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Gamification:
From emerging conceptualization to coexisting explanatory models in the context of education

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Content

Declaration of scientific integrity

The author hereby declares that she/he has read and fully adhered the Code for Good Practice in Research of the University of Basel.

Abstract

The term gamification has drawn a lot of attention in the past years but also caused confusion. In this thesis, I will reveal some of this confusion by pointing out ongoing debates in conceptualization and giving room to critical viewpoints. Additionally, I want to introduce the most prominent definition of gamification, illustrate possible implementations and highlight the objectives of the phenomenon. One purpose of this thesis is to exhibit the current state of gamification research. A promising approach to understand the effect mechanisms of gamification is by focusing on motivation theories. I will introduce different explanatory models deriving from motivation theories and provide a rough overview of their theoretical foundation. Based on certain inclusion criteria, I will then examine empirical research of gamification by conducting a literature search in the context of education. The obtained search results will be analyzed to clarify, what definition of gamification particular authors used and which explanatory models as theoretical underpinning were suggested in the studies. The goal of this literature search result analysis is to determine if there is a consensus in gamification research, both on the use of coherent definitions and in the utilization of explanatory models. My findings suggest that despite a variety of potential definitions of gamification, the one provided by Deterding, Dixon, Khaleda and Nacke (2011) as "the use of game design elements in non-game contexts" is the most prominent one. A majority of empirical studies is using their suggested definition consistently. However, when it comes to the explanatory models, there is a considerably greater variety of 19 models in circulation. This complicates the establishment of agreed on frameworks and the comparison of validated research on the theoretical level. In the final part of this thesis, I will conclude what this circumstance might imply for the present state of gamification research and what future studies should consider.

Introduction

The term gamification is commonly defined as "the use of game design elements in non-game contexts" (Deterding et al., 2011). Although there seems to be a broad consensus in HCI (human-computer interaction) research regarding this definition, other authors such as Zichermann and Cunningham (2011) and Huotari and Hamari (2012) suggest other definitions based on different argumentation. These circumstances raise the question of what the differences in definitions are and why they occurred in the first place. One part of the misconception can already be resolved by precisely isolating gamification from related emergences such as "serious games" or "playful design" as suggested by Deterding et al. (2011). By doing so, important distinctions as well as potential overlaps between the terms can be identified. It is important that researchers use the same terms and concepts, while also giving them the same meaning. In the first part of this bachelor thesis, I will show that certain inconsistencies in terminology exist and that they have led to a somewhat vague conceptualization of the term gamification. In the second part, possible implementations and objectives of gamification will be introduced. Another relevant aspect concerning the inconsistencies in research is the variety of explanatory models that have emerged over the years. Whereas Aparicio, Vela, Sánchez and Montes (2012) stress the importance of self-determination theory, other authors such as Hanus and Fox (2015) emphasize cognitive evaluation theory or in the case of Hamari and Koivisto (2014), theories of flow. Concerning this, Richter, Raban and Rafaeli (2015), as well as Vassileva (2012) laid a good foundation for possible explanatory models by providing an overview of motivation theories in psychology and introducing a "model of motivation in games". Based on their work, I will introduce and outline prominent explanatory models in the second part of this thesis.

In the third part, I will firstly investigate if the varying definitions of gamification are also apparent in existing empirical research. Secondly, I will determine to which explanatory models the effects of gamification are accounted for. To approach this issue, I conducted a literature search based on certain inclusion criteria in the context of education. Education was chosen because it is one of the most investigated contexts in gamification research. The main purpose of this literature search is to examine which definitions of gamification are de facto in circulation and what explanatory models are being used in empirical studies. Based on my findings, it is possible to think that there is a disagreement in definitions and a certain abundance of suggested explanatory models. Depending on my results, both factors affected empirical studies available, making findings difficult to compare.

Conceptualization of gamification

Definitions between different academic disciplines

The first distinction of definitions when discussing gamification must be done between academic disciplines. The issue starts with two viewpoints of games themselves. There are games in a classical sense (e.g. Monopoly) and games in the more recent context of computer games (e.g. Tetris). Regarding this, Fuchs, Fizek, Ruffino and Schrape (2015) point out that all definitions of gamification since 2002 are based on digital comprehension. They further explain that predigital ideas of gamification before the usage of digital computers were already in existence. Making this differentiation between classic and digital games is crucial when talking about gamification, as the term alone does not clarify which context is addressed. For this reason, Deterding et al. (2011) provide a more distinct definition of games and differentiate the act of gaming and playing. Given this, Raessens (2006) makes a wrong conclusion when he attempts to treat the related term ludification and gamification equally. According to Bouca (2012), the concept of ludification originates from media theory and characterizes the increasing usage of "play" as a routine activity in human life. However, from the understanding of Deterding et al. (2011), as mentioned above, there is a crucial difference between "play" and "game". Thus, gamification and ludification sufficiently differ from one another. The differentiation of "play" and "game" will be elaborated in the next segment of this thesis.

The definition of gamification by Huotari and Hamari (2012) received comparatively little attention. The authors take a different approach and investigate gamification from a service marketing perspective. For them, gamification is "a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation" (Huotari & Hamari, 2012). I will shortly highlight that whereas Deterding et al. (2011) base their definition on the implementation process (e.g. design elements such as leaderboards, scores etc.), Huotari and Hamari (2012) focus on the objective of gamification (e.g. value creation). Aside from that, Terry Heick (2014) claims that our lives in the 21st century is itself gamified through informal social competition. According to Heick, boy scout badges, collecting frequent flyer miles or even piercing pins into the map of every travelling destination a person has ever visited is a form of gamification. Sometimes the term is even openly criticized: In his work, Ian Bogost (2011) described gamification as the easy answer for deploying games as a marketing miracle. He suggested replacing gamification with the better suited term "exploitationware", claiming that the phenomenon is nothing but a marketing fad.

By looking at this interdisciplinary scale, we already get a glimpse of how controversially the term is being disputed between academic disciplines. However, comparing every circulating definition of gamification goes beyond the scope of this thesis. To narrow down possible interpretations, I will in the following solely focus on definitions given in HCI research and education, for this context will be important in the third part of this thesis.

In one of the most cited papers in HCI research, gamification is described as "the use of game design elements in non-game contexts" (Deterding et al., 2011). It has since become the most popular term (Seaborn & Fels, 2015). In their understanding, game design refers to a specific practice within the field of computer games as an industry. Deterding et al. (2011) state that the first mentioning of the term in HCI dates to 2008 and has only been commonly used since around 2010. In their later work, Nacke and Deterding (2017) cite that the development of gamification as a field can be understood as three waves:

1. Debates around definitions, frameworks and taxonomies for gamification
2. Emergence of technical papers describing systems, designs and architectures
3. User studies on effect of gamified systems

This indicates how persistent the discourse on terminology, conceptualization and frameworks for gamification is. In this first part of my thesis, I will focus on this first wave. To obtain a better understanding, essential distinctions with related emergences in HCI research must initially be made.

Differentiation from similar concepts in HCI

Deterding et al. (2011) deliver a good overview on the different phenomena in HCI that appeared next to gamification. They distinguish the terms "toys", "serious games", "playful design" and "gameful design" along two dimensions; the first being "gaming/playing", while the second dimension consists of "whole/parts" (see Figure 1.).

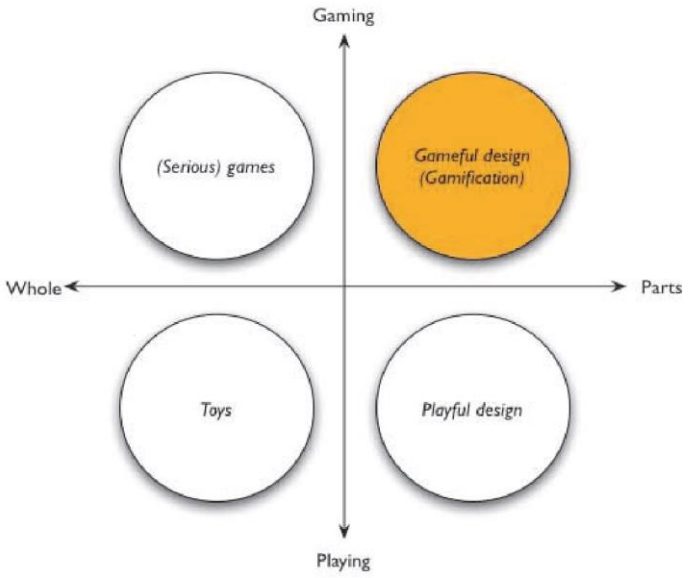

Figure 1. Gamification between game and play, whole and parts. Adapted from "From Game Design Elements to Gamefulness: Defining Gamification", by Deterding et al. (2011).

The distinction between "gaming" and "playing" originates from the concept of *paidia* and *ludus,* as two poles of playing (Caillois, 2001). Deterding et al. (2011) note that whereas *paida* (or "playing") constitutes a free, expressive and improvisational recombination of behaviors, *ludus* (or "gaming") accounts for competitive behavior towards a goal, structured by rules. This given, classic definitions characterize gaming and games by explicit rule systems towards discrete goals in contrast to playing and toys, which can even have a random tumultuous character, just for the fun of it. In the light of the aforesaid, there is a distinction between "playing" and "gaming", but also between the experience of "playfulness" (characterizing the experiential qualities of playing) and "gamefulness" (characterizing the experiential qualities of gaming). In their work, Deterding et al. (2011) also distinguish between "whole" and "parts", implying that there is a difference in creating whole games and implementing just some game design elements. By considering these dimensions "gaming/playing" and "whole/parts" as seen in Figure 1., it is possible to distinguish between the different emergences in HCI.

Table 1. *Differentiation of similar terms in HCI.*

"Serious games": ***(Whole + Gaming)***	Creation of whole games with high gaming component (i.e. towards a goal). Interactive computer-based game software with the intention to be more than entertainment.	Example: Surgical skill training
"Toys": ***(Whole + Playing)***	Creation of whole games with high playing component (i.e. improvisational recombination of behaviors).	Example: Playmobile
"Playful design": ***(Parts + Playing)***	Implementation of game elements, with the purpose of creating playfulness (i.e. paidia-type activities).	Example: The piano stairs in a Stockholm subway station[1]
Gamification or "gameful design": ***(Parts + Gaming)***	Implementation of game elements, with the purpose of creating gamefulness (i.e. ludus-type activities).	Example: Foursquare, a local search and discovery service mobile app[2]

Note that Deterding et al. (2011) treat gameful design and gamification as equal over the extent of parts and gaming (see Table 1.). Yet there is a difference: gamification is the design strategy of using game design elements, whereas the goal of designing for “gamefulness” is captured by "gameful design". In addition to the above-mentioned emergences in HCI (see Table 1.) there continue to appear other terms such as "pervasive games" (augmented reality games, e.g. "Pokémon Go", which add a game-layer over the real world) or "alternate reality games" (games through storytelling and narrative elements that are distributed across various platforms). Regarding the explosion of similar terms, Deterding et al. (2011) note that parallel terms continue to be used and new ones are still being introduced, such as “productivity games”, “surveillance entertainment”, “funware”, “playful design”,

[1] http://www.thefuntheory.com/piano-staircase
[2] https://de.foursquare.com/

“behavioral games”, “game layer” or “applied gaming”. This gives a good insight into how similar some HCI terms are, and that it is sometimes hard to make a convincing distinction between them. Yet, gamification has arguably managed to institutionalize itself as the most commonly used term. It appears that there is a certain abundance and disagreement in terminology, both within HCI research and across different academic disciplines.

Differentiation from game-based learning

Since I will conduct a literature search result analysis for gamification in the context of education in the third part of my thesis, one last definition must be distinguished from gamification: The concept of game-based learning (GBL) or digital game-based learning (DGBL). The purpose behind GBL are the same as in gamification - to increase motivation and engagement or change behavior and experience. Nevertheless, there are again certain differences. As the name suggests, game-based learning is used exclusively in learning environments whereas gamification has a wide range of application. In a definition by Kiili (2005), GBL is founded on the use of full games with the purpose of creating optimum challenge while creating "playfulness". Therefore, the main differences between gamification and GBL can likewise be established through the mentioned dimensions "gaming/playing" and "whole/parts", as proposed by Deterding et al. (2011). Through its implementation in learning environments, GBL refers to the use of full games to support teaching, making game-based learning first and foremost about learning through games. Another distinction between GBL and gamification can be made by their distribution over time. Kapp (2012) points out that GBL is often used as a one-time instructional event, whereas the gamification content is usually distributed over a longer time period. An example for a game-based learning system is Kahoot[3], an educational platform to formatively display learners’ progress. Kahoot fulfils four key GBL characteristics: It is a full game, supporting the feeling of "playfulness" in a one-time instructional event and is used specifically in learning environments. GBL and gamification must be differentiated since at first appearance and especially in the context of education, the concepts seem to be identical. Yet again, there are disparities in the level of implementation and purpose, making gamification and game-based learning distinct from one another.

[3] https://kahoot.com/what-is-kahoot/

Implementations of gamification

As already mentioned above, the definition of gamification as "the use of game design elements in non-game contexts" (Deterding et al., 2011) is the most commonly used. Having said that, the question remains what the authors mean exactly by "game design elements". They established five levels of game design elements as can be seen in Figure 2.

Level	Description	Example
Game interface design patterns	Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations	Badge, leaderboard, level
Game design patterns and mechanics	Commonly reoccurring parts of the design of a game that concern gameplay	Time constraint, limited resources, turns
Game design principles and heuristics	Evaluative guidelines to approach a design problem or analyze a given design solution	Enduring play, clear goals, variety of game styles
Game models	Conceptual models of the components of games or game experience	MDA; challenge, fantasy, curiosity; game design atoms; CEGE
Game design methods	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design

Figure 2. Levels of game design elements. Adapted from "From Game Design Elements to Gamefulness: Defining Gamification", by Deterding et al. (2011).

Deterding et al. (2011) deliver a comprehensive overview of game design elements. For them, points, badges and leaderboards as well as game physics or storytelling are considered as game design elements. This means that all those components can be used to gamify a system and that merely the level of abstraction between them differs. Game design elements range from straightforward implementations such as game interfaces (e.g. visual representation of points, badges and leaderboards) to more abstract ones like game design methods for planning and defining gameplay (e.g. narrative thread or emphasizing exploration and discovery).

Werbach and Hunter (2012) picked up this interpretation and refined the five levels of game design elements to condense them into three categories: dynamics, mechanics and components. For them, dynamics represent the highest conceptual level in a gamified system, such as emotions, narrative and relationships. Mechanics summarize elements like challenges, competition and feedback while the basic level of a gamified system is formed by components, containing avatars, levels or points. To

allege an example: levels (components) provide feedback (mechanics) and create a sense of progression (dynamics). Also following this approach of abstraction, Dicheva, Dichev, Agre, and Angelova (2015) investigated possible implementations of game design elements in education. This consideration is important since in the third part of this thesis, gamification in the context of education will be examined. Dicheva et al. (2015) also focused on the five levels of abstraction proposed by Deterding et al. (2011) but combined the first two levels (game interface design patterns / game design patterns and mechanics) and referred to them as *game mechanics* as an umbrella term. Next, they analyzed 34 empirical studies for gamification in education and examined the implemented game mechanics as defined by them. According to their work, the most popular implementations of game mechanics in education are points, badges, leaderboards and levels. These results confirm similar research conducted by Hamari, Koivisto and Sarsa (2014), who reached the same conclusion by analyzing empirical research papers in various contexts, not just education. Dicheva et al. (2015) further explain that point systems quantify user performance, whereas badges are assigned for special achievements and levels represent the user's experience and progress. Based on the received points and badges, it is also possible to rank the users on leaderboards, which then reflect their performance in comparison to others. The premises for receiving points, badges etc. can vary among studies. Sometimes they are awarded for performance and accomplishment, then again, they are given for time management or carefulness (Dicheva et al., 2015). Despite the differences in interpretation and implementation of game design elements, the underlying objective behind game dynamics, mechanics and components is the same – creating a gameful experience or “gamefulness”.

Objective of gamification

From the viewpoint of Deterding et al. (2011), gamification is an approach in which certain game design elements from different levels of abstraction (see Figure 2.) result if successfully applied to the experience of "gamefulness". Thus, making a certain task more enjoyable for the user and leading to positive effects on constructs such as experience and motivation. Despite the revealed debates in terminology, Hamari et al. (2014) point out that in most academic research, there is a consensus when it comes to the objective of gamification. This is promoting motivation, engagement and behavior change. They conducted a literature review, revealing that a majority of empirical studies investigating the effectiveness of gamification emphasize the measurement of motivation- and engagement-related psychological outcomes, respectively behavior-related outcomes. Especially the

context of education is being investigated in gamification research since motivation is one of the most indicating predictors of student academic achievements (Linehan, Kirman, Lawson, & Chan, 2011). Gamification in education refers to the implementation of game elements in the design of learning processes to create a gameful experience. Dichev, Dicheva, Angelova and Agre (2014) outline that gamification is implemented in learning environments in order to enhance engagement of the learner. The main way gamification reshapes learning is by setting goals, redefining failure and by giving a frequent feedback. Codish and Ravid (2015) take another approach and argue that the rational of gamifying learning is to create immersion with learning activities, similar to what happens with individuals while gaming. This immersion then influences the effort and time a student spends engaged in learning. While authors seem to agree on the objective of gamification, the debate begins when it comes to the explanatory models acknowledging those effects on motivation, engagement, behavior and experience. This issue will be further investigated in the following chapter.

Explanatory models

As I mentioned before, Nacke et al. (2017) described the gamification research as three waves. The first of those waves revolved around the question, "what is gamification?", which was the content of the first part of this thesis. The next wave of research dealt with the question, "how does gamification work?". This latter issue will be examined in this second part of the thesis. As mentioned above, the purpose of gamification is to create a gameful experience or "gamefulness" in users, which then modulates behavior change or experience over constructs such as motivation, engagement and participation. There are many explanatory models from different fields of studies such as economics, education, sociology and psychology, which all explain the effects on those constructs differently. Despite this variety, most of the explanatory models originate from theories of motivation (Hamari et al., 2014). Due to this and because of the nature of this thesis, I will solely focus on motivation theories in psychology. Vassileva (2012) provides a general overview of motivation theories in psychology, which were later modified by Richter, Raban and Rafaeli (2015) for the context of games (see Figure 3.). They created a model covering the spectrum of motivation from intrinsic (meaning driven by interest or enjoyment from within the individual) to extrinsic motivation (meaning driven by external rewards or pressure from outside the individual), with the social motivation being between these poles. Concerning the applicability of this model and distinction between intrinsic/extrinsic in gamification,

Richter et al. (2015) note that gamification combines these two aspects of motivation by using external rewards such as levels, points and badges to improve extrinsic motivation, while at the same time raising feelings of engagement, autonomy and mastery which are beneficial for intrinsic motivation. However, in a more recent study, Mekler, Brühlmann, Tuch and Opwis (2017) reasoned that performance does not mirror intrinsic motivation of participants, completing an image annotation task. They suggest that points, levels and leaderboards function as an extrinsic facilitator, effective only for promoting performance quantity and not increasing intrinsic motivation per se.

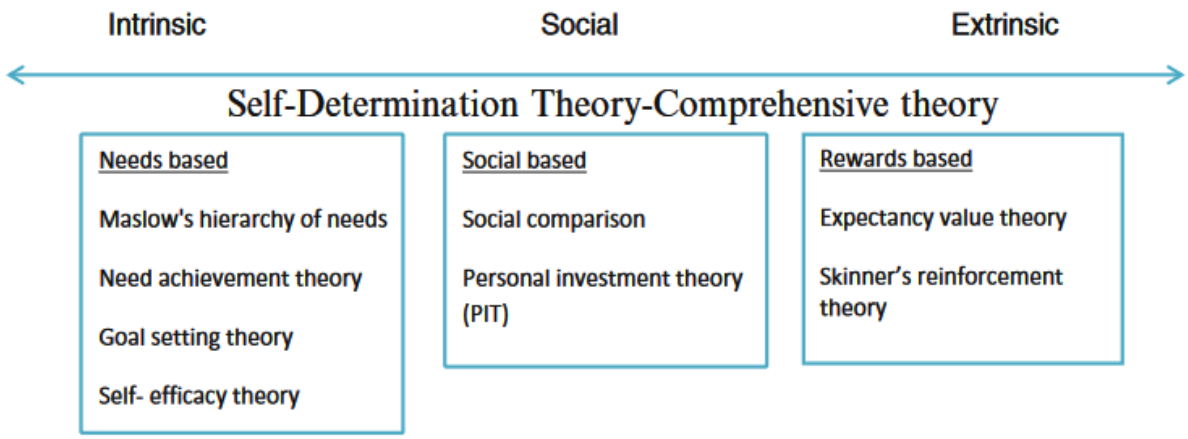

Figure 3. Model of motivation in games. Adapted from "Studying Gamification: The Effect of Rewards and Incentives on Motivation" by Richter et al. (2015) and Vassileva (2012).

How exactly gamification influences intrinsic/extrinsic or social motivation is still under debate and objective of current research. As shown in Figure 3., several motivation theories exist, but given the limited extent of this thesis, not all of them can be addressed nor exhaustively discussed. Only the most prominent ones will be introduced in the following part. For this purpose, I will address once again the work of Nacke et al. (2017) and mainly focus on the theories they proposed. The model in Figure 3., with its motivation theories shall only function as an orientation to answer the question of where to place the presented theories on the spectrum of motivation theories. Nevertheless, in the literature search result analysis in the third part of this thesis, all the motivation theories in circulation will be addressed.

Self-Determination Theory (SDT)

The theory of self-determination was first introduced by Deci and Ryan (1987) more than 30 years ago and is arguably the most commonly used explanatory model for gamification (Nacke et al., 2017). This circumstance also becomes apparent considering the fact that Richter et al. (2015) define

SDT as a "comprehensive theory" (see Figure 3.). Deci and Ryan (1987) based their theory on three psychological needs: competence, autonomy and relatedness. In their paper *analysis and application of gamification,* Aparicio et al. (2012) make the connection from SDT to gamification and define the three needs as follows:

1. **Competence:** The need to participate in challenges and feel competent. Being optimally challenged or receiving positive feedback improves the perceived level of competence, which is beneficial for intrinsic motivation. If people feel competent while performing a task, they like to perform it.
2. **Autonomy:** When activities are performed by personal interest, perceived autonomy is high. Therefore, it is important to let the people choose options and to not control the instructions given to them. This has been shown to improve autonomy and subsequently intrinsic motivation of individuals.
3. **Relatedness:** Is experienced when individuals feel connected to others. The more someone feels related to a topic, the more this person is intrinsically motivated to be engaged in it. The current integration between games and social networks is promising to promote relatedness and therefore to reinforce intrinsic motivation.

SDT proposes that when those psychological needs are supported, it leads to greater intrinsic motivation. For Aparicio et al. (2012), this means that intrinsically motivated activities are those that individuals perform without any kind of condition, just for the mere pleasure of it. To allege an example: Implementing game design elements such as points, levels or leaderboards function as a sort of positive feedback, supporting the psychological need of "competence" and therefore leading to an enhancement in intrinsic motivation over gameful experience. On the other hand, more abstract game design elements (as introduced in Figure 2.) can support the presented constructs of "autonomy" and "relatedness". SDT is one of the most promising explanatory models, but has a downside: for a long time, there has been a controversial debate whether extrinsic motivational factors undermine intrinsic motivation (Deci, Koestner, & Ryan, 2001). This is an important issue, since one of the purposes of gamification is inducing intrinsic motivation over extrinsic (game design) elements. A meta-analysis of studies examining the effects of extrinsic rewards on intrinsic motivation by Deci, Koestner and Ryan (1999) revealed that external rewards significantly harmed intrinsic motivation. It was argued that some individuals experience feedback as controlling, which undermines perceived autonomy and consequently intrinsic motivation. However, Mekler, Brühlmann, Opwis and Tuch (2013) could not confirm this in the case of gamification. They concluded that intrinsic motivation

remains unaffected by the presence of common gamification elements such as points, levels and leaderboards. However, little research on this matter has been done and it is still debated what long-lasting impact game elements exactly have on intrinsic motivation.

Theory of flow

Another promising explanatory model is the theory of flow, introduced by Csikszentmihalyi (1979). The state of flow can be understood as a cognitive concept of optimal information processing. According to Admiraal, Huizenga, Akkerman and Ten Dam (2011), flow is a state of deep absorption in an activity that is intrinsically enjoyable. Individuals in the state of flow perceive their task to be pleasurable and worth doing for its own sake, meaning that the experience itself becomes its own reward. To be able to achieve this state of flow, certain requirements must be fulfilled. The most important one being the perceived challenge to be adequate to the capacities of an individual. When one's capacities do not match the high challenge of a task, the individual will experience anxiety. On the contrary, if the challenge is not demanding enough, the individual will experience boredom. The state of flow is the equilibrium between challenge and capacity and promotes feeling of play, creativity and so on (see Figure 4.). The distinction between "play" and "game" as shown in the first part of this thesis and its relation to the notion of "play" in the sense of theory of flow, will not be further elaborated.

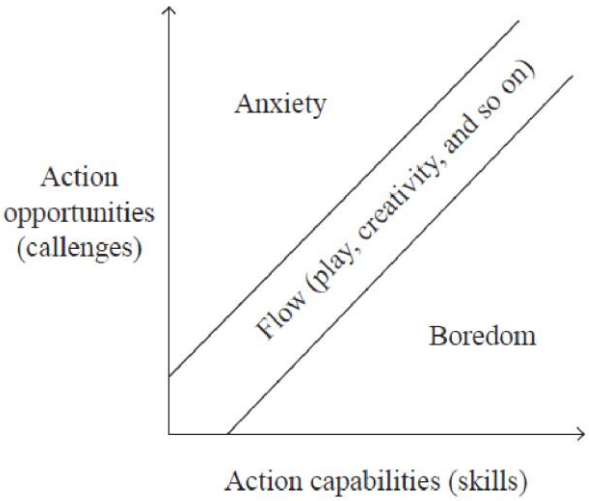

Figure 4. The flow state as angle bisector of the axes "action opportunities" (challenge) and "action capabilities" (capacity). Adapted from "The concept of flow" by Nakamura and Csikszentmihalyi (2014).

Furthermore, Csikszentmihalyi and Nakamura (1979) stress the importance of clear proximal goals and immediate feedback to progress. This helps to adjust capacities (actions) according to the task given and enables to better put oneself in the state of flow, in which people experience immersion with their exercise and a peak in performance (Dichev et al., 2014). Here again, the concept of gamification with its use of game design elements such as points, levels and badges can be brought into effect and act as a facilitator for progress feedback. The appeal of this explanatory model as a framework for gamification becomes apparent considering that much-cited authors such as Hamari and Koivisto (2014) attempt to measure the experience of flow in gamification with a dispositional flow scale (DFS-2). Additionally, research in HCI from Webster, Trevino and Ryan (1993) has shown that the state of flow probably has a positive effect on learning, making it a valid framework in the context of gamification in education.

Goal-setting theory

Another theory of motivation is goal-setting, which was first introduced by Locke (1968). The idea behind it is that individuals with conscious goals perform better at tasks due to the psychological process of self-regulation. This means that individuals can gradually adapt their behavior when there is a discrepancy between performance and goal (Landers, Bauer, & Callan, 2017). Gamification with its use of leaderboards and badges can deliver goals or at least subgoals. According to goal-setting theory, this should lead to better task performance. For the most motivating effects, goals must be "SMART", meaning **s**pecific, **m**easurable, **a**ttainable, **r**ealistic and **t**imebound as specified by Moskowitz and Grant (2009). Gamification can fulfill those requirements (especially the notion of specificity and measurability), making it a valid candidate for effective goal-setting and consequently for better task-performance.

ARCS model of motivational design

As the name suggests, the ARCS (**a**ttention, **r**elevance, **c**onfidence, **s**atisfaction) model is based on motivation as well but focuses particularly on design and its effect on learning. The model is often used as a design guideline for applying motivational strategies in learning environments. The ARCS model was first introduced by Keller (1984) and is based on the expectancy-value theory of achievement motivation (Tolman, Hall, & Bretnall, 1932; Wigfield, 1994). Keller (1984) noted that expectancy-value theory assumes that people are motivated if the performed activity is perceived to

be linked to the satisfaction of personal needs (the value aspect of the model) and if there is an expectancy for success (the expectancy aspect of the model). He further proposes four factors that influence the perception of value and expectancy and thus keep people motivated: attention, relevance, confidence and satisfaction, which form the acronym "ARCS". In the context of design, Dichev et al. (2014) explain that the factor "attention" can be achieved by capturing the interest of users over perceptual arousal and variability, whereas "relevance" is closely linked to goal-orientation and describes the importance of matching individuals motive and personal needs. Furthermore, "confidence" occurs when people have a feeling of improvement and control over their success and finally "satisfaction" is reinforcing accomplishments with rewards or building up expertise. Gamification can reinforce the four factors of the ARCS model of motivational design by its different levels of game design elements.

Fogg's behavior model (FBM)

Whereas the last models mainly focused on motivation, Fogg's model also describes the process of behavior change, particularly emphasizing in designing for persuasive technologies. Fogg (2009) explains that in the FBM behavior is a product of the elements motivation, ability and triggers. For a successful change of behavior, an individual must be sufficiently motivated (the motivational aspect of the model) but also needs to possess the ability to change towards the desired behavior (the ability aspect of the model). Finally, an effective trigger must be present. All these requirements must be fulfilled at the same time to successfully lead to a change in behavior.

Figure 5. The FBM has three factors has three factors: motivation, ability and triggers. Adapted from "Gamification in higher education by the use of a quiz-app" by Hussmann, Kranz and Roppelt (2014).

Figure 5. illustrates the Fogg's behavior model over the x-axis "ability" and the y-axis "motivation". To shift towards a target behavior, an individual must be highly motivated while also possessing high ability. This means that motivation and behavior are dependent on one another. Motivation alone does not lead to behavior change and neither does the mere presence of ability. If there is a lack in ability or motivation and no trigger present, a change in behavior fails to happen. Contrarily, triggers can fail or succeed relative to the magnitude of motivation and ability. This indicates that there is a certain activation threshold for the trigger to be effective (see Figure 5.). As soon as the activation threshold is exceeded and a trigger present, behavior change occurs. Fogg (2009) further notes that a trigger can take almost all forms - an alarm, a growling stomach and so on but whatever the form, successful triggers go through three phases:

1. Perception of the trigger.
2. Association of the trigger with a target behavior.
3. Execution of the trigger when the individual ha sufficient motivation and ability.

The purpose of gamification is to boost the user of a gamified application in the aspect of motivation or ability. Regarding this, Dichev et al. (2014) note that to encourage an individual to perform a task, it is possible to either increase their ability or the task's perceived simplicity. Gamification seems to be a possible option in many ways: to motivate people, to facilitate the presence of a trigger or to increase perceived simplicity over game design elements.

Literature search result analysis for gamification in education

Now that I have provided an overview, both for conceptualization and potential explanatory models, I will examine empirical research in the context of education. I do this in order to clarify what definitions of gamification were actually used and which explanatory models as theoretical underpinning were suggested in empirical studies.

Gamification in different contexts

In their literature review of empirical studies, Hamari et al. (2014) highlight that education is the most common context for the implementation of gamification. This claim is confirmed when comparing different Google Scholar searches from Table 2. I used the search query "gamification X OR Y" and then filled in different terms, related to the implementation of gamification for X and Y.

Table 2. *Google scholar search results, using different search terms in conjunction with gamification.*

Contexts (X OR Y)	Google Scholar results
Education / Learning	27'100
Commerce / Commercial	17'200
Health / Exercise	17'600
Workplace / Business	17'000
Market / Marketing	16'400
Network / Community	17'900

Gamification in the context of learning/education yield by far the most results with 27'100 hits. Compared to other terms, education and learning seems to be of greater interest in books, papers, academic journals, reports, conference materials and dissertations. Because of this relevance of gamification in education and learning, I will focus solely on this context in the third part of this thesis.

Focused search and inclusion/exclusion criteria

Searches were performed in four scientific databases: SCOPUS, ACM, Web of Science and ScienceDirect. The keywords were gamification OR "gamif*" with the supplement AND education OR learning. I used the search query "gamif*", following the idea of Seaborn and Fels (2015) who ensured that way that also studies using valid alternatives to gamification such as "gamified", "gamify", "gamifying" or "gamifiable" were involved in the query. In that way, a total of 3'340 papers were obtained, of which 2'879 were identified by the database SCOPUS. Because of the large number of hits and the limited amount of resources (both in time and assistance) I decided to focus on open access papers only and not all results listed by SCOPUS. This reduced the count on SCOPUS considerably from 2'879 to 68 results, decreasing the total count after the first filtering to 539 search results. Please note, that on the databases ACM, Web of Science and ScienceDirect all papers, not only open access papers, were included in the search result analysis.

After a first screening, based on title, abstract and removing all duplicates, I further condensed the search results to 346 papers. Thereafter, the criteria of inclusion were the following:

- Peer-reviewed empirical studies.
- Primary studies with human participants (students) in an experimental or quasi-experimental setting with measurable outcomes on motivation, engagement, learning or experience.
- Not exclusively qualitative variables, but at least one quantitative variable had to be presented.
- Only papers with the implementation of game (design) elements and not whole games were included, following the definition of Deterding et al. (2011).
- The research had to concern the context of education. This was ensured by only focusing on studies, being performed on students or being conducted in schools, courses etc.
- Only papers in English were chosen.

After a second screening based on these inclusion criteria and reading introduction, conclusion and methods, 78 papers remained. It must be mentioned that especially this part of the review was highly subjective. Especially the term game-based learning was often mentioned in combination with gamification, even though there are substantial differences between the two concepts as indicated in the first part of this thesis (see "differentiation from game-based learning"). More of this subjectivity and certain biases in the review process will be addressed in the discussion of this thesis. Finally, after reading the full texts and careful consideration, 22 papers were identified to meet the inclusion criteria and were included in the analysis of this literature search. A detailed list of the selected empirical studies can be found in the appendix, more specifically in Table 5.

Results and summary

Result analysis of terminology

The analysis of the full texts revealed that seven different definitions of gamification were mentioned in the 22 selected papers. However, a majority of them used the definition of gamification by Deterding et al. (2011). 20 out of 22 studies (91%) at least once mentioned their definition and out of these 20 papers, only three used additional definitions. This means that 85% of all papers included exclusively used the definition of gamification proposed by Deterding et al. (2011). The results also showed that the differing six definitions of gamification are referred to in just four empirical studies and that only one paper mentioned a different definition of gamification without also citing Deterding et al.

(2011). One paper did not define gamification altogether. The definitions in circulation as well as the corresponding Google Scholar citations can be found in Table 3.

Table 3*. Identified definitions of gamification in circulation by number of studies mentioning the definition and Google Scholar citations (search conducted on the 24.03.2018)*

Authors	Definition	Number of studies
(Deterding et al., 2011) 3'458 Google Scholar citations	"The use of game design elements in non-game contexts"	**20**
(Lee & Hammer, 2011) 790 Google Scholar citations	"The use of game mechanics, dynamics, and frameworks to promote desired behaviors"	**2**
(Kapp, 2012) 1'930 Google Scholar citations	"Gamification is using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning and solve problems"	**1**
(Werbach & Hunter, 2012) 1'132 Google Scholar citations	*Book was not accessible and therefore precise definition not available.*	**2**
(Zichermann & Cunningham, 2011) 1'774 Google Scholar citations	"The process of game-thinking and game mechanics to engage users and solve problems"	**1**
(Huotari & Hamari, 2012) 758 Google Scholar citations	"A process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation"	**1**
(Landers, 2014) 89 Google Scholar citations	"The use of game attributes, as defined by the Bedwell taxonomy, outside the context of a game with the purpose of affecting learning-related behaviors or attitudes"	**1**

Table 3. also contains Google Scholar citations for the corresponding definitions of gamification. Those citations will be addressed later in the summary to support certain assumptions.

Result analysis of explanatory models

Focusing now on the explanatory models, the analysis of the 22 papers revealed that 19 different explanatory models or frameworks are in circulation as can be abstracted from Table 4. It appears that 18 out of 22 empirical studies (82%) mentioned at least one explanatory model, while four papers did not refer to any theoretical background at all. Also, four of those 18 papers did not

refer to explanatory models in their full text but cited theoretical work or corresponding explanatory models in their references instead. A detailed list of the mentioned explanatory models and theories, as well as the number of papers citing them can be found in Table 4. The analysis showed that self-determination theory was referred to most with 12 studies, followed by theory of flow and social comparison theory, both with 5 number of studies. 14 of the 18 studies supporting their work with a theoretical foundation mentioned more than one explanatory model (78%), and six of them even cited three or more explanatory models (33%).

Table 4*. Identified theories of gamification in circulation (search conducted on the 24.03.2018)*

Mentioned Theories	**Number of studies**	**Mentioned Theories**	**Number of studies**
Self-Determination Theory	12	Motivational Affordances	1
Theory of Flow	5	Theory of Planned Behavior	1
Social Comparison Theory	5	Social proof	1
Cognitive Evaluation Theory	3	Causality Orientation Theory	1
Goal-Setting Theory	3	Four drive Theory	1
Fogg's Behavior Model	2	Self-Efficacy	1
Situated Motivational Affordances	2	Organismic Integration Theory	1
Goal-Commitment	1	User-Centered Design	1
Skinner's Operant Conditioning	1	Concept of Locus of Control	1
Principle of seven Cycles of expertise	1		

It is important to mention that some of the listed theories are sub-theories and can be summarized into broader terms with others. For example: cognitive evaluation theory is a sub-theory of SDT and situated motivational affordances is a hybrid between SDT and motivational affordances, as suggested by Deterding (2011). For this exact reason, self-determination theory is described by Richter et al. (2015) as a "comprehensive theory" (see Figure 3.). Also, goal-setting theory, goal-commitment and self-efficacy share some fundamentals. The same applies to social-comparison and social proof. This circumstance of theory clustering will be elaborated in the discussion.

Summary

The main purpose of this literature search was to examine which definitions of gamification are in circulation and what explanatory models are being referred to in empirical studies. The analysis of the results revealed that several definitions by different authors are mentioned, but to state that there is a significant disagreement in terminology would be an exaggeration, considering two results of the analysis:

1. 91% of all examined papers at least once mentioned Deterding et al. (2011).
2. 85% of all empirical studies exclusively used the definition by Deterding et al. (2011).

These findings indicate that there seems to be a certain consensus despite the variety of definitions available. This statement holds true at least for the empirical research investigated. Furthermore, the comparison of the earlier mentioned Google Scholar citations (as indicated in Table 3.) independently supports this conclusion and illustrates the relevance of the definition by Deterding et al. (2011). Their theoretical paper yields by far the most results with 3'458 citations. The second most cited work is from Kapp (2012) with 1'930 counts, followed by the notion of gamification from Zichermann and Cunningham (2011) with 1'774 Google Scholar citations (see Table 3.).

Furthermore, I inspected those 20 papers which referred to Deterding et al. (2011) for their definition. The validation revealed that only one of them failed to correctly adopt the definition given by Deterding et al. (2011), namely De-Marcos, Domínguez, Saenz-de-Navarrete and Pagés (2014). The authors state that gamification “is the use of game-thinking and playful design in non-game contexts" (De-Marcos et al., 2014). However, in the first part of this thesis I demonstrated that Deterding et al. (2011) made a clear distinction between playful and gameful design. This might be an exceptional case, but could also imply that even when a study refers to one definition, errors in adoption of the term, respectively failures in implementation in the study design can occur. The analysis of the literature search results was able to confirm the claim that several definitions of gamification exist. Nonetheless, the assumption that those differences have a substantial impact on empirical studies, making empirical findings difficult to compare, can not be easily advocated.

With reference to the explanatory models, the following can be said: Considering the fact that 82% of the reviewed studies cited at least one explanatory model, my work seems to be in line with the notion of Nacke and Deterding (2017) - that there is a shift from theory-less effect studies to theory-driven

studies. I conclude that 67% of all studies with a theoretical foundation mention self-determination theory, making SDT a promising candidate for theoretical underpinnings. However, there appears to be a great variability of explanatory models ranging from extrinsic over intrinsic to social approaches. Moreover, it was hard to differentiate between explanatory models and frameworks at times, which I will further debate in the discussion. I identified a total of 19 explanatory models accounting for effects on gamification as can be seen in Table 4. Unlike in the case of terminology, where there seems to be a certain consensus on the use of definitions, there is a greater variety in the use of explanatory models *between* studies. More importantly, this could also be the case *within* studies, since 78% of all studies support their work by more than one explanatory model and 33% refer to three or even more explanatory models. With that said, it is conceivable that the variety of explanatory models effect available empirical studies, at least making theoretical implications difficult to compare with one another. This issue will be further elaborated in the discussion.

Discussion

Implications of this thesis

Gamification has managed to institutionalize itself as the most commonly used term in HCI, ahead of related terms such as “playful design” or “applied gaming”. More importantly, it appears that there is consistent usage of the definition by Deterding et al. (2011) in empirical research. Nevertheless, making a convincing distinction between similar or parallel terms remains somewhat difficult, especially because new terms are still being introduced. This leads to blurry boundaries between similar emergences, which then mistakenly are confound with one another. The proposed classification by Deterding et al. (2011) over the dimensions "gaming/playing" and "whole/parts" (see Figure 1.) surely gives a clearer conceptualization of gamification, but when looking at finalized gamified applications, overlaps between playful/gameful designs can exist and boundaries appear indistinct. This seems to be the case especially for game-based learning and gamification. Applying the argumentation of Deterding et al. (2011), game-based learning with its combination of the characteristics whole game + playful, would meet the criteria of being a “toy” (see Table 1.). However, this conception of GBL seems odd since game-based learning is still structured by rules and designed towards a specific goal. Therefore, GBL also contains the game (or "ludus") character, making its classification as a “toy” unreasonable. I argue that a gamified application can be experienced as

"playful" even though the purpose of implementation is still characterized by explicit rule systems, competition and setting of discrete goals. This raises the question if the distinction between "playful" and "gameful" is empirically meaningful altogether. Aside from that, it seems reasonable to ask if the inherent requirements of the definition are always fulfilled in finalized conceptualization and methodology of empirical research. The work of De-Marcos et al. (2014) can serve as an example of such misapplication. Likewise, it appears that despite Deterding et al. (2011) providing several levels of game design elements such as game mechanics, patterns, principles and heuristics (see Figure 4.), a majority of the analyzed studies exclusively focus on game design elements on the level of interfaces. Namely on the trinity: points, badges and leaderboards. Considering this, the game developer Margaret Robertson (2010) stated that points and badges are the elements least essential to games yet is posed as the core gamification. I personally think that by diminishing gamification to these sub-components, we risk a loss of information. It is conceivable that motivational factors dwell in more abstract levels of game design elements as for instance in narratives, exploration or game choices. Future research should further investigate those levels and contrast game design elements of different levels of abstraction with one another.

Regarding the explanatory models, I was able to demonstrate that models range from extrinsic over intrinsic to social approaches, as presumed by Vassileva (2012). However, it seems that few explanatory models have been empirically validated with respect to applied gamification. This makes it difficult to contrast findings from empirical research, at least on a theoretical level. In addition, the presence of numerous theories prevent the establishment of validated gamification frameworks and standardized implementations of game design elements. Motivation for instance is associated with several related concepts such as interest, attention, engagement, goals and so on. The measurement of those motivational concepts therefore varies significantly, leading to a large number of study designs. Dichev and Dicheva (2017) propose that improving our understanding of motivational aspects of gamification also enables us to predict effects on those related concepts. Without theoretical frameworks supporting the study design, it is difficult to differentiate which of the implemented game design elements were essential for obtaining the observed effects and to draw convincing conclusions from empirical results. The connection between explanatory models and used frameworks sometimes remains unclear. This makes it hard to comprehend researcher's justification for how their gamification approach is supported by theories. Until now, the proposed explanatory models seem insufficient for a complete understanding of the motivational mechanisms of gamification in an educational context.

Several questions remain unanswered: What is genuinely changing within the learner when a process is gamified? What causes this change and is it by virtue of intrinsic, extrinsic or social pressure? A deeper understanding will help to improve knowledge of how to design for an appropriate gamified experience. Only by challenging theories and validating existing explanatory models empirically, we will genuinely understand the underlying mechanisms and gamification can uphold its scientific legitimation.

Limitations of this thesis

As mentioned before, in the search result analysis, it was difficult to ensure that all defined inclusion criteria were always met. Thus, a certain degree of subjectivity in the selection process of empirical studies was unavoidable. This is particularly true for the inclusion criteria of focusing only on game design elements rather than whole games. Again, this is as consequence of the wide spectrum of possible study designs and frameworks for gamification. Dicheva et al. (2015) note that the approaches for implementation range from gamified plugins, platforms or apps to gamified courses and software. The finalized gamified system then frequently appears as a full game, making it hard to set convincing boundaries for the inclusion. This was especially the case for standalone applications, which already had some aspects of games and were subsequently gamified. This issue revolves around the question: Can a game be gamified? Concerning this, Deterding et al. (2011) urge that the only thing that “non-gaming contexts” explicitly intend to exclude is the use of game design elements as part of designing a game. Since this would merely be game design, not gamification. Moreover, the findings are somewhat distorted since I focused solely on open access papers on the database SCOPUS. This was because of the large number of search results. Another approach could have been to just exclude the SCOPUS results, but this would have caused a loss of relevant information. Another reason why I decided to include the open access papers is my conviction in free research without restrictions on usage and distribution. As mentioned before, another limitation is that it also remains unclear if there are any overlaps in the proposed 19 explanatory models and of what nature they exactly are. This also holds true for the overlaps of existing theories and frameworks. For future research, I suggest that the merges and relations of different explanatory models are investigated, e.g. by means of cluster analysis. It would be interesting for further investigation to determine possible overlaps of models and why authors stress certain models differently. The "model of motivation in games" by Richter et al. (2015) could serve as an assistance or first foundation in such an analysis.

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Appendix

Table 5. *Search results and identified sources of the literature search (conducted on the 24.03.2018).*

Source	Number of Definitions	Number of Models
Attali & Arieli-Attali (2014)	**1**	**3**
Barata, Gama, Jorge & Goncalves (2013)	**1**	**2**
Buisman & Van Eekelen (2014)	**1**	**2**
Çakiroglu, Basibüyük, Güler, Atabay & Memis (2017)	**4**	**2**
De-Marcos, Domínguez, Saenz-de-Navarrete & Pagés (2014)	**1**	**1**
De-Marcos, Garcia-Lopez & Garcia-Cabot (2015)	**1**	**0**
Denny (2013)	**1**	**0**
Dias (2017)	**3**	**1**
Domínguez, Saenz-de-Navarrete, De-Marcos, Fernández-Sanz, Pagés & Martínez-Herráiz (2013)	**1**	**3**
Hamari (2015)	**3**	**7**
Hanus & Fox (2014)	**1**	**3**
Hew, Huang, Chu & Chiu (2015)	**1**	**2**
Khandelwal, Sripada & Reddy	**1**	**0**
Kyewski and Krämer (2017)	**1**	**3**
Landers, Bauer & Callan (2015)	**0**	**2**
Mekler, Brühlmann, Tuch & Opwis (2017)	**1**	**3**
O'Donovan, Gain & Marais (2013)	**1**	**1**
Severengiz, Roeder, Schindler & Seliger (2018)	**1**	**1**
Tan & Hew (2016)	**1**	**2**
Topirceanu (2017)	**1**	**2**
Tsay, Kofinas & Luo (2018)	**1**	**4**
Yildirim (2017)	**1**	**0**