS)*, Münster, Germany.

Schöbel, S.; Janson, A.; Ernst, S. -J. & Leimeister, J. M. 2017. "How to Gamify a Mobile Learning Application – A Modularization Approach," *International Conference on Information Systems (ICIS)*. Seoul, South Korea.

*Seaborn, K., and Fels, D. I. 2015. "Gamification in theory and action: A survey," *International Journal of human-computer studies* (74), pp. 14–31.

*Shen, W. C. M., Liu, D., Santhanam, R., and Evans, D. A. 2016. "Gamified Technology-Mediated Learning: the Role of Individual differences," In *PACIS* 2016 Proceedings. 47.

*Silpasuwanchai, C., Ma, X., Shigemasu, H., and Ren, X. 2016. "Developing a comprehensive engagement framework of gamification for reflective learning," In P*roceedings of the 2016 ACM Conference on Designing Interactive Systems*, pp. 459-472. ACM.

*Simoes, J., Díaz Redondo, R., and Fernández Vilas Ana. 2013. "A social gamification framework for K-6 learning platform," *Computers in Human Behavior* (29), pp. 345–353.

*Smith, A. L., and Baker, L. 2011. "Getting a clue: creating student detectives and dragon slayers in your library," *Reference Services Review* (39:4), pp. 628-642.

Söllner, M.; Bitzer, P.; Janson, A.; Leimeister, J. M. 2017. "Process is king - Evaluating the performance of technology-mediated learning in vocational software training," *Journal of Information Technology*, pp. 1–21.

Sousa Barreto, L. de, Cavaco, I. N., Monteiro, A., Rousy, D., and Silva, C. 2016. "Gamification Aspects in Detail: Collectanea of Studies to Renew Traditional Education," *Revista Eletrônica Argentina-Brasil de Tecnologias da Informação e da Comunicação* (1:4).

Suh, A., Wagner, C., and Liu, L. 2015. "The Effects of Game Dynamics on User Engagement in Gamified Systems," *Hawaii International Conference on System Sciences (HICCS)*.

*Su, C. H., and Cheng, C. H. 2015. "A mobile gamification learning system for improving the learning motivation and achievements," *Journal of Computer Assisted Learning* (31:3), pp. 268-286.

*Suh, A., Wagner, C., and Liu, L. 2015. "The Effects of Game Dynamics on User Engagement in Gamified Systems," *Hawaii International Conference on System Sciences* (HICCS).

*Summers, J., and Young, A. 2016. "Gamification and Brand Engagement on Facebook: An Exploratory Case Study," *Twenty-second Americas Conference on Information Systems*, San Diego, 2016.

*Tang, J., and Prestopnik, N. R. 2016. "Toward an Understanding of the Influences of Meaningful Framing on User Participation in a Gamified Information System," *European Conference on Information System (ECIS)*, Istanbul, Turkey.

*Thiebes, S., Lins, S., and Basten, D. 2014. "Gamifying Information Systems: A Synthesis of Gamification Mechanics and Dynamics," *European Conference on Information Systems (ECIS)*, Tel Aviv, Israel.

*Thom, J., Millen, D., and DiMicco, J. 2012. "Removing gamification from an enterprise SNS," In *Proceedings of the acm 2012 conference on computer supported cooperative work*, pp. 1067-1070.

*Toda, A. M., do Carmo, R. S., Mesquita, M. A. A., da Silva, A. L., and Brancher, J. D. (eds.). 2014. *A gamified online system to aid in math lessons of junior and middle high students*, IEEE.

*Tomaselli, F., Sanchez, O., and Brown, S. 2015. "How to engage users through gamification: the prevalent effects of playing and mastering over competing," *International Conference on Information Systems (ICIS)*, Fort Worth, Texas, USA.

*Usami, H., Eguchi, H., Ozaki, M., and Adachi, Y. 2015. "Development of Web Learning Support System using "My Dictionary" in English Study," *Procedia Computer Science* (60), pp. 944-951.

Vallerand, R. J., and Losier, G. F. 1999. "An integrative analysis of intrinsic and extrinsic motivation in sport," *Journal of applied sport psychology* (11:1), pp. 142–169.

Vom Brocke, J., Simons, A., Niehaves, B., and Reimer, K. 2009. "Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process," *European Conference on Information Systems (ECIS)*, Verona, Italy.

Vos, N., van der Meijden, H., and Denessen, E. 2011. "Effects of constructing versus playing an educational game on student motivation and deep learning strategy use," *Computers & Education* (56:1), pp. 127–137.

Webster, J., and Watson, R. T. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), pp. 13–23.

*Weiser, P., Bucher, D., Cellina, F., and Luca, V. de. 2015. "A taxonomy of motivational affordances for meaningful gamified and persuasive technologies,".

*Wilson, D., Calongne, C., and Henderson, S. B. 2015. "Gamification challenges and a case study in online learning," *Internet Learning* (4:2). 8.