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Capturing the complexity of gamification elements: a holistic approach for analysing existing and deriving novel gamification designs

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ABSTRACT

Gamification is a well-known approach that refers to the use of elements to increase the motivation of information systems users. A remaining challenge in gamification is that no shared understanding of the meaning and classification of gamification elements currently exists. This impedes guidance concerning analysis and development of gamification concepts, and often results in non-effective gamification designs. The goal of our research is to consolidate current gamification research and rigorously develop a taxonomy, as well as to demonstrate how a systematic classification of gamification elements can provide guidance for the gamification of information systems and improve understanding of existing gamification concepts. To achieve our goal, we develop a taxonomic classification of gamification elements before evaluating this taxonomy using expert interviews. Furthermore, we provide evidence as to the taxonomy's feasibility using two practical cases: First, we show how our taxonomy helps to analyse existing gamification concepts; second, we show how our taxonomy can be used for guiding the gamification of information systems. We enrich theory by introducing a novel taxonomy to better explain the characteristics of gamification elements, which will be valuable for both gamification analysis and design. This paper will help guide practitioners to select and combine gamification elements for their gamification concepts.

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1. Introduction

Keeping users of information systems (IS) motivated when using an IS, exploiting IS features, or simply achieving intended IS outcomes is a key challenge for IS designers (Benlian, 2015; Burton-Jones & Grange, 2013; Depura & Garg, 2012; Wu & Lu, 2013). One way to boost motivation among IS users is to integrate those gamification elements into IS design that have their origins in playing games, and which have become a part of our digital lives (Hess et al., 2014; Petter, 2017). Often, practitioners use so-called points, bonuses, and leaderboard elements to enhance the playfulness of IS, increase user motivation, and change user behaviour when, for instance, considering education or health fields (Hamari et al., 2014; Santhanam et al., 2016). This very briefly outlined practical phenomenon is described in research and practice as the concept of gamification. Gamification is defined as the use of game-like elements in non-entertainment based contexts to motivate IS users to change their behaviour (Deterding, Sicart et al., 2011; Hamari et al., 2014). Gamification has a strong practical impact due to its wide adoption (Hamari et al., 2014), and powerful market growth worldwide (Statista, 2019). Gamification is also highly relevant for human–computer interaction, and is intensively discussed in the literature (Li et al., 2012; Santhanam et al., 2016; Seaborn & Fels, 2015; Simoes et al., 2013).

Despite the increasing popularity of the concept of gamification, some challenges have arisen concerning its classification and the meaning of its elements. As we show in detail in the subsection "Classification of Elements used in Gamification", existing classifications of gamification elements lack rigour and require further development (please see also Bui & Veit, 2015). In general, the purpose of a classification of objects extends beyond the mere ordering of elements; it also involves reducing complexity, identifying similarities among objects, and understanding object relationships. Such classifications can support researchers and practitioners in generalising, communicating, and applying research findings (Glass & Vessey, 1995). Under some circumstances, classifications support theory building because they better describe a phenomenon of interest and its relationships towards other objects (Doty & Glick, 1994). Looking at existing gamification research and existing taxonomies suggests that we need to reconsider our understanding of gamification elements and their characteristics. Gamification concepts are often intended to reward users for their behaviour. Some

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studies classify rewards as the building blocks for a game. However, rewards summarise a certain group of other elements – including points, badges, or virtual goods – which are also classified as building blocks for the concept of gamification (Hunicke et al., 2004; Thiebes et al., 2014). Besides, an element that is classified as a reward is not necessarily perceived as such, and some support exists regarding the negative effects of badges that are typically classified in this way (Mckernan et al., 2015). Different understandings of gamification element classifications are not only of a theoretical nature, and any meaningful classification of objects must also support practical utility (Corley & Gioia, 2011). Classifications supporting theory development can be directly applied to problems facing practitioners (Corley & Gioia, 2011). If we asses gamification elements as the most crucial design components of a gamification concept, a meaningful categorisation and a shared understanding of their characteristics will be needed, because it is not automatically clear what existing elements represent (Liu et al., 2017). The multitude of different gamification elements that researchers and practitioners can use in countless combinations makes it difficult to differentiate between gamified and non-gamified systems (Treiblmaier et al., 2018).

Other observations can be made about outcomes caused by specific combinations of elements. Gamification is intended to change user behaviour (Deterding, Dixon et al., 2011; Hamari et al., 2014). However, each element has different characteristics that decide the success of a gamification concept in terms of the addressed outcomes that must be better understood; this is because the addressed outcomes are still a black box for researchers and practitioners (Scheiner, 2015). Replacing a level with a leaderboard in a bundle of elements may result in negative effects or no effect on user motivation (Hamari & Koivisto, 2015; Hew et al., 2016; Shute et al., 2015). Leaderboards are typically classified as competitive elements, the effects of which controversial and may not be fully understood (Santhanam et al., 2016). Classifications of these elements might therefore be imprecise regarding leaderboard outcomes, for which academic literature offers little direction to, or understanding of their designs (Robson et al., 2015). All such observations result from different understandings concerning the characteristics and classifications of gamification elements. The characteristics of gamification elements will be crucial for achieving a better understanding of the overall concept of gamification. A better understanding of elements and their origins, relationships, and characteristics will help to enrich research and practice (Farjoun et al., 2015). Therefore, the goal of our research is to develop a taxonomy that provides more knowledge about gamification elements while providing usefulness for the design and analysis of gamification concepts. By following this goal, our paper focuses on the following research questions:

RQ1: How can gamification elements and their characteristics be described and classified in a taxonomy?

RQ2: How can the developed taxonomy be used to guide the design and analysis of gamification concepts?

To achieve our research goals it is important that we use a diverse set of methods when building our theory (Te'eni et al., 2015). First, we conduct an extensive literature analysis. Second, we rigorously develop a gamification taxonomy in stages to help developers categorise gamification elements while also providing further guidance for the design and analysis of gamification concepts. Third, we evaluate and revise our taxonomy according to recommendations provided through expert interviews. Fourth, we use two different cases to demonstrate the validity of our taxonomy.

In accordance with this goal, our paper makes theoretical contributions by providing a shared understanding about gamification, as well as introducing new terminology that facilitates the sharing of knowledge on the meaning and characteristics of gamification elements. Accordingly, we hope to assist researchers in designing and analysing gamification concepts using element classification. Our paper also empowers practitioners and IS designers in analysing and refining gamification designs, helping them to develop an appropriate gamification design when creating a new IS from scratch.

After explaining the motivation for our study, we present the related theoretical background and literature about gamification and existing gamification taxonomies. Next, we outline the details and different steps of our methodology. Subsequently, we present the results of our research study and conclude our paper with a discussion of these results, the implications of our study, and future avenues of research.

2. Theoretical background

The goal of this section is to present a shared understanding of aspects relevant to this study. First, we discuss the term gamification and the meaning of gamification elements; second, we discuss the current state-of-the-art gamification taxonomies and demonstrate how taxonomies can support solving existing problems and challenges through the classification of gamification elements.

2.1. Gamification and gamification elements

The term gamification remains controversial and there is no final consensus on its definition. Some research studies define gamification by underlining its relevance

in the different contexts in which it is used, such as in finance, marketing, health, education, sustainability, and productivity (Allam et al., 2015; Fernandes et al., 2012; Muntean, 2011). Gamification can also be defined as a tool for solving problems or achieving organisational goals (Buckley & Doyle, 2017). Comparatively, gamification can be defined as the process of enhancing IS with (motivational) affordances to invoke gameful experiences and provoke behavioural outcomes such as continuous use (Hamari et al., 2014). In this paper, we refer to the most prominent definition of gamification provided by Deterding, Dixon et al. (2011), who define gamification as the use of game design elements in non-game context to improve the user's experience and engagement (Morschheuser et al., 2015; Suh et al., 2017), as well as their activity (Jakubowski, 2014). Further, gamification is useful to socialise, support fun, and to destress users (Zichermann & Cunningham, 2011). Gamification elements comprise the central component of gamification concepts, which can be defined in several ways. Gamification elements (alternatively, game design elements) can be described as a general description of all those components and aspects necessary for designing and understanding a gamification concept. A general description of existing gamification components is presented in Table 1.[1] Hunicke et al. (2004) and Werbach and Hunter (2012) specify three components of games. Game mechanics comprise the essential components of a gamification concept; they are the building blocks used to develop a gamification concept and are selected and combined to create a gameful experience (Blohm & Leimeister, 2013). We refer to these as *construction elements* because they are selected and used by designers as central components for the creation of gamification concepts. *Dynamics* describe how users experience construction elements (Hunicke et al., 2004). A point is a collectable construction element (Thiebes et al., 2014) related to the collection dynamic (Blohm & Leimeister, 2013).

Motives, also referred to as aesthetics (see Hunicke et al., 2004; Werbach & Hunter, 2012), describe an individual's psychological disposition (Leimeister et al., 2009), and are closely related to dynamics. For example, badges can be collected (Davis & Singh, 2015), and this collection activity can lead to the achievement motive. However, based on the underlying design, construction elements may cause different dynamics that correspond to different motives (Blohm & Leimeister, 2013). Gamification concepts are developed with the intention of changing a user's behaviour (Deterding, Sicart et al., 2011), and so different *behavioural components* can be addressed through a gamification concept. Changing the behaviour of users by using construction elements can refer to different things, such as increasing a user's usage behaviour or satisfaction, or merely influencing their motivation when completing an action (Davis & Singh, 2015; Denny, 2013; Hanus & Fox, 2015). Motivation differentiates gamification tasks from tedious tasks and so is an important component of gamification concepts (Deterding, Sicart et al., 2011).

Terminology pertaining to motivation can be oriented in different ways, such as intrinsically or extrinsically (Gardner, 2007; Petri & Govern, 2012). Intrinsic motivation can be described as "doing something because it is inherently interesting or enjoyable (…)" (Ryan & Deci, 2000, 55). Intrinsic motivation refers to what individuals will do without external inducement (Lowry et al., 2015). Comparatively, extrinsic motivation is about "doing something because it leads to a separable outcome" (Ryan & Deci, 2000, 55); it is the desire to perform an activity in order to yield positive consequences or avoid negative ones (Kuvaas et al., 2017; Ryan & Deci, 2000). Some claim that extrinsic motivation only concerns the obtaining of money or tangible assets, however, it is inaccurate to assume that extrinsic motivation is induced by these alone (Kuvaas et al., 2017). Indeed, the same effect may arise if someone is informed about intangible rewards they are able to collect, such as badges or points. The success associated with collecting a point can be easily quantified, and collecting a point is also connected to positive consequences such as being rewarded for completing a goal. Extrinsic motivation and intrinsic motivation should not be seen as antipodal. Extrinsic motivation can, under some circumstances, be self-determined and thus can also trigger intrinsic motivation (Deci et al., 2001). Finally, *technical components* determine how construction elements are presented within an IS. When using points to reward users for a desired

Table 1. Gamification elements.

Components	Description	Example and Reference	
Construction Elements (Game Mechanics)[2]	Building blocks of a game implemented in an IS	Leaderboard, Points, Level, Avatar	Thiebes et al. (2014)
Game Dynamics	Effects of construction elements on subjective user experience over time	Competition, Collaboration, Status, Challenge	Hunicke et al. (2004)
Motivational Components	Motives addressed by dynamics	Social recognition, Achievement, Collection	Blohm and Leimeister (2013)
Behavioural Components	User behavioural reaction based on the usage of a game concept	Motivation, Satisfaction, System Usage	Werbach and Hunter (2012)
Technological Components	Technical construction of construction elements	Usernames in a leaderboard vs. fictional names	Christy and Fox (2014)

behaviour, the number of points awarded to a user and whether the collection of points is connected with a sound, must both be specified.

In addition to covering all these components when developing a gamification concept, it is also important to consider context – or domain-related aspects that might change the concept of gamification itself. Some construction elements might not work for specific contexts or user groups. For example, a differentiation can be made between performance and mastery learners (Zusho et al., 2005) when considering technology-mediated learning environments where gamification is oftentimes used (Schöbel et al., 2016); the former group prefers comparisons with other users, while the latter group wishes to act independently. Therefore, a leaderboard and a one-size-fits-all gamification concept may be unsuitable for learning contexts.

All components of a gamification concept are interrelated, and game construction elements comprise the starting point when designing a gamification concept. Dynamics and motives can be used to better understand the characteristics of each construction element. Accordingly, we shall use the description of construction elements – along with those of components – to describe their characteristics in a taxonomy. In the following section, we describe why a taxonomy is suitable and necessary for better-describing construction elements.

2.2. Classification of elements used in gamification

The previous section explained the different components of gamification. To better understand the relevance of a gamification taxonomy, we must first understand what a classification is and what it is used for. The classification of objects is a fundamental cognitive aid (Hambrick, 1984); without a classification scheme, researchers and practitioners must deal with individuality and many variables of interest (Hambrick, 1984). Classifications help us better understand complex domains (Nickerson et al., 2013).

There are different ways to classify objects, one of which concerns the development of a typology or taxonomy. Typologies are usually characterised by two or more dimensions, which are used to characterise names in individual cells (Bailey, 1994). A taxonomy is a theoretical study of classification, and taxonomies include bases, principles, procedures, and rules (Bailey, 1994; Usman et al., 2017). In simple terms, typologies are often developed according to a conceptual base, and taxonomies are often developed according to an empirical basis (Bailey, 1994). However, research specifies that taxonomies can be both empirical and conceptual (Doty & Glick, 1994). Taxonomies go beyond classifying objects, they ease knowledge sharing, provide a better understanding of interrelationships among objects, and support decision making (Bailey, 1994; Usman et al., 2017; Knote et al., forthcoming).

Bearing in mind the uses of classifications and taxonomies allows us to better judge state-of-the-art of classifications of gamification components. Assuming an abductive reasoning approach seems to provide a very different understanding of those elements used in gamification and – from a pragmatic perspective – how these elements might support researchers and practitioners in gamifying IS. A useful taxonomy of gamification elements can change the way we think about gamification elements. Doty and Glick (1994), maintain that this is because taxonomy goes beyond the mere classification of objects, and might be used as a means of predicting outcomes.[3] Therefore, and very much in line with "typical" theory development (Grover et al., 2008), the constructs of a taxonomic theory must be well defined, as must the relationships among constructs. Another criteria is that a taxonomic theory must also be falsifiable. More precisely, having a falsifiable theory is necessary to validate the utility of a taxonomy, as is the case with any other theory (Corley & Gioia, 2011; Doty & Glick, 1994). Additionally, a taxonomy can also be judged by its attributes (Nickerson et al., 2013). First, a taxonomy should comprise parsimonious dimensions and characteristics, which should be easy to comprehend or apply. Second, a taxonomy should have a robust meaning, and enough dimensions and characteristics should be included so that it is possible to differentiate among those objects presented in the taxonomy itself. Third, a taxonomy should be comprehensive and should both cover and provide a complete description of all known objects. Fourth, a taxonomy should be extendible and should allow for the inclusion of additional dimensions and characteristics. Finally, a taxonomy should be explanatory, meaning that the taxonomy should explain its objects rather than merely describing them.

Additionally, explanatory taxonomies enable the identification of objects based on certain characteristics and vice versa. Bearing general taxonomic attributes in mind along with the contributions these attributes have made to theory development, we can now judge those challenges facing existing gamification taxonomies (Hunicke et al., 2004; Liu et al., 2017; Weiser et al., 2015; Werbach & Hunter, 2012) (see Figure 1).[4]

A description of the components of each taxonomy and how these are used in existing research is provided in Supplementary Appendix A.

First, we can observe that the *list of elements* varies among taxonomies. Some lists of elements presented in existing taxonomies are not exhaustive and do not cover the full range of their elements. Werbach and

Attributes of a Taxonomy*		Challenges of Gamification Taxonomies							
		Incomplete list of elements	Encapsulation of elements	Generic classify-cation of elements	Different catego-rizations of elements	Missing presentation of characteristics	Descriptive focus	Different understandings about relationships	Missing validation
Concise	• Limited number of dimensions and characteristics • Not difficult to comprehend and apply		x	x	x	x	x	x	x
Robust	• Enough dimensions and characteristics to clearly differentiate between objects of a taxonmy		x	x	x	x		x	
Comprehensive	• Classify and identifies all relevant objects • Complete description of each ideal type	x							
Extendible	• Allows for inclusion of additional dimensions and characteristics		x	x		x			
Explanatory	• Should be explanatory not descriptive • Characteristic supports finding an object, and an object can be described by a characteristic • Specified the relationship between objects	x	x	x		x	x	x	x
Applicable	• Is validated to demonstrate practical usefulness • Is evaluated					x	x	x	x

Figure 1. Attributes of a taxonomy and challenges of gamification taxonomies.

Hunter (2012) classify avatars as components of a game, and as a visual representation of a player's character. However, an avatar is not necessarily only the visual representation of a user, and they can be used as tutors, teachers, or someone who guides a user as they use an IS (Clark & Choi, 2005). Accordingly, existing taxonomies need to be improved in terms of their comprehensive and explanatory objects. Second, in referring to the *encapsulation of elements*, some taxonomies classify certain elements, such as "rewards", as game mechanics. Having the definition of the mechanics category in mind, these rewards are described as particular components or building blocks of a game (Blohm & Leimeister, 2013; Hunicke et al., 2004). However, elements such as rewards are encapsulated when considering how they are used in both research and practice. By definition, a reward does not necessarily become a component of a game merely because it has been categorised as such; instead, elements such as badges, points, or virtual goods reward users for certain behaviours (Thiebes et al., 2014). This makes it difficult to further include other elements (extendible) in a taxonomy. This has been criticised by other researchers, who claim that the classification of mechanics is not currently itemised or classified in an effective way that supports the designers of gamification concepts (Robinson & Bellotti, 2013). Additionally, the conciseness of existing taxonomies suffers because it becomes more challenging to apply a taxonomy to other contexts. Finally, the dimensions of existing taxonomies seem to be insufficiently precise (robust, explanatory).

Another challenge concerns the *generic classification* of gamification elements and the *missing representation of characteristics*. Among extant gamification taxonomies, elements are simply classified to inform practitioners and researchers about existing gamification elements. However, each element can be characterised in more detail. The element "reward" is commonly used to describe elements that reward users, though rewards can also be a characteristic of elements such as points, badges, and virtual goods (Thiebes et al., 2014). The classification of mechanics, dynamics, components, and aesthetics may offer a general way to categorise elements. More detailed characteristics are necessary for describing elements in greater detail, thereby making taxonomies more robust and extendible. Thus, existing taxonomies are *descriptive* and not explanatory because they focus on clustering a group of elements without providing detailed information about the characteristics of those elements. Such descriptive taxonomies might help to give an overview about those elements that exist within the taxonomy concerned (Nickerson et al., 2013); however, they must be developed further so to provide an improved understanding of each individual element. It is difficult to apply a descriptive taxonomy to a context or phenomenon (applicable, robust), and this difficulty can also be observed regarding how elements are *categorised*.

In considering the mechanics dynamics aesthetics (MDA) framework from Hunicke et al. (2004), Bista et al. (2014) classifies points and badges as dynamics (which are, by definition, the run-time behaviour of

game mechanics), while Toda et al. (2014) classify them as mechanics. These different ways of categorising elements might also result from different understandings about the elements definitions. Ibánez et al. (2014) define dynamics and claim that they drive users into a state of flow. Comparatively, BISTA et al.'s (2014) definition of dynamics suggests that they are used for fun. Toda et al. (2014) explain that mechanics are utilised mechanisms within a system, while SUH et al. (2015) define mechanics as tools, techniques, and widgets. These descriptions seem to be insufficiently detailed (robust) and a more detailed (concise) descriptions are needed. The MDA taxonomy characterises three objects: mechanics (components of a game), dynamics (run-time behaviour of mechanics), and aesthetics (motives of users) (Hunicke et al., 2004).

Obviously, the inconsistencies of a *relationship* between different element categories becomes clear when investigating how the taxonomy is applied. Ibánez et al. (2014) state that MDA does not outline connections between assigned game elements. It is not clear which mechanic leads to which dynamic, nor which emotions are addressed. Accordingly, such taxonomies are lacking in terms of conciseness, applicability, and explanation. Finally, *validation* should be considered if we are to present a taxonomy that contributes to theory (Corley & Gioia, 2011; Doty & Glick, 1994) (they must be concise, applicable and explanatory). All the taxonomies we identified have a descriptive character and require additional validation when demonstrating their usefulness to research and practice. This requirement might explain the different ways and inconsistencies as to how taxonomies are used.

Despite these challenges, each taxonomy has its own goal. Existing taxonomies provide useful insights into gamification elements, and facilitate a better understanding of the constitution of gamification elements and how gamification itself can be described. Insights from existing taxonomies have helped us derive a more useful taxonomy to support researchers and practitioners in constructing gamification concepts. This also supports decision making, making it easier to adapt gamification concepts to a target group or a context, and helps to specify the relationships of gamification elements so that we can better predict user behaviour.

3. Methodology

To achieve our goal, we proceeded according to four different steps (see Figure 2 for an overview). First, we conducted a literature review; second, we iteratively designed our taxonomy; third, we evaluated and revised our taxonomy using expert interviews; and fourth, we conducted a validation of our taxonomy using two cases, thereby completing its development.

We conducted a literature review to identify existing construction elements and better understand the origins of each element. To cover a broad set of publications, we used the keywords "gamification" and "gamification elements" or "game design elements" when undertaking a search across six databases: ACM, EBSCO, Emerald, IEEE, AIS, and JSTOR. In addition, we considered key publications from several IS journals such as MISQ, JMIS, JAIS. The results of the literature review were used to identify existing elements and were employed in our taxonomy's iterative development. Developing a taxonomy involves classifying different kinds of objects to better describe elements and generally improve understanding of their meaning (Nickerson et al., 2013). From a pragmatic viewpoint, the classifications of objects can support researchers and practitioners in examining how categories (or elements) originate, improving understanding of these elements across multiple levels and showing how they relate to one another (Farjoun et al., 2015). Taxonomies provide structure and organisation to a field of knowledge, enabling researchers and designers to study the relationships among different objects (Glass & Vessey, 1995; Nickerson et al., 2013). We reviewed several taxonomy development approaches to inform the development of our own

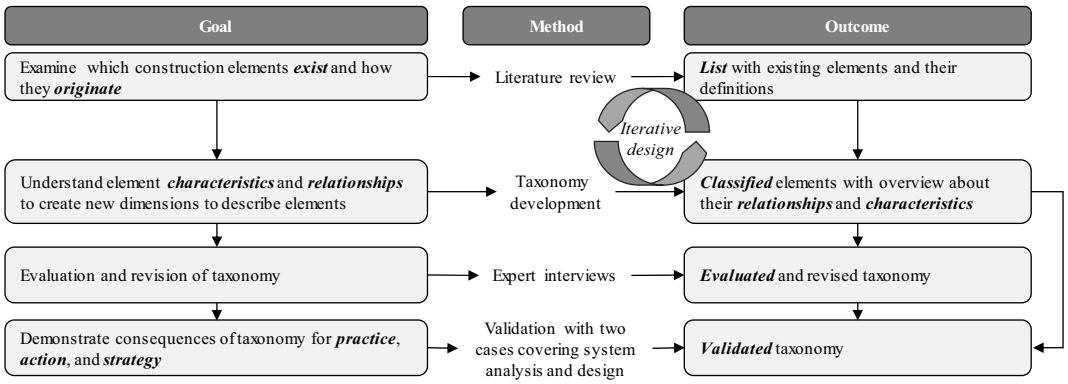

Figure 2. Methodology overview.

taxonomy (including those of Bradley et al., 2007; Hambrick, 1984; Nickerson et al., 2013; Usman et al., 2017). We decided to use Nickerson et al.'s (2013) approach because it is the most prominent and widely used approach in the field, and because it offers the most systematic and step-by-step method for developing taxonomies while guaranteeing a complete identification of dimensions and the characteristics of objects (an overview of Nickerson et al.'s 2013 development is provided in Figure 3).

In a first step, a meta characteristic must be defined, which must summarise the identification of different characteristics within each iteration and provide information about characteristics that need to be defined. This helps researchers eliminate irrelevant characteristics from the taxonomy and should be based on the target group for which the taxonomy is being designed.

Next, iterations follow, beginning with either an empirical-to-conceptual or a conceptual-to-empirical approach and any exchanges between the two. A conceptual-to-empirical approach involves the examination of empirical cases to see how they fit within the conceptualisation, while an empirical-to-conceptual approach involves starting with empirical data clusters before conceptualising the nature of each cluster (Nickerson et al., 2013).

Finally, ending conditions need to be defined due to the iterative development process, (step 2 in Figure 3). Four ending conditions assisted us in deciding when a taxonomy was complete and whether all characteristics and dimensions had been identified within the iterative process (Nickerson et al., 2013). First, all identified objects of a taxonomy must have been examined. Second, at least one object must be classified under every characteristic of every dimension. Third, no dimensions or characteristics can be added to the final iteration. Fourth, dimensions, characteristics, and cell combinations are unique and should not repeat. After the completion of the iterative design step has been completed, an evaluation was conducted to analyse the usefulness of our taxonomy. Determining the usefulness of a taxonomy is difficult, and may be determined by the effectiveness of that taxonomy's use among practitioners and researchers (Nickerson et al., 2013). Accordingly, expert interviews were used to analyse our taxonomy and determine its usefulness in developing and understanding gamification concepts among practitioners and researchers. Interview results were then used to revise our taxonomy.

In the final step, and to demonstrate our taxonomy's usefulness, we conducted a validation test using two cases covering both system analysis and design. Judging the usefulness of a taxonomy is difficult when only using quantitative measures, to ensure taxonomic usefulness we considered a usefulness demonstration (Nickerson et al., 2013). Such cases can help researchers and practitioners better understand why, how, and with what results certain decisions are made (Yin, 2003).

Accordingly, two cases were presented for the final step of our taxonomy's development: one to test the analysis, the other to test the design of gamification concepts

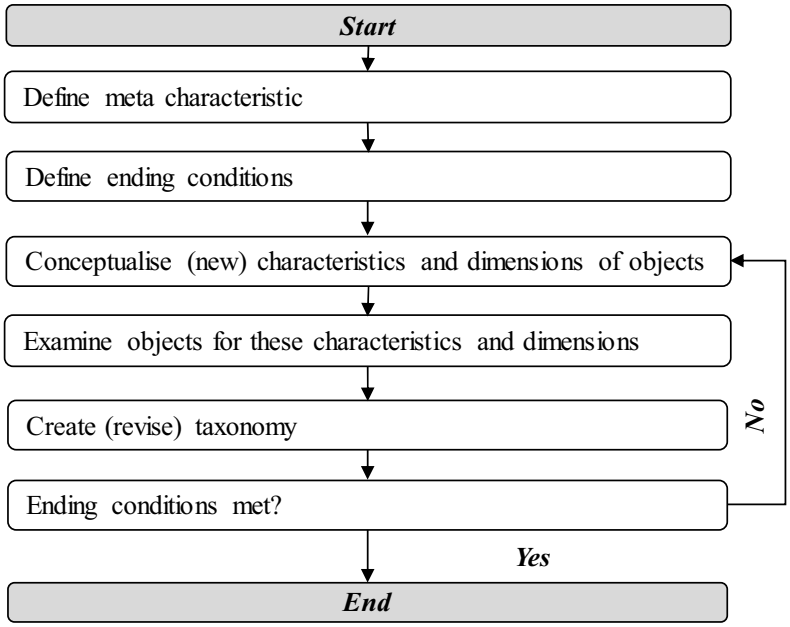

Figure 3. Taxonomy development steps.

4. Results

In this section, we present the findings from our literature review as well as the results pertaining to our taxonomy and its evaluation. Lastly, we demonstrate the use and validation of our taxonomy.

4.1. Identification of elements and characteristics

In our literature review, we selected papers that focus on gamification in terms of definition, elements, game design. Given the large number of papers that fit the criteria presented above, we excluded papers that did not list the elements they used because these papers are irrelevant to our analysis. We also included additional papers found through cross-referencing. A total of 104 papers were used in the analysis (these are listed in supplementary Appendix B).

We identified existing elements before classifying them according to their characteristics. When identifying existing elements, we observed that different categories of elements and alternative terms for single elements exist. *Figure 4* depicts how we summarised similar terms among the elements, referring to the names of those elements most frequently used in the literature (similar to Seaborn & Fels, 2015).[5]

Our taxonomy comprises 14 different construction elements. We decided to add two kinds of avatars to our list of elements; some were used as visual representations of users within an IS (Buckley & Doyle, 2017), while others refer to avatars that accompany and instruct users (Lee et al., 2013). We added a collection system to the list of construction elements because some studies refer to construction elements as "badge systems" or "point systems", which are used to document the collection progress (Denny, 2013; Mollick & Rothbard, 2014). An overview of the description of each construction element, which are significant to our taxonomy's development, is given in Appendix A.

4.2. Taxonomic classification of construction elements

First, we derived a meta-characteristic. This meta-characteristic was defined as "*characteristics of construction elements*", because the goal of our research is to understand the origins and relationships of construction elements. Descriptions and/or definitions of each element were used for the first version of our taxonomy because definitions help

Construction Elements	They are the core elements of an gamification concept and are used by system developers and designers as building blocks that are implemented into information system.
Points	Experience Points, Loyalty Points, Reputation Points, Scores, Credits, Currencies
Badges	Trophies, Medals, Stamps, Icons
Feedback	Audible Feedback
Time Pressure	Deadline, Time Banking, Time Limit, Time Constraints
Leaderboard	Ranking, High-Score Tables, Score Boards, Badge Board, Line Chart
Progress Bar	Progress, Performance Graph, Performance Stars, Progress Notification
Level	User Level, Progression
Tasks	Missions, Quests, Assignments, Goals
Virtual Goods	Virtual Gifts
Avatar	Roles, Virtual Character, Character, User Profile
Narratives	Meaningful Stories
Reminder	History, Progression, Time Line
Collection System	Badge System, Point System, List of Medals, Point Grading System
Dynamics	Describe how construction elements are experienced by users that use a gamification concept. This experience depends on how systems developers or designers design an construction element based on their different characteristics.
Rewards	Incentives, Awards
Cooperation	Collaboration, Team, Team Building, (Social Networking Features)
Competition	
Challenge	
Motivational Elements	Describe the motives of user se and/or their emotional response and reaction of users to construction.
Social Facilitation	
Ownership	
Achievement	
Self-expression	
Altruism	

Figure 4. Existing gamification elements and alternative terms.

us understand the meaning of objects and their characteristics (an overview of these definitions is given in supplementary Appendices C and D).[6] We then used an inductive empirical-to-conceptual approach to identify dimensions and characteristics. This approach proved to be feasible, and consequently, we were able to identify many published gamification studies (Nickerson et al., 2013). We also considered conceptual-to-empirical approaches and referred to important streams of gamification literature to determine dimensions for our taxonomy. Six iterations were needed to develop the first version of our taxonomy, an overview of which is depicted in *Figure 5*; dimension definitions are provided in Appendix B.

Six iterations led to the following taxonomy:

T6 = {Reward (Rewarding, Not Rewarding), Punishment (Punishing, Not Punishing), Bonus (Bonus, No Bonus), Interdependency (Independent, Dependent), Development (Developing, Static), User Design (Partial Involvement, No Involvement), Competition (Competitive, Not Competitive), Cooperation (Cooperation Possible, Individual), Intrinsic Motivation (Intrinsically, Not Intrinsically), Extrinsic Motivation (Extrinsically, Not Extrinsically)}

We then matched the objects with the dimensions and characteristics (see *Table 2*).

4.3. Taxonomy evaluation using expert interviews

Expert interviews were used to evaluate our taxonomy. We considered both practice (P1, P2, P3) and research (R1, R2, R3, R4) gamification experts, and selected these experts based on their experience and their gamification publication expertise (see Table 3 for demographic data of interviewees). To guarantee anonymity, we refer to each interviewee's recommendations by referring to the numbers listed in Table 3. The final version of our taxonomy and the final definition for each dimension were submitted to interviewees one week before the interviews. Interviewees were asked to make comments and note everything that should be changed or revised. The seven interviews were conducted via skype or phone. All interviews were recorded with the permission of the interviewee.

The shortest interview lasted 24 minutes and the longest interview lasted one hour and 17 minutes. Transcripts were made from each interview recording. We were then able to consolidate the interview statements given by our interviewees using transcripts and the evaluation criteria. An overview of these consolidated interviewee suggestions and the corresponding actions we took are presented in Appendix C. All recommendations were used to improve the

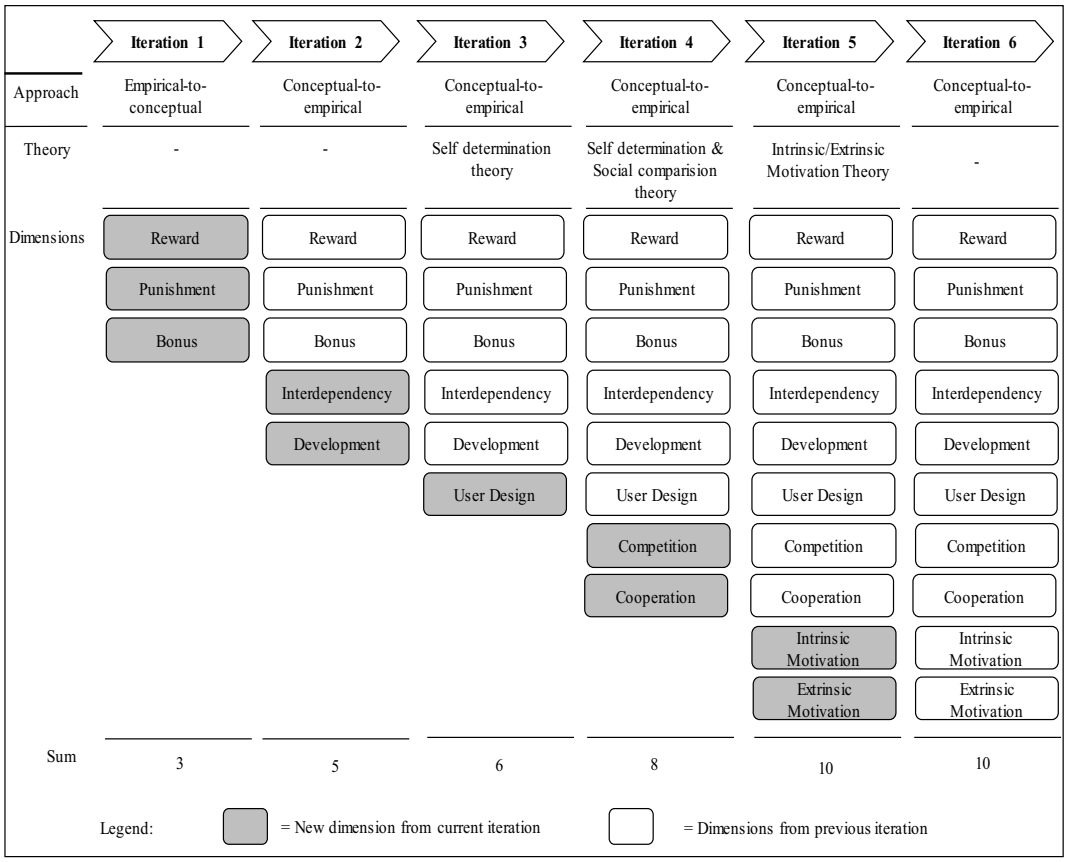

Figure 5. Iterations and dimensions.

Table 2. First version of taxonomy.

	Gamification Construction Element Dimensions and Characteristics																			
	1		2		3		4		5		6		7		8		9		10	
Gamification Construction Elements	Rewarding	Not Rewarding	Punishing	Not Punishing	Bonus	No Bonus	Independent	Dependent	Developing	Static	Partial Involvement	No Involvement of Users	Competitive	Not Competitive	Cooperation possible	Individual	Intrinsically	Not Intrinsically	Extrinsically	Not Extrinsically
Collection System		x		x		x		x	x			x		x		x	x			x
Point	x		x		x		x			x		x	x		x			x	x	
Badge	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. Demographic data of interviewees.

Practitioners

No.	Work Description	Age	Gender	Years of Gamification Experience
P1	Consultant	24	Female	0.5
P2	Manager	28	Male	5.5
P3	Senior Consultant	33	Male	1.5

Researchers

No.	Work Description	Age	Gender	Gamification Publications*	Citations
R1	Researcher – Professor	35	Male	3	303
R2	Researcher – PhD Student	29	Male	10	151
R3	Researcher – PhD Student	28	Male	7	14
R4	Researcher – PostDoc	31	Male	2	4

* We considered conference as well as journal publications.

taxonomy. A suggested separation between micro and macro feedback (or absolute and relative leaderboards) was unnecessary because both elements have the same characteristics. A separation of these elements was not necessary as they are classified in the same way as feedback and leaderboards. R3 recommended that we exclude the bonus dimension stating that it was equivalent to the reward dimension. A bonus is different to a reward; it is defined as an additional reward for having completed a series of challenges or set of core functions (Hiltbrand and Burke 2011). We decided that the bonus dimension should remain part of our taxonomy. R3 also recommended we use involvement vs. no involvement instead of partial involvement vs. no involvement. At some point, system developers must decide about the general game design structure. Even if users can determine all the components of an avatar, they must still select their favourite items from a given list that has been included by a system designer. Thus, the full involvement of users is impossible. In addition, we decided to differentiate between those dimensions that follow an underlying game logic and those that support the design of a gamification concept.[7] Finally, R1 indicated that levels can be both punishing and rewarding; users can be awarded for achieving higher levels or punished for falling to lower levels. However, these awards and punishments depend on the element with which a level is connected, such as points or badges. In this case, points are awarded to – or taken from – users, resulting in them having a higher or lower level position. The final version of the taxonomy is described accordingly:

T6 = {Reward (Rewarding, Documenting), Punishment (Punishing, Neutral), Bonus (Bonus, No Bonus), Interdependency (Independent, Dependent,), Development (Developing, Static), User Design (Partial Involvement, Prescribed by Developer), Competition (Competitive, Individual), Cooperation (Cooperation Possible, Cooperation Impossible), Surprise (Surprising, Regular), Initial Motivation (Intrinsic, Extrinsic)}

Visual changes in the new version of our taxonomy are marked in green in *Table 4*.

Table 4. Revised taxonomy.

	Element Dimensions and Characteristics																			
	Underlying Game Logic								**Game Design**											
	Interdependency		*Development*		*User Involvement*		*Initial Motivation*		*Reward*		*Bonus*		*Punishment*		*Surprise*		*Competition*		*Cooperation*	
Construction Elements	Independent	Dependent	Developing	Static	Partial Involvement	Prescribed by Developer	Intrinsic	Extrinsic	Rewarding	Documenting	Bonus	No Bonus	Punishing	Neutral	Surprising	Regular	Competitive	Individual	Cooperation possible	Cooperation impossible
Collection Systems		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	x		x	
Virtual Goods	x	x		x	x			x	x		x		x		x	x	x		x	
Leaderboard		x	x			x	x			x		x		x		x	x		x	
User 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	
User Avatar	x		x	x	x		x			x		x		x		x	x		x	
Mediating Avatar	x		x	x		x	x			x		x		x		x		x		x
Missions	x			x	x		x			x		x		x		x	x		x	
One-Time Narratives	x			x		x	x			x		x		x		x	x		x	
Processing Narratives	x		x			x	x			x		x		x		x	x		x	
Reminder	x		x			x	x			x		x		x		x		x		x
Time Manipulation	x			x		x	x			x		x		x		x		x		x

Table 5. Excerpt of implications and examples for element designs.

Element	Characteristic	Implication	Example
Badges	Developing	Developing badges can be used to encourage the progress of users in completing tasks, particularly if tasks comprise several parts.	Bronze, silver, and gold badges.*
	Static	Static badges can be used to reward users each time they have completed a task, and if tasks do not develop.	A user earns a badge for answering quiz questions (Alcivar & Abad, 2016).

* Recommendations were given by interviewees.

Some elements can be assigned to multiple characteristics. Assigning an element to both characteristics of a single dimension removes their mutual exclusivity (Nickerson et al., 2013). For example, developers of gamification concepts must decide whether to design static or developing badges, or whether to use both variations. To provide further guidance and overcome the limitations of mutually exclusive characteristics, we developed an additional table to assist the design of gamification concepts when using our taxonomy.[8] Recommendations concerning design variations were provided either by interviews or from consulted literature (see *Table 5* for an excerpt of the complete table, which can be seen in Appendix D).

Badges can be used as developing or static elements: developing badges can be used to further encourage a user when working on tasks incorporating different stages of difficulty by using bronze, silver, and gold badges (mentioned by P2); static badges can be used to reward users when completing a task, such as providing correct answers (Alcivar & Abad, 2016).

4.4. Case-based taxonomy validation

The final step concerned the validation of our taxonomy to demonstrate its usefulness and to provide further guidance to gamification concept developers. Our taxonomy was validated using two case studies (Yin, 2003): one demonstrating how it supports the analysis of gamification concepts, the other describing how it can be used to design new gamification concepts.

4.4.1. Analysing Gamification Concepts: Nike+ Case Study

We used Nike+ to validate the utility of our taxonomy and demonstrate how it can be used to analyse gamification concepts (see Figure 6).

The analysis of existing gamification concepts includes five steps: identification of elements, understanding characteristics, analysis of game design variations, matching of goals, and refinement of gamification concepts.

Nike+ is a popular mobile application that supports users' running behaviour (Nike, 2019). As noted earlier, the first step of our taxonomy involves identifying gamification concept elements. Our taxonomy classifies 15 different elements, of which Nike+ uses seven: collection system, points (miles), badges, leaderboard, progress bar, time manipulation, and reminders.

Marking these elements, according to our taxonomy, reveals part of the logic and design of the Nike + game and provides a transition to the second step. Integrated elements have a dependent focus that reflects the overall concept of the application, reflected by elements that are focussed on acting as developing elements. Most elements are prescribed by the system designer and are grounded on an intrinsic and motivating concept. Looking at selected elements and their use shows that the Nike+ gamification concept does not focus on punishment, collaboration, or surprise. Rather, its concept is grounded on rewards, and badges are given for successful behaviour and as bonuses. We found that most elements do not act as bonus elements, however, it was found that the app uses additional badges to highlight progress milestones. The competitive concept is grounded on individual improvement; each time a new user commences a new run they are encouraged to surpass their previous results. Comparing results among friends, using a leaderboard, is possible but does not dominate the overall concept.

The third step concerns understanding variations in the game design based on the logic that certain elements can be represented through multiple characteristics. The list of elements reveals that badges are either developing or static. Static badges remain unaltered, while developing badges change over time; Nike + uses both. Static badges highlight individual successes and developing badges highlight milestones.

After understanding the underlying game logic and design of Nike+, we looked at its overarching goals and how the gamification concept contributes to these goals. The app tracks individuals' running behaviour, which is reflected by the developing character of the elements used. Supporting individuals improvement is represented by the developing nature of the gamification concept; similarly, progress in running behaviour is best reflected in the developing character of the game's elements. Competition with one's friends is a central component.

Goals not directly addressed by the gamification concept are important in the fifth step. Now that we know which goals are addressed by the game concept

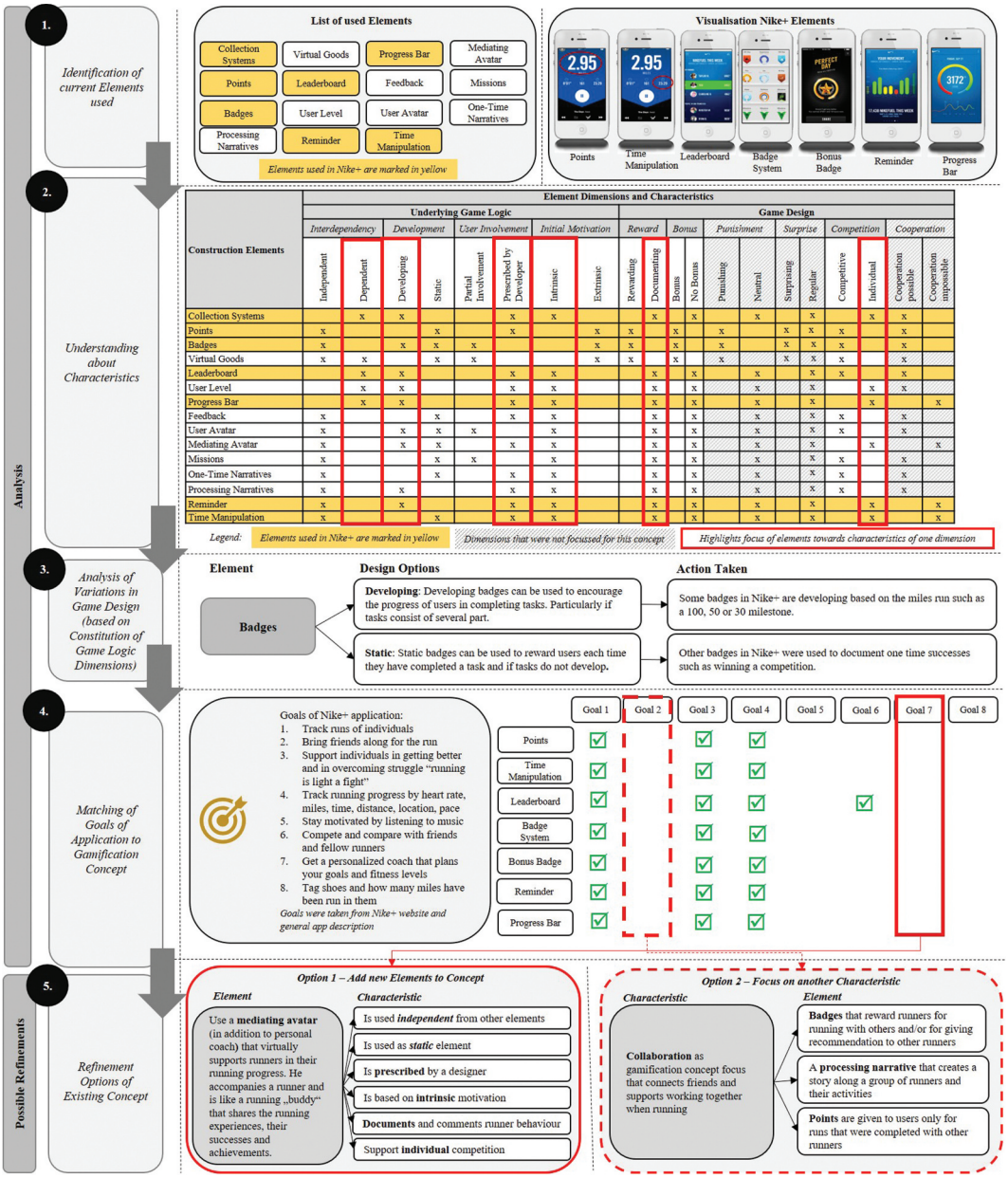

Figure 6. The case of Nike+ – analysing existing gamification Concepts.

and which are not, the concept can be further refined by adding new elements or characteristics. The goal of Nike+ is to connect runners to a human personal trainer. Adding a virtual personal trainer supports individuals to work on their running success, a criterion that is fulfilled by a mediating avatar. Another option is to select other game design components. In the current concept, badges and points serve as rewarding components; however, grounding these on a collaborative concept – together with processing narratives – supports the secondary goal of connecting with friends.

4.4.2. Designing Gamification Concepts: Validation of Mobile Learning Application Case Study

To underscore the utility of our taxonomy for guiding and designing user-centred gamification concepts, we discuss the case of a mobile learning application we designed for Chinese vocational students in the automotive field. The application was designed within the context of a larger design of a science research project (Ernst et al., 2016) (see Figure 7).

As above, five steps were used to design a new gamification concept: identification of goals, identification of characteristics, element selection, refinement of gamification concept, and implementation.

When starting the mobile learning application, users can choose between different learning-module tasks. While working on tasks, students can see a short task description as well as their task progress. Some tasks improve students' declarative knowledge; for example, one task involves users finding parts of a car in a scavenger hunt (Ceipidor et al., 2009). Other tasks improve students' procedural knowledge; for example,

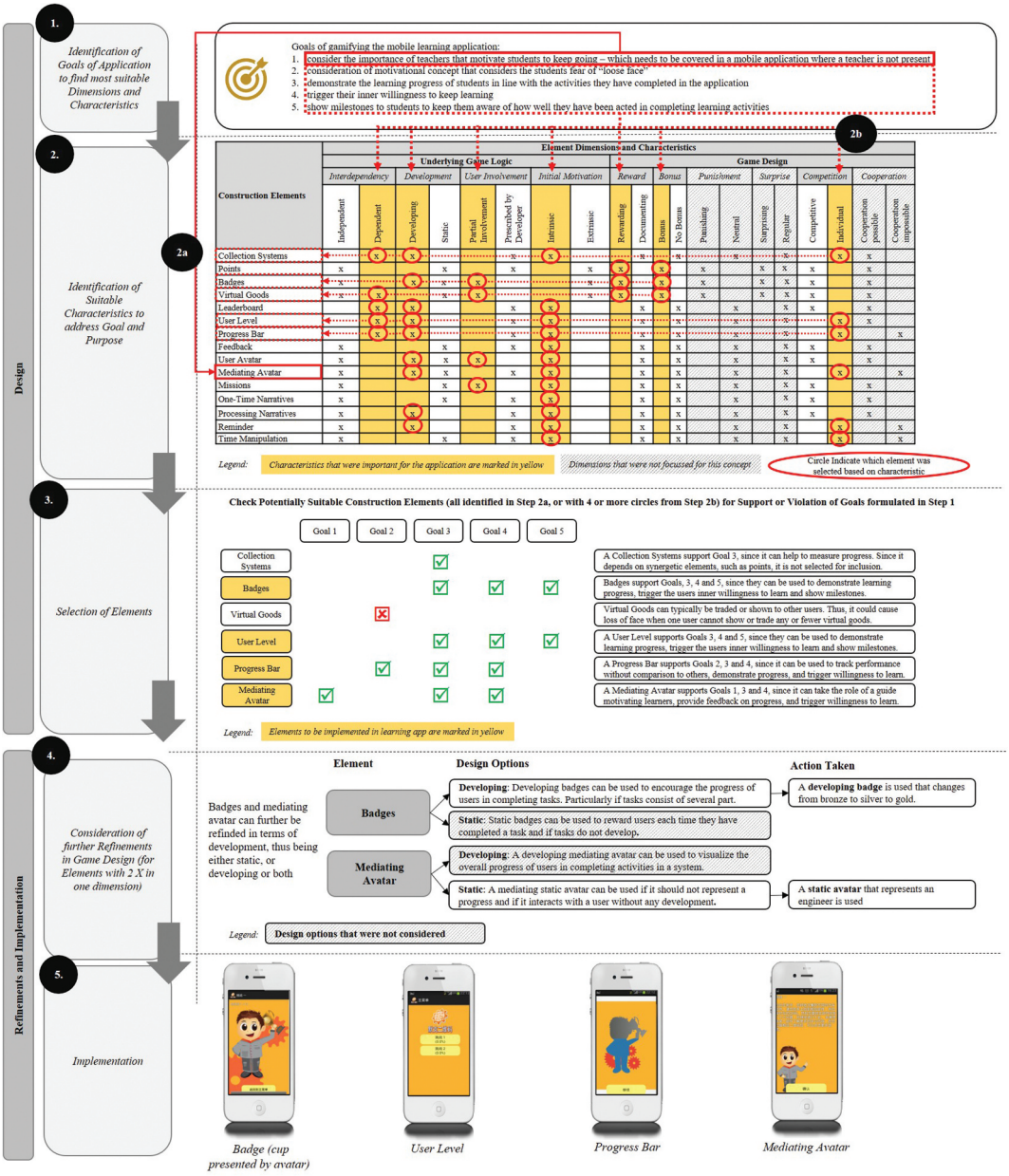

Figure 7. The case of a mobile learning application – designing new gamification concepts.

one task poses the following problem: "The street is not illuminated enough. What do you do to fix this problem?" Learners are required to search for a car using QR codes of the relevant car parts that need fixing. After selecting a QR code, a user provides explanations about car parts related to the code.

The first step is to identify the goals of the mobile learning application. These goals are then used for the second step, whereby dimensions and characteristics important to the gamification concept are identified, especially when considering specific user contexts.[9] In China, teachers guide students through different cases while representing someone students respect (Ernst et al., 2016). This supports the implementation of mediating avatars representing teachers within the learning app (step 2a). Dimensions and characteristics are used to identify elements for the gamification concept for other goals (step 2b). Dependent elements are relevant when demonstrating students' overall progress. Another important characteristic of mobile learning apps is the documentation of a user's *development* (Hakulinen & Auvinen, 2014). To address a student's feelings of autonomy (Deci et al., 2001), a gamification concept allows for the *partial involvement* of users.

Overall, *intrinsic* motivating components have more positive effects on the quality of a student's learning outcomes compared with their effects on extrinsic motivating components (Hanus & Fox, 2015). Learners easily become frustrated when punished, so we used a *reward-based* gamification

approach (Hattie & Timperley, 2007). To keep students motivated and give them additional rewards, we decided to use a *bonus* to support the goal pertaining to progress milestones.

Cooperation and competition were considered irrelevant because Chinese students tend to lose face when losing competitions or cooperating unsuccessfully (Redding & Michael, 1983). Surprises are irrelevant because the milestone goals are supported by bonuses.

The third step concerns the identification of elements for a concept, which includes decisions as to how many elements are included. Existing research supports the use of four elements for a learning gamification concept (Schöbel et al., 2016). Assessment of characteristics reveals six relevant elements: collection systems, virtual goods, user level, progress bar, mediating avatar, and badges. Virtual goods are not part of these concepts because they are rarely shown to other users, potentially resulting in loss of face. As collection systems are based on synergetic elements these were not considered for the gamification concept.

Further refinements of the gamification concept are possible in the fourth step. The gamification concept uses badges and a mediating avatar, and both are assigned to developing and/or static element development. At this point, a designer must decide on the specific characteristics they want to address. A developing trophy badge was used to support the application's goal of highlighting milestones and support the role of teachers in China and was represented by a mediating avatar. The development aspect is addressed by a level and progress bar, and a static mediating avatar is used for the gamification concept.

In the fifth step, elements must be transferred into the app (see Figure 7).

The two cases were used to validate the taxonomy. In addition, our taxonomy addresses Nickerson et al.'s (2013) validation criteria, who suggest five attributes. A concise taxonomy has a limited number of dimensions (Nickerson et al., 2013) so we reduced the number of dimensions in our taxonomy to four (game logic) and six (design). A robust taxonomy provides for differentiation among the objects of interest (Nickerson et al., 2013). Through our study's interviews and case studies, we have demonstrated that each element has a different meaning and, by presenting both the similarities and differences among these elements, have thereby contributed to a robust differentiation. Additionally, interviewees' feedback demonstrates that dimensions help explain existing elements, which contributes to the explanatory taxonomy aspect (Nickerson et al., 2013). Comprehensive taxonomies classify all objects of interest (Nickerson et al., 2013), and so we collected descriptions from over 100 research studies. Additionally, we presented similar terms to describe construction elements, thereby addressing the comprehensive taxonomy attribute. Finally, an extendible taxonomy allows for the addition of new dimensions and characteristics (Nickerson et al., 2013); adding characteristics to our taxonomy should be unproblematic as we have two for each dimension. With additional meta-characteristics, it should be possible to add more dimensions.

5. Discussion, contributions, and research agenda

5.1. Discussion of the results

The theoretical background section of this paper presents and discusses those challenges facing the attributes of taxonomies.

Table 6 shows how we addressed these challenges when developing our taxonomy, and informs this section of our paper, whereby we provide insights for future research studies to improve understanding of the development process of gamification concepts.

The goal of this paper was to present a taxonomy that supports researchers and practitioners in acquiring a shared understanding of existing gamification elements. We have shown considerable diversity among the classifications and descriptions of construction elements. An explanation for this might be that we do not yet understand what gamification means in terms of its various elements.

Dimensions such as cooperation and competition do not necessarily limit the engagement experience, or the fun experienced through elements such as leaderboards. Cooperation can also be realised by connecting gamification concepts with social media, which enables users to share what they have achieved with others (Aparicio et al., 2012). Additionally, competition is not solely about seeing one's position on a leaderboard, since competitive experiences cannot simply be handled as 'one-size-fits-all' solutions (Santhanam et al., 2016). Although our taxonomy is extendible, we recommend that researchers and practitioners should not limit their concepts to elements of our taxonomy and should consider the aims of their own gamification concepts. The gaming experience is about designing a concept users enjoy (Schmidt-Kraepelin et al., 2018). Gamification taxonomies can, therefore, be seen as starting points of the gamification development process, which are not limited to the selection and combination of elements.

Our taxonomy presents a two-staged process for the development of gamification concepts. Existing gamification taxonomies are mostly descriptive and used to describe existing elements and their categorisation. Gamification should not be viewed as selecting and combining elements to change users' motivation,

Table 6. Taxonomy challenges and action taken.

Challenge	Action Taken	*Concise*	*Robust*	*Comprehensive*	*Extendible*	*Explanatory*	*Applicable*
Encapsulation of elements	• Screening of gamification literature to identify and consolidate all terms and kinds of existing elements • Consolidation of similar terms to describe elements • Separation of elements (user avatars, meditating avatars)	x	x		x	x	
Incomplete list of elements				x		x	
Different categorisations of elements	• Presentation of dimensions and characteristics that describe each element in detail that	x	x		x		
Generic classification of elements		x	x			x	
Missing presentation of characteristics	• Consideration of element definitions and in combination with dynamics, and motives • Possibility to include additional dimensions, characteristics or elements • Additional recommendations about how to design elements under consideration of characteristics (if one dimension has more than two characteristic)	x	x		x	x	x
Different understandings about relationships	• Mapping of elements with dimensions and characteristics	x	x			x	x
Missing validation	• Evaluation and revision of developed taxonomy	x				x	x
Descriptive focus	• Validation with two cases to design and analyse gamification concepts	x				x	x

rather it is as an ongoing development process incorporating various design steps. Although inconsistencies in describing and classifying construction elements exist, all of them aim to motivate users, which then promotes a better user experience (Looyestyn et al., 2017). Depending on whether a gamification concept is analysed or designed, the first step in its design concerns selecting the best combination of elements in relation to concept characteristics. Further refinements can then be made to each element's design. Although we present design variations of our taxonomy, its technical aspects – such as the number of points or the concrete design of a leaderboard – require further work. Additionally, gamification should be seen as a process incorporating several iterations needed to develop a meaningful concept. Individuals do not play games just for points, they play to overcome challenges and to socialise with others (Kapp, 2012). Such psychological outcomes are important drivers of making gamification concepts effective (Harms et al., 2015). Therefore, our taxonomy could be used as part of an iterative method to develop gamification concepts and gamification methods that require more detailed refinement (Deterding, 2015). Through a shared understanding of construction elements as well as their characteristics and relationships, we can take a step forward in designing a more gameful experience for users. Furthermore, research is yet to determine the effects gamification on end-users (Seaborn & Fels, 2015). The role of motivation is a key component of gamification but it is still not fully understood (Seaborn & Fels, 2015), particularly regarding the extrinsic–intrinsic motivation relation, which requires further discussion (Ryan & Deci, 2000a). Further, we still do not know under what circumstances construction elements may actually undermine users' motivation (Mekler et al., 2013). The taxonomy we developed categorises each element in terms of its motivational orientation.

Our taxonomy was subject to validation and evaluation. However, more must be learned about those relationships that exist among construction elements, and how motivation is constituted according to different elements and element combinations. Element combinations may comprise the next step forward in realising a better understanding of the role and meaning of different motivational orientations. While some literature supports the view that extrinsic motivation can harm intrinsic motivation (Kuvaas et al., 2017), this cannot be explained by the current version of our taxonomy. The addition of further dimensions may help to analyse this issue. Through our taxonomy's dimensions, we present new possibilities of analysing elements concerning their expected outcomes, such as increasing cooperation and competition, which itself supports the identification of different construction element combinations.[10]

Our taxonomy could be further improved by considering contextual aspects. Contextualisation in gamification is important because if we take some elements and plug them into a specific context we do not know if the same combination of elements will also work in another context (Te'enIi, 2016). Santhanam et al. (2016) as well as Sailer et al. (2017) suggest that not all competitions are the same and that no one-size-fits-all design can be used in gamification design; they recommend that gamification designs should be adapted so that they are more meaningful to users. Accordingly, Liu et al. (2017) present a list of less successful gamification examples that increase the contextual relevance of gamification design to users. Omnicare developed a gamification approach to improve helpdesk waiting times using time pressure, leaderboard, and point-system game mechanics (Hein, 2013). Employees reported that they felt like they were being watched, which resulted in increased pressure and dissatisfaction (Liu et al., 2017). The JetBlue badge programme was used in combination with a leaderboard to engage the airline's customers and motivate spending (Liu et al., 2017). The concept was unsuccessful because customers felt that the programme requested too much personal information (Meermann, 2013). These examples indicate that elements, and the design of those elements, should vary depending on the contexts and user groups addressed by the overall gamification design. In line with this, we need to better understand how construction elements can be used in the context of organisations and how they affect employees and their reactions (Holzer et al., 2020). Our taxonomy is extendible and therefore supports the acquisition of a better understanding of element characteristics.

The JetBlue example also highlights a further issue that requires discussion, namely, that of element combinations and the examination of patterns of element combinations in gamification. Our taxonomy introduces a discussion to the literature regarding the relationships that exist among elements. Different element combination patterns might work better in specific contexts. In addition, gamification somehow needs to be personalised because different contexts can lead to different responses (Rozi et al., 2019). A typical pattern in gamification is the combination of points, badges, and leaderboards; however, relying on this combination of elements is not the key to successful game design, as has been demonstrated through the implementations of various gamification concepts (Burke, 2012; Liu et al., 2017). Clearly, different kinds of gamification patterns work better than others regarding the effects they have on motivation, and this is seen by observing different element combinations that influence motivation. For example, DA Rocha Seixas et al. (2016) combine points, badges, levels, and goals and demonstrate positive effects on user motivation. Hanus and Fox (2015) used the same elements but,

instead of using levels and goals, the researchers used a leaderboard to leverage competition among users, though without positive effects on user motivation. Both of these studies were conducted in a learning context and so it is possible that the benefits of competition in learning contexts may depend on how competitive elements are designed. For example, the epistemological perspective is central for the context of learning (Janson et al., 2019) and should be considered when designing gamification concepts. The taxonomy presented in this study helps us to better understand relationships among construction elements, though the relationship between gamification patterns and the context for which a gamification concept has been developed requires further discussion. Therefore, we encourage researchers to use our taxonomy to identify different patterns in gamification that might facilitate understanding of the relationships of elements and their characteristics and dimensions.

5.2. Contributions and research agenda

Our paper makes several theoretical and practical contributions and contributes to type-IV theory (Gregor, 2006). To conclude, we present a summary of research questions, and future research concepts based on our research study.

The research questions are highlighted in Figure 8.

We categorised our research agenda in three categories – classification & relationship of elements, game concept development, game concept effectiveness– to better guide our contributions and future research directions.

Classification & relationship of elements

Referring to the category of ***construction elements***, our literature review provides an overview of how current research studies use taxonomies to gamify IS. The review highlights inconsistencies regarding the meaning and classification of gamification elements. We provide an overview of all existing construction elements, and the relationships they hold with other elements, by presenting different element characteristics. We focus on describing and synthesising gamification, and cover a very broad set of publications from many different disciplines (Leidner, 2016). By describing and focussing on constitutions of element characteristics from these research studies, we make a broad sample of the literature understandable. What we did not consider are the differences that could exist among different disciplines and between users and their reactions (Liu et al., 2013). This issue, and whether elements and their characteristics differ in relation to the context in which they are used, is for future research to analyse. In doing so, research should try to isolate and classify collaboration and competition to help us get a better understanding of how to avoid so-called one-size-fits-all designs that seem to be especially prevalent for categories such as competition (Santhanam et al., 2016).

Our taxonomy provides a new classification of elements that facilitates the sharing of knowledge and helps researchers avoid randomised selection and combination of elements. We provide a more rigorous overview about how each element is related to other elements, and thereby assist in providing an improved understanding of effects caused by specific elements. Our findings contribute to the body of gamification knowledge, as the taxonomic dimensions we have developed specify the meaning of

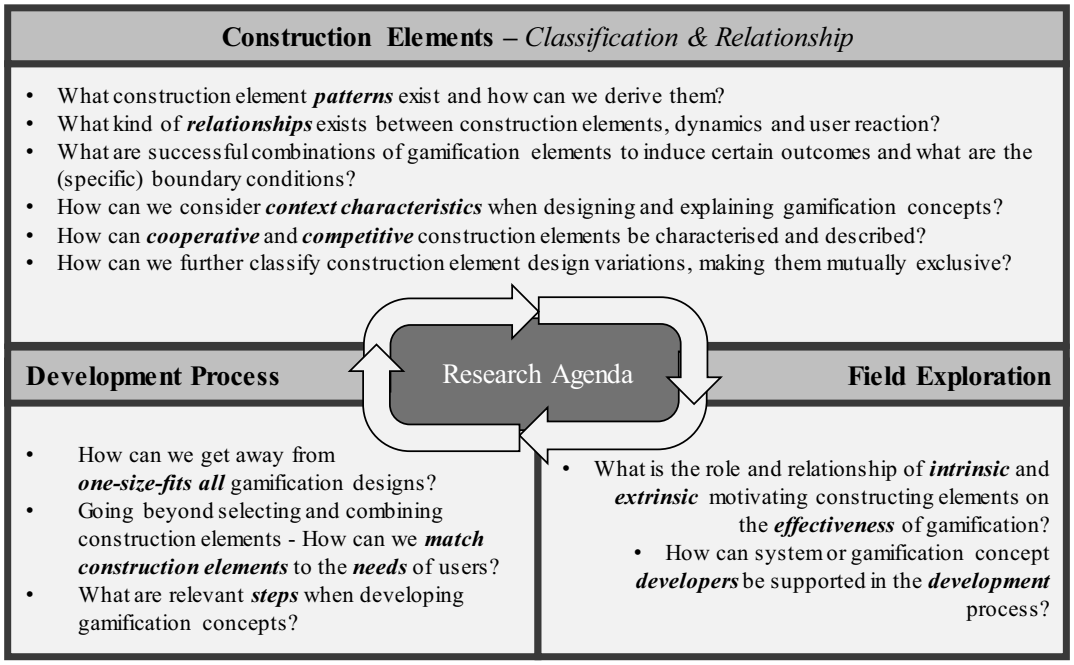

Figure 8. Research agenda.

each individual element. Through this, we extend existing research on gamification frameworks by focusing on the unique characteristics and relationships of elements, rather than focusing on an overall understanding of gamification elements and their meta-design principles (Santhanam et al., 2016). Accordingly, we are able to better explain concepts behind existing gamification approaches while guiding researchers looking to develop new approaches.

In line with this, future research should conduct analyses to determine whether different element combination patterns exist for different gamification contexts. This should be further aligned to a more detailed analysis of element relationships, which will help us to better understand how we can induce certain outcomes and configurations (Schöbel et al., 2017), and also how we codify design knowledge related to those successful gamification patterns. This should enable design science researchers to accumulate gamification-related design knowledge (Hevner et al., 2004). Examples for research questions would be: *what construction element pattern exist and how can we derive them? How can we consider context characteristics when designing and explaining gamification concepts?*

Game concept development

Our second research agenda category focusses on the ***gamification development process*** and can be aligned to several theoretical contributions as well.

Our taxonomy describes the characteristics of each construction element that exists in gamification. It enables researchers and practitioners to step away from so-called one-size-fits-all solutions and helps them in better matching the characteristics of construction elements to a specific context or the needs of a target group. With our taxonomy, we address these issues by describing element characteristics in more detail. It is up to future research to analyse how our taxonomy can assist in developing individualised gamification designs and how to better align elements to the needs of a group of users or a specific context.

We enrich theory by presenting a new way of using the classifications of elements to support gamification concept developers. Development should not be seen merely as the selection and combination of elements, but as an ongoing process. Creating a gamification concept requires significant design and developmental effort (Dicheva et al., 2015). Through the development of our taxonomy, we found that using element characteristic extends beyond merely finding different classifications of elements, and this allowed us to concentrate on gamification concept design. We present a two-staged process for the development of gamification concepts based on the characteristics of elements used in gamification. Accordingly, we not only contribute to gamification theory but also to theories about the role and meaning of classifying objects within IS. Accordingly, future research should focus on getting a better understanding about how and what to consider when developing gamification concepts. Research questions to focus on could be: *how can we get away from one-size-fits-all gamification designs? What are relevant steps when developing gamification concepts?*

Game Concept Effectiveness

Finally, we could clarify the relationship of construction elements to intrinsic and extrinsic motivation. However, although we can give general recommendations about which construction elements address a specific type of motivation, further ***field explorations*** are necessary (Koivisto & Hamari, 2014). Such field explorations should determine how intrinsic and extrinsic motivation constitutes specific elements. To better understand the effects of intrinsic motivation, future research could also refer to cognitive absorption – or other motivational factettes such as self-expression or exploration – that trigger motivation (Dale, 2014). This might help us to better demonstrate and understand how intrinsic motivation constitutes (Agarwal & Karahanna, 2000). Intrinsic motivation often involves many other factors, such as the need for competence (resulting from self-determination (Deci et al., 2001; Lowry et al., 2012), that allows other researchers to exceed our taxonomy. A research questions could be: *what is the role and relationship of intrinsic and extrinsic motivating construction elements on the effectivness of gamification?*

Practically, our taxonomy offers system designers a pragmatic solution for solving a real-world problem: the process of selecting, combining, and designing customised elements for IS. Our taxonomy helps developers of gamification concepts to design more sophisticated gamification approaches, and it can be used as a guide for the construction of gamification concepts. By specifying the meaning of each element, practitioners can adapt their approaches to context characteristics and users' needs and interests. This aspect could be further analysed with detailed ***field exploration*** that evaluates how our taxonomy is and can be used by gamification concept developers. Furthermore, our research provides an overview of all element characteristics, thereby improving developers' understanding of existing gamification concepts. We therefore invite other researchers and stem designers to analyse applications of our taxonomy so that it might be improved. Developers can further refine and adapt their gamified ISs to specific contexts or the specific needs of target groups, while also being able to identify element combination types. Finally, through our case-related validation, we show how taxonomies can be used to support the developers of gamification concepts. In accordance with this, we suggest practical means of overcoming issues that are related to taxonomic characteristics but that are not mutually exclusive by presenting different design variations of elements. According to Deterding (2015), academic

research on gamification and gameful design methods is still in its infancy Existing frameworks in gamification do not yet provide guidance as to how appropriate elements might be identified, and current research studies about gamification methods do not match elements with the basic needs of target groups. Regarding our research agenda and the ***development process***, future research should focus on the development of a gamification method that systematically guides gamification concept developers in selecting, combining, and adapting gamification concepts to specific contexts.

Finally, future research should focus on providing a deeper understanding about taxonomies, especially in terms of taxonomic dimensions that do not offer mutually exclusive characteristics. To make characteristics mutually exclusive, most approaches refer to a combined solution, such as categorising "developing and static" gamification elements. However, if the design of components is to be considered within the development of a taxonomy, then additional explanations and descriptions will be necessary if that taxonomy is to support a better understanding about the characteristics of its dimensions.

6. Limitations and conclusion

This study is not without limitations. First, we did not apply our taxonomy to different contexts or to different kinds of users; rather, we considered just two areas of application: learning and sports. Therefore, our taxonomy could be used to further explain existing gamification concepts and to develop new concepts in different contexts.

Second, based on Leidner's (2016) recommendations, we conducted a literature review that focuses on describing and synthesising existing literature, and tried to address the main gamification issues highlighted among existing researches.

Third, the taxonomy we developed only focusses on construction element characteristics, while we did not consider design variations of each element. For example, a leaderboard might present individuals with their real names or with self-created usernames; alternatively, the first three positions, or all positions, might be shown on a leaderboard.

Fourth, we offer new ways of evaluating the success of gamification concepts in terms of specific kinds of criteria. A collaborative or competitive gamification concept can, for example, be tested by asking users about their experiences of a gamification concept and whether it supports cooperation or competition.

Gamification is an important concept for influencing user motivation and changing users' usage behaviour. The results of our research indicate that inconsistencies remain regarding existing classifications of elements, which makes the development and design of gamification concepts difficult. For example, different terms for defining single elements exist; a leaderboard can also be described as a scoreboard or as a ranking. However, the results of our taxonomy development reveal that each element has its own characteristic and constitution. Our research offers guidance on gamifying IS, and we have shown how our taxonomy can be used to guide practitioners in developing gamification concepts, as well as how it might serve researchers as an instrument to better understand existing gamification concepts. Given the immense growth of gamification projects and the potential to motivate users through gamification, further research on this topic is guaranteed. Such research will require a solid theoretical understanding. In this paper, we have offered such an understanding by presenting our taxonomy and demonstrating its possible uses by researchers and practitioners.

Notes

1. These different components were derived from existing taxonomies.
2. This class of elements is typically described as "game mechanics" when we look at Hunicke et al.'s (2004) and Werbach and Hunter (2012) taxonomies. We decided to rename mechanics "game construction elements" due to the aforementioned inconsistencies relating to this term.
3. Thus, the taxonomy theory development approach used herein belongs to theory of explanation and prediction type (specifically, a type-IV theory, when accounting for Gregor's (2006) view on theories within IS research, instead of a type-I theory of analysis).
4. Identification of these challenges is based on observations of how existing studies use gamification taxonomies. These studies are included in the literature review, as explained in the methodology section. The development of each gamification taxonomy is assessed so that certain aspects, such as missing evaluations, can be observed. These observations were made by reading the original papers that present the various taxonomies.
5. We compared the definitions and/or descriptions of each identified element when making decisions as to their similarity to other elements and terms. Elements with similar designs and/or descriptions were summarised accordingly. We summarised all identified terms under the most prominent identifiable term; for example, "leaderboard" (which is well-known and is used to describe rankings, score tables etc.) was used to derive the characteristics of construction elements.
6. By definition, dynamics can result from construction elements and so can be used to better describe the characteristics of those construction elements. Therefore, we also considered their descriptions and definitions (see supplementary Appendix D).
7. Underlying game logic dimensions are necessary conditions for construction elements. Game design dimensions are optional (a construction element is not necessarily be competitive or cooperative). These aspects become important when taxonomies are used to analyse or design those gamification concepts presented in the results section of the final section.
8. In a prior version of our taxonomy, we included a third characteristic, "developing and static", which made the characteristics mutually exclusive. However, when we

use a taxonomy to design gamification concept, mutually exclusiveness should be ignored. Accordingly, all options should be presented to developers so they can determine those characteristics that should be further addressed by changing construction element design.

9. This design step supports our decision to overrule our taxonomy's criteria of mutually exclusivity. If we work using three characteristics for development (developing, static, developing, and static), decide on developing elements, and consider the "developing" row, we will be unable to consider badges as elements because these are assigned to both characteristics. However, to deliver greater support when developing gamification concepts, we present an additional table with suggestions from consulted literature and expert interviews to decide about the characteristics of an element.
10. According to Gregor (2006) and Doty and Glick (1994), a type-IV theory requires testable propositions. Our taxonomy allows for each dimension to be measured in terms of its successfulness. It is also possible to derive and test ideal types of element combinations using our taxonomy.

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Appendix A – Definitions of Construction Elements

There are several alternatives to describing a single gamification construction element. For our paper, we developed a definition for each element that we focus on in our taxonomy (Note: the names used for the elements have been adapted according to suggestions made in the expert interviews).

Element	Definition
Badge	A badge is a visual icon that signifies an achievement a user accomplishes while working on an activity and/or an action in an information system.
Collection System	Collection systems are used to measure a user's progress and performance when working on activities and/or actions in an information system. Therefore, a numeric value is added to an overall score.
Feedback	Feedback provides users with information about how well they have performed, and helps to keep users aware of their progress and failure when working on activities and/or actions in an information system. Feedback is therefore content related and informs users about why they might have failed in working on an activity and/or task.
Mediating Avatar	A mediating avatar guides users while they use an information system, and provides feedback on their performance and IS outcomes. Mediating avatars are created by the system designer with a specific goal.
Leaderboard	On a leaderboard, a user can compare their own performance with the performance of other users. A user's performance is often presented as a ranking.
Level	A level shows a user's progress in working on system activities or actions and displays their experience through different level positions. Levels are cumulative, thus a higher level can be reached by completing previous levels.
One-Time Narratives	Narratives are used to tell a story and generally embed every action or activity in an information system.
Processing Narratives	Narratives that tell an ongoing story according to all a user's actions or activities in an information system.
Point	A point is a numerical unit that is obtained for completing an activity and/or action in an information system.
Progress Bar	A progress bar is used to indicate the user's progress when working on activities and/or actions in an information system without comparing a user's performance to those of other users, and without challenging them.
Reminder	A reminder is used to visualise the user's past behaviour by presenting them with a history of their actions.
User Avatar	A user avatar is used as a visual representation of the user so that their user profile can be personalised in an information system. User avatars are typically chosen or created, and are modified by users.
Mission	Missions are achievable steps that users can accomplish while working on actions and/or activities in an information system.
Time Manipulation	Time manipulations are achievable steps that users can accomplish while working on actions and/or activities in an information system.
Virtual Goods	Virtual goods are assets with a perceived value that can be purchased or traded (e.g., coins).

Appendix B – Definitions of Dimensions

The developed taxonomy comprises dimensions and characteristics. Characteristics describe the dimensions. The following table provides an overview of the definitions of each dimension in the taxonomy.

Dimension	Definition	Example
Reward	Elements that reward users for successfully completing an activity in an information system. They can be either rewarding or documenting: rewarding means that the activity of a user is connected to something, while documenting concerns informing a user about their activity without giving them anything.	A point is awarded to a user for giving the correct answer in a knowledge test (reward). Feedback is given to a user about the correct answer (documenting).
Punishment	Elements that punish users for not successfully completing an activity in an information system. They can be either punishing or neutral. Punishing takes away something from a user that they previously earned. A neutral element informs a user without taking anything away from them.	A badge is taken away from a user because they failed to continue with their activities (punishing). A mediating avatar informs a user about their previous activities in the system (neutral).
Bonus	Elements that are given to users in addition to rewards for completing a series of activities. Such elements can act as bonus elements or not.	A badge is given to a user for the successful completion of 10 successive activities (bonus). A level documents the users overall system progress (no bonus).
Interdependency	Elements that require the existence of other elements. They can be either independent (do not need other elements to work) or dependent (need other elements to work).	A level needs points to document the users' progress in working on activities (dependent). A mediating avatar welcomes a user when they starts working in a system (independent).
Development	Elements that develop over time based on the user's activities in an information system. They can be either developing (showing the overall progress of users over time) or static (show one-time behaviour).	A progress bar indicates the progress of users in collecting points (developing). A point informs a user about their success in finishing a activity (static).
User Involvement	Elements that allow for the involvement of users. Some elements are given by the designer (and can be changed or selected by users) while other allow for the partial involvement of users (users can decide about what they would like to pick, or can even decide about specific components).	A user can select components of their user avatar like their hair or skin colour (partial involvement). A designer decides upon those activities for which a user can earn a point (prescribed).
Competition	Elements that involve at least two users who compete against one other to achieve the same goal. Depending on its design elements, these can either be competitive (users compete against other users for being better at an activity), or individual (users do not compete against other users but focus on their own activities to get better in their own activities).	A leaderboard is used to present the efforts of all users in collecting points (competition). A user likes to get into a higher level by completing more activities in a system (individual).
Cooperation	Elements that support the cooperation (working together) between or among users. Depending on its design, cooperation can be possible (an elements supports a user in working with other users), or impossible (the element is focused on the users own activities).	A group of users gets a badge for completing an activity together (cooperation possible). A progress bar shows the users' progress in working on activities (cooperation impossible)
Surprise	Elements that are given to users that they did not expect. Element can be either surprising or regular. Surprising elements are not expected by a user. Regular elements are known.	A user gets an additional badge for working in an information system for more than 30 days (surprise). A user can select the badge they want, and so can work towards listed badges; they receive the badge after completing related activity (regular).
Initial Motivation	Elements that are based either on intrinsic motivation or on extrinsic motivation. Intrinsic motivation is addressed when something is done without having a desirable outcome; for example, when an element triggers to do something because it is inherently interesting. Extrinsic motivation is addressed when an activity leads to a desirable outcome.	Receiving a point concerns getting a desirable outcome and addresses extrinsic motivation. Collecting elements like points or badges concerns addressing intrinsic emotion. Collection concerns achievements that also address intrinsic motivation.

Appendix C – Consolidated Interview Results

Expert interviews were used to evaluate our taxonomy. Three experts with practical experience and four experts with research experience were consulted as part of this evaluation. Five different criteria were used in the questionnaire: completeness, level of detail, simplicity, ease of use, elegance, and real world phenomenon. The consolidated results are presented in this together with changes that were made based on interviewee suggestions.

Criteria and Interviewee Suggestions (consolidated)		Action Taken
Completeness	Include a dimension that describes surprises (P1).	Addressed as suggested.
	Categorises rewards into financial and non-financial rewards (P1).	Not addressed, because the taxonomy is used to describe characteristics of gamification elements, not their design possibilities.
	Use feedback and micro feedback instead of just feedback (R2).	Not addressed, because the characteristics that describe feedback are not different for micro feedback.
	Use an absolute and relative leaderboard instead of just a normal leaderboard (P2, P1).	Addressed as suggested.
	Use processing narratives and one-time narratives instead of just normal narratives (R2).	Not addressed, because a bonus is an additional reward that is given to users for fulfilling activities outside of the anticipated rewards.
	Bonusses are not necessary; they are the same as rewards (R3).	Not addressed, because the designer always has some involvement.
	Use involvement and no involvement instead of partial involvement and no involvement (R3).	Addressed as suggested.
	Virtual goods are also collection systems (P3).	Not addressed, because this information is already included in development dimension.
	Include cascading information as a dimension (P3).	Not addressed, because points or other items are taken from, or given to users, which changes their level.
Level of Detail	Levels are rewarding and punishing when someone reaches a higher or lower level (R1).	We categorised the elements as suggested. We did not categorise level as a competitive element. If users compare their level with others it ends up in a ranking. In addition, a leaderboard is dependent from other elements that are used to as base for comparison with other users.
	Different assignments of elements to characteristics: • Leaderboard can be cooperative and independent (P2), • Virtual goods can be competitive (P2, R2, R3), • Badges can develop (P2), • User and mediating avatar can develop (P2, R2), • Levels can be competitive and cooperative (P2), • A representing avatar can be cooperative (P2), • User's avatar can be used for competitive purposes (P2, R2), • Collection systems can be cooperative (R2), • Narratives can be cooperative and competitive (P2), • Feedback can be competitive (R3).	
	Rename: • Tasks to missions (R2), • Time pressure to time manipulation (P2), • Level to user level (R3), • User design to user interaction (R3), • Interacting avatar to mediator (R3), • Representing avatar to user avatar (R3).	Addressed as suggested.
	Separating between intrinsic and extrinsic motivation is difficult because it depends on users (R3, P1, P2).	Not addressed; we refer to the initial motivation caused by the element.
	Just use extrinsic and intrinsic motivation as characteristics of one dimension: motivation (R1, R2).	Addressed as suggested.
	Do not use not extrinsic and not intrinsic (P1, R3).	Addressed as suggested.
	Include a dimension for the idea that a level has to be passed; tasks can be passed and thus are voluntary (P2).	Not addressed; this is already part of our taxonomy with the development dimension, and thus developing and not developing.
Simplicity	Separation of collection systems is not understandable (P2, P1, R1, R2).	Collection system is handled as own element.
	Use collection system as its own element and points badges and goods as a separate elements (P2).	Addressed as suggested.
	Motivation should be a separate dimension (P1, R4).	Addressed as suggested.
Ease of use	Presentation of taxonomy is very complex (P1, R1, R4).	We added dimensions in the first row instead of numbers. Therefore, how the characteristics fit to the dimensions is clearer. We also added two further categories to better explain our dimensions (underlaying game logic and game design)
	Include a table with possible element combinations (R1).	Not addressed because this was not the aim of our taxonomy.
	Replace numbers of dimensions with names (R1).	Addressed as suggested.
	Include an example of how to use the taxonomy (R1).	We present its validation in the last part of this paper.
	Combine dimensions such as rewards, punishment, and bonus (R1, R2).	Not addressed, because of Nickerson et al.'s (2013) guidelines.
	Try to avoid yes/no terms in dimensions (R4, P1).	Addressed based on the new taxonomy visualisation.
Elegance	Consider context characteristics for the next version of the taxonomy (P3).	Addressed as implication for future research.
	Use different gamified information systems or mobile games to develop a next version of the taxonomy (R1).	
	It would be interesting to see how elements can be used together (R1).	
Real World Phenomenon	Taxonomy is useful to better understand elements (P1, P2, P3, R1, R2, R3, R4).	-
	The taxonomy can assist researchers and practitioners developing a gamification concepts for their information systems (P1, P2, P3, R1, R2, R3, R4). neighbours	

Appendix D – Implications for Construction Element Adaptations

Evaluation of our taxonomy revealed that some elements fit more than one characteristic in a single dimension. To provide better guidance for the development of gamification concepts using our taxonomy, we developed an additional table. This table provides implications and examples about how to design each construction element depending on the characteristic upon which a gamification concept developer likes to focus. Implications and examples were either given by our interviewees or derived from consulted literature.

Element	Dimension and Characteristic	Implication	Example
Badges	Development – Developing	Developing badges can be used to encourage the progress of users in completing tasks, particularly if tasks comprise several parts.	Bronze, silver, and gold badges.*
	Development – Static	Static badges can be used to reward users each time they have completed a task, and if tasks do not develop.	A user earns a badge for answering quiz questions (Alcivar & Abad 2016).
	Surprise – Surprise	Surprise badges can be used to further support users in continuing with activities because they receive a good they did not expect to receive.	A user gets a new badge that they could not previously see in his badge list.**
	Surprise – Regular	Regular badges can be used as a visual representation of the different activities a user has to complete. They can be seen by a user, for example, in a badge board.	Badges are used to show the users expertise in specific fields (Suh et al. 2017)
Virtual Goods	Interdependency – Dependent	Independent virtual goods can be used if system designers want to control those system activities for which users are rewarded or punished.	User collects goods by completing activities.*
	Interdependency – Independent	Dependent virtual goods can be used if a user's autonomy is to be further addressed by giving them the possibility of selecting goods on their own.	User spends points to earn a good (de-Marcos et al. 2014)
	Surprise – Surprise	Surprising virtual goods can be used to further support users in continuing with their activities because they receive a good that they did not expected to receive.	A user receive a new virtual good that they did not know about before.**
	Surprise – Regular	Regular virtual goods can be used to support a user in completing activities in a system. The user knows about the goods they can earn.	Users get coins for completing activities (Weiser 2015).
Points	Surprise – Surprise	Surprise points can be used to further support users in continuing with their activities because they receive a good that they did not expected to receive.	A user gets additional extra points for an activity that was not previously bound to any points**
	Surprise – Regular	Regular points are given to users for completing activities in a system. The user knows about the points they can earn.	Using points, learners can claim rewards to advance in learning applications (Hamzah et al. 2014).
User Avatar	Development – Developing	A developing user avatar can be used to visualise the overall progress of users in completing activities in a system.	An avatar can acquire new items, such as a new hat.*
	Development – Static	A static user avatar can be used if it does not represent progress and if it interacts with a user without any development.	A user selects a human avatar to represent themselves at the beginning of their system use (Faghihi et al. 2014).
Mediating Avatar	Development – Developing	A developing mediating avatar can be used to visualise the overall progress of users in completing activities in a system.	An avatar can change its expressions based on the user's results in working on activities.*
	Development – Static	A mediating static avatar can be used if it should not represent progress and if it interacts with a user without any development.	A user cooperates with a human avatar that is used as a teacher that assists them during their use of the system (Perry 2015).

*Examples given by interviewees; **Added based on the constitution of elements and the meaning of surprise, this is because these are grounded on a new dimension as recommended by an interviewee.