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The Potential Impact of Gamification Elements on the Acceptance of Technology in the Context of Education: A Literature Review

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The Potential Impact of Gamification Elements on the Acceptance of Technology in the Context of Education: A Literature Review

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Abstract Innovative new digital technologies arise within the field of education every day. There seems to be a large potential impact in using gamification for improving acceptance and use of new technologies in education. This study aims to gain better and new insights on how to improve the acceptance of new educational technology by applying gamification elements. To this aim, we performed a systematic literature review of 1271 publications, yielding 56 relevant studies. We positioned these studies based on which gamification element(s) and which educational technology acceptance constructs were discussed. Our results show that few studies focus on individual gamification elements and that most studies focus on the same elements and constructs, i.e. Learning Expectancy, Social Influence and Hedonic Motivation are the most discussed constructs related to increasing the acceptance of educational technology when applying gamification, while Points, Badges, Leaderboards and Social Games & Teamwork are the most discussed gamification elements. The impact of gamifying educational technology is mixed – both negative and positive results are being reported – and thus we conclude that the knowledge of how to successfully gamify educational technology is still limited.

Keywords: • Gamification • Acceptance of Technology • Technology-Enhanced Learning • Adoption • Literature Review •

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1 Introduction

Innovative new digital technologies arise within the field of education every day. Many educational technologies have been developed over the last years: e-learning, Massive Open Online Courses (MOOCs), Computer Supported Collaborative Learning (CSCL) and many more (Kirkwood & Price, 2014). In literature, all are referred to as 'Technology-Enhanced Learning' (TEL). TEL has the potential to reproduce existing teaching methods and supplement or transform teaching and/or learning processes and outcomes (Kirkwood & Price, 2014).

Recent research on the acceptance of mobile e-banking (Baptista & Oliveira, 2017) showed that using gamification - 'the use of game elements in a non-gaming context' (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011) - has a big impact on the adoption of new mobile banking technology. Using game elements in a non-gaming context is already being applied in different industries, domains and subjects, such as health, retail, military, government and in education (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015).

It is expected that gamification will more easily capture and sustain the interest of millennials (Baptista & Oliveira, 2017) - as they are 'raised on games' (Gamrat, Zimmerman, Dudek, & Peck, 2014). There seems to be a large potential impact in using gamification for improving acceptance and use of new technologies in education. This study aims to gain better and new insights on how to improve the acceptance of new educational technology by applying gamification elements. Currently, gamification has a low solution maturity (Liu, Santhanam, & Webster, 2017); we recognize the opportunity to contribute new knowledge to this field and to propose new connections. Our research intends to yield a deeper understanding on the impact of gamification in the adoption of technology (Baptista & Oliveira, 2017) by answering the following research question: 'What is the relationship – according to literature - between gamification elements and the core constructs that influence the acceptance of technology, in the context of education?'.

2 Theoretical Background

2.1 Technology-Enhanced Learning

Technology-Enhanced Learning (TEL) gives the advantage of easier access to information and creates flexibility in time and location of learning for the student, the lecturer and the organization. It is focused on being learner-centered to achieve positive learning results (Trepule, Tereseviciene, & Rutkiene, 2015). These advantages explain why innovations such as flipping the classroom or blended learning, backed by digital technologies have become popular lately (Y. Song & Kong, 2017). Various research (Al-Qahtani & Higgins, 2013; Garrison & Kanuka, 2004; Rovai, 2004; Yapici & Akbayin, 2012) shows that students' achievements and their attitudes toward learning in blended learning positively changed compared to face-to-face learning. The discrepancy between the intentions of TEL and its acceptance by learners is a widely recognized problem in educational settings and has been subject to various recent studies. The acceptance and adoption of TEL by students is influenced by the ease of use, usefulness, utility, enjoyment and software availability perceived by students (Acosta-Gonzaga & Walet, 2018; Bouchrika, Harrati, Mahfouf, & Gasmallah, 2018).

2.2 Acceptance of Technology

Problematic adoption of new educational technology is not without precedent (Flavin, 2017). To find reasons for (non)acceptance of new technology, multiple adoption theories have been introduced since the 70s. In 1980, Ajzen and Fishbein (Ajzen & Fishbein, 1980) published the 'Theory for Reasoned Action' (TRA), which was adapted by Davis (Davis, 1989) to the 'Technology Acceptance Model' (TAM). This model suggests that the adoption of an IT system is determined by the users' intention to use the systems, which is determined by the users' attitude towards this system (Davis, 1989; Surendran, 2012). The attitude is influenced by two perceptions: (1) the perceived ease of use, and (2) the perceived usefulness of the system. The most widely accepted theory today is the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh, Morris, Davis, & Davis (Venkatesh, Morris, Davis, & Davis, 2003). Venkatesh, Thong and Xu (2012) consequently introduced a further refinement of the UTAUT model: the UTAUT2 model. While the first

UTAUT model only had four constructs, the new model has seven constructs (Venkatesh, Thong, & Xu, 2012): 1) Performance Expectancy; 2) Effort Expectancy, 3) Social Influence, 4) Facilitating conditions, 5) Hedonic Motivation, 6) Price, 7) Habit. In recent research on the acceptance of mobile e-banking (Baptista & Oliveira, 2017), it was found that using gamification has big impact on the acceptance of the new 'mobile banking' technology. In the next paragraph, we will elaborate on the concept of gamification.

2.3 Gamification

Gamification is defined in several different ways, and tends to differ per person, both in industry as within academia (Landers, Auer, Collmus, & Armstrong, 2018). However, the most accepted definition of gamification is "the use of game elements in a non-gaming context" (Deterding et al., 2011). This definition accurately describes both the means (game elements) and the context of application (non-gaming).

The world of games in real-life is immense: in 2015, 91.5 billion dollars was spent on playing digital games (Warman, 2015). Games are not only playful and fun, but have the opportunity to be instructive and meaningful for learning at the same time (Hummel et al., 2011). Central to the concept of gamification lies on the belief that, as gaming is more fun, adding game elements to a non-gaming system can make dull activities more attractive (Zichermann & Cunningham, 2011), and it triggers, if used in the right way, intrinsic motivation to use that system (Yildirim, 2017).

Gamification elements are the basic building blocks for gamified applications (Deterding et al., 2011; Liu et al., 2017; Werbach, 2014). The term 'elements' shows the difference of gamification and serious games (Deterding et al., 2011). In general, gamified solutions can be split up into three elements: rules, a system and fun (Mora, Riera, González, & Arnedo-Moreno, 2017). According to the MDA–framework proposed by Hunicke, LeBlanc and Zubek (2004), gamification can be divided into three design components:

1. ***Mechanics***, describing the particular components of the game, at the level of data representation and algorithms; They do not change from

one player to the next, but stay the same (Robson et al., 2015) and are the foundational aspects of the gamified experience.

2. ***Dynamics***, describing the run-time behavior of the mechanics on acting on player inputs and any other outputs over time; Dynamics are about 'how' the player follows the mechanics.
3. ***Aesthetics***, describing the desirable emotional responses evoked in the player when reacting with the game system (Hunicke et al., 2004).

Robson et al (Robson et al., 2015) conceptualized Aesthetics as Emotions. Gamification emotions are 'the mental affective states and reactions evoked among individual players when they participate in a gamified experience' (Robson et al., 2015). A preliminary, explorative literature review yielded no single accepted list of default gamification elements. Based on that review, we give a list of the gamification elements we encountered most often in gamification literature below, categorized based on the MDA-framework.

Table 1: Most encountered gamification elements in literature.

Mechanics	**Dynamics**	**Aesthetics/Emotions**
Points	Increasing Task	Avatars
Badges	Difficulty	Meaningful stories
Leaderboards	Social Games &	
Performance Graphs	Teamwork	
Virtual Gifts & Items		

2.4 Linking gamification elements to UTAUT2-constructs

To explore the possible impact of gamification elements on UTAUT2 constructs, we created the table below with (an adaptation of) UTAUT2-constructs as columns and the above listed gamification elements as rows. Our adaptation of the list of UTAUT2-constructs is two-fold: 1) we changed Performance Expectancy into Learning Expectancy, since performance in TEL can be defined as learning and 2) we removed the construct Price, since users of TEL-solutions (pupils, learners, students) usually do not pay for this usage (licenses are paid for by the school or university). We will use Table 2 as an instrument to position studies we find in our systematic literature review later.

Table 2: Table to position studies that relate gamification elements to technology acceptance constructs.

		Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation HM)	Habit (HT)
Mechanics	Points						
	Badges						
	Leaderboards						
	Performance Graphs						
	Virtual Gifts & Items						
Dynamics	Social Games & Teamwork						
	Levels, Missions, Challenges & Quests						
Aesthetics	Avatars						
	Meaningful Stories						

3 Methodology

In this study, we aim to gain insights into which gamification elements have the potential to influence which aspects of the acceptance of technology. To achieve this goal, we performed a systematic literature review by following three steps as adapted from the approach by (Mortenson & Vidgen, 2016):

1. Define search criteria; To search though these databases we used a search query which was formulated based on our first explorative literature research: ("Gamification" OR "Game element*") AND ("Learning* OR "Learning Expectancy" OR "Effort*" OR "Social Influence" OR "Facilitating Conditions" OR "Hedonic Motivation" OR "Habit");
2. Searching in databases; We used a meta search engine which is connected to 63 of the biggest research databases worldwide. The following inclusion criteria are used during our search process:
   - Full-text, peer-reviewed publications;
   - Published in the last five years (between 2013 and 2018);
   - Written in the English language.
3. Selection; The resulting publications were selected based on relevancy for our research objective, with the specific focus on the acceptance of technology (instead of increasing learning performance in itself).

Whenever we found relevance sources in the full text, we followed the same process to check their relevance.

The included publications were then added to our database with name of the author(s), (sub)titles, and results (outcomes, game elements used), and used to fill Table 2.

4 Results

In this section the results of our literature review are presented. The total hits for our search terms (N = 1271), resulted in a total of 56 studies that meet the inclusion criteria, see Figure 1. After we selected the relevant studies, we positioned these studies according to the gamification elements and the technology acceptance constructs discussed in the respective studies. This gives us the complete overview and main result as presented in Table 3.

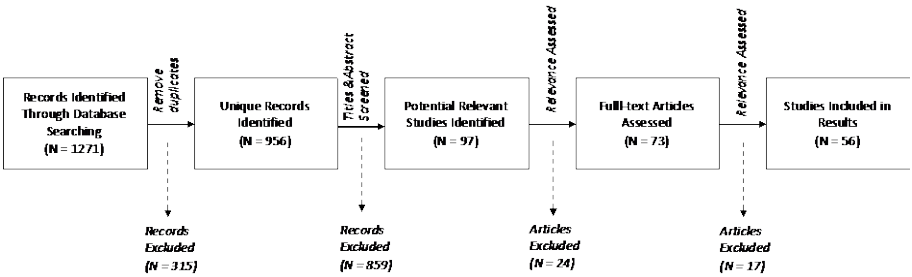

Figure 1: Search process results.

		Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation HM)	Habit (HT)
Mechanics	Points	(Attali & Arieli-Attali, 2015) (Hamari, 2013) (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2016) (Sailer, Hense, Mayr, & Mandl, 2017)		(Sjöblom, Törhönen, Hamari, & Macey, 2017)		(Aparicio, Vela, Sánchez, & Montes, 2012) (Doherty, Palmer, & Strater, 2017) (Mekler, Brühlmann, Tuch, & Opwis, 2017) (Pappas, 2015) (Przybylski, Rigby, & Ryan, 2010) (Robson et al., 2016)	(Chou, 2016) (Goehle, 2013) (Robson et al., 2016)
	Badges	(Gåsland, 2011) (Sailer et al., 2017) (van Roy & Zaman, 2018)		(Anderson, Huttenlocher, Kleinberg, & Leskovec, 2013) (Depura & Garg, 2012) (Hamari & Koivisto, 2013) (Kyewski & Krämer, 2018) (McDaniel, Lindgren, & Friskics, 2012)		(Aparicio et al., 2012) (Hamari, Hassan, & Dias, 2018) (Denny, 2013) (Hamari, 2017) (Hanus & Fox, 2015) (Mekler et al, 2017)	(Lucassen & Jansen, 2014) (Seaborn & Fels, 2015)
	Leaderboards	(Landers, Bauer, & Callan, 2017) (Sailer et al., 2017)		(Baabdullah, 2018) (Depura & Garg, 2012) (Jia, Liu, Yu, & Voida, 2017)		(Burguillo, 2010) (Landers, Collmus, & Williams, 2018) (Pappas, 2015) (Ruhi, 2015) (Song, Kim, Tenzek and Lee, 2013) (van Roy & Zaman, 2018)	(Landers and Landers, 2014) (McDaniel et al., 2012)
	Performance Graphs	(Cardador, Northcraft, & Whicker, 2017) (Ling et al., 2005) (Sailer et al., 2017)				(Doherty et al., 2017)	
	Virtual Gifts & Items	(Domínguez et al., 2013)				(Snyder & Hartig, 2013)	(Domínguez et al., 2013)
Dynamics	Social Games & Teamwork	(Diep, Cocquyt, Zhu, & Vanwing, 2016) (Hamari & Koivisto, 2015) (Hsu & Lu, 2004) (Toda, do Carmo, da Silva, Bittencourt, & Isotani, 2018)	(da Rocha Seixas, Gomes, & de Melo Filho, 2016)	(Baabdullah, 2018) (Hamari & Koivisto, 2015) (Molinillo, Muñoz-Leiva, & Pérez-García, 2018) (van Roy & Zaman, 2018).	(van Roy & Zaman, 2018)	(Hamari & Koivisto, 2015) (Hsu & Lu, 2004) (Lin, Wang, & Chou, 2012) (Mekler et al., 2017) (Shen, Cheung, & Lee, 2013) (Wang & Wang, 2008)	(Molinillo et al., 2018).
	Levels, Missions, Challenges & Quests	(Dong et.al, 2012) (Robson et al., 2016) (Toda et al., 2018)	(Landers et al., 2017)			(Aparicio et al., 2012) (Banfield & Wilkerson, 2014) (Dong et al., 2012) (Li, Grossman, & Fitzmaurice, 2012) (Seaborn & Fels, 2015) (van Roy & Zaman, 2018)	
Aesthetics	Avatars	(Annetta, 2010)		(Annetta, 2010)		(Annetta, 2010)	
	Meaningful Stories	(Groh, 2012) (Hitchens & Tulloch, 2018)	(Doherty et al., 2017) (Nicholson, 2015)	(Sailer et al., 2017)		(Clark & Rossiter, 2008) (Malamed, 2012) (Stott & Neustaedter, 2013)	

Table 3: Results of the systematic literature review.

A first glance at Table 3 makes us notice three aspects immediately:

1. Some of the cells are empty, i.e. we did not find any literature on the relation of 21 out of the 54 combinations of a gamification element and an UTAUT2-construct;
2. Some of the cells are very densely filled with references, i.e. most studies we found concentrate on the same combinations of a gamification element and an UTAUT2-construct;
3. Some of the selected studies appear in multiple cells, i.e. few studies focus on single gamification element and/or a single UTAUT2-construct.

We focus our review of the content of Table 3 on three notable aspects: Learning Expectancy, Social Aspects and Hedonic Motivation. For the sake of completeness, the entire table with results of the review is included as an appendix to this manuscript.

4.1 Learning Expectancy

For all gamification elements, we found studies that related that element to the construct Learning Expectancy. For the Mechanics elements such as Points, Badges and Performance Graphs and Virtual Gifts, many studies find that rewarding and showing progress increases the expectancy of the learner of the value of the TEL solution (Attali & Arieli-Attali, 2015; Cardador, Northcraft, & Whicker, 2017; Hamari, 2013; Landers, Bauer, & Callan, 2017; Ling et al., 2005; Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2016; Sailer, Hense, Mayr, & Mandl, 2017). Points are typically used to give a reward for successful accomplishments of specified activities in the game, and serve to represent the progress of the player (Attali & Arieli-Attali, 2015). Badges indicate the achieved competence level and visibly show the level and goals (van Roy & Zaman, 2018). Clear achievements, like badges, improve safety and understanding of learning goals (Gåsland, 2011). By rewarding the player with an item, they will feel that they are performing well (Domínguez et al., 2013). Such Mechanics elements provide a continuous and direct feedback mechanism which links directly to perceived usefulness (Attali & Arieli-Attali, 2015; Cardador et al., 2017; Sailer et al., 2017) and visualizing competence development, increasing the feeling of value (Hamari, 2013) and the task meaningfulness (Sailer et al., 2017).

Furthermore, Dynamics and Aesthetics elements also have potential impact on Learning Expectancy. For example, interaction between students can achieve cross-learning and affect the performance expectancy of a game (Toda, do Carmo, da Silva, Bittencourt, & Isotani, 2018). Working in a team can positively influence the learner-learner interaction and improves knowledge sharing (Diep, Cocquyt, Zhu, & Vanwing, 2016), showing direct and explicit value. By giving players all a meaningful role, a sense of relevance can be triggered (Groh, 2012; Hitchens & Tulloch, 2018), boosting the expected feeling of value. And finally, avatar offers the players freedom of choice and autonomy and increases decision freedom and task meaningfulness (Annetta, 2010).

4.2 Social Aspects

We see a clear relation in Table 3 between the element Social Games and Teamwork and the construct Social Influence. Studies in this cell note that social gaming affects experiences of social relatedness (Molinillo, Muñoz-Leiva, & Pérez-García, 2018), e.g. students can 'play' in groups, and share their results and high-scores conveniently on (external) social networking platforms (Baabdullah, 2018; Hamari & Koivisto, 2015). Social gamification elements can even spark the 'fear of missing out' (van Roy & Zaman, 2018).

Mechanics elements also have a potential impact on social influence. For example, individuals are more likely to engage in behaviors that they perceive others are also engaged in (Sjöblom, Törhönen, Hamari, & Macey, 2017), which can further be triggered through badges and leaderboards. Badges symbolize membership in a group of those who own the same badge and it has a social influence on players and co-players, especially when these badges are rare or hard to obtain (Hamari & Koivisto, 2013). With a leaderboard, players are 'ranked' according to their relative success, measured against chosen success criteria. As it shows who of the players performs best, it triggers competitiveness. This competition can have a positive influence for the people at the top of the list, but can have negative effects for the players at the bottom of the list (Jia, Liu, Yu, & Voida, 2017). Landers (2017) states that positive effects are more likely if the 'competitors' have approximately the same level. Kyewski & Krämer (2018) showed that using badges that could only be viewed by the individual themselves was evaluated more positively than those that were openly shared with others. Aesthetics elements can also have impact on the Social Influence. A shared,

meaningful goal, can foster experiences of social relatedness (Sailer et al., 2017) and in cooperative games, avatars can help to become a part of a community (Annetta, 2010).

4.3 Hedonic Motivation

Most selected studies that focus on Hedonic Motivation, operationalize this construct in terms of enjoyment, intrinsic motivation or engagement. Most studies relate this construct with the elements Points, Leaderboards and Social Games & Teamwork.

Interactivity and feedback have a positive impact on the perceived enjoyment (Hsu & Lu, 2004; Lin, Wang, & Chou, 2012; Wang & Wang, 2008). Pappas (2015) found in a survey that 89% of the students state that a point system would increase their engagement.

However, several studies propose conditions before gamification elements can have positive effects on Hedonic Motivation. For example, Aparicio et al (2012) found that positive effects only occur when Mechanics elements are presented in a non-controlling and voluntary setting. Points only increase intrinsic motivation when the reward is the outcome of an achievement (Doherty, Palmer, & Strater, 2017). Mekler, Brühlmann, Tuch, & Opwis (2017) found in a controlled experiment with points and badges - contrary to earlier studies - that points and badges did not affect intrinsic motivation significantly. Leaderboards also might have a negative impact: students in a team low in the rankings seems to suffer lower levels of self-believe and will likely move away from the solution (van Roy & Zaman, 2018).

Using social media or multi-player games creates a 'we-intention' (Shen, Cheung, & Lee, 2013) and social norms (Hsu & Lu, 2004). Meaningful stories, with narrative context, will give meaning to score more points and achievements (Malamed, 2012).

The element Levels, Missions, Challenges & Quests is closely related to the motivational aspect of mastery and indeed we see several studies stating that increasing the task difficulty does increase engagement and enjoyment (Banfield & Wilkerson, 2014; Li, Grossman, & Fitzmaurice, 2012; Seaborn & Fels, 2015).

However, again not all potential impact is positive. For example, (van Roy & Zaman, 2018) found challenges to only be effective for those students who we already motivated to do well from the very start.

5 Conclusion

We have conducted a systematic literature review on the potential impact of gamification elements on the acceptance of technology in the context of education. Supported with previous systematic reviews of current gamification research (Hamari, Koivisto, & Pakkanen, 2014; Mekler et al., 2017; Oliver, 2017; Pedreira, García, Brisaboa, & Piattini, 2015; Seaborn & Fels, 2015) and critical review studies related to gamifying education (Dichev & Dicheva, 2017; Stott & Neustaedter, 2013), we can conclude that:

1. few studies have investigated the effect on individual gamification elements, especially in encountered in a controlled experimental setting;
2. the success of its application is mixed and the knowledge of how gamify educational environments is still limited.

We see several opportunities for future research. It is still unclear how these gamification elements can be successfully implemented in existing TEL solutions in practical settings. Other listings or classifications of game elements could also be explored. Sometimes, several studies we reviewed contradict each other in terms of positive or negative impact on the acceptance. We still believe applying gamification in educational settings can have benefits, but we also acknowledge it is not an easy undertaking and requires both contextual and situational considerations. We hope our results can support both researchers and practitioners to make such considerations based on relevant literature. Finally, our model of positioning studies might help researchers in designing their studies and practicitioners in designing their interventions.

Appendix 1: Full Table with Results of the Systematic Literature Review

Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation (HM)	Habit (HT)	
Points provide direct feedback regarding task performance, which is one of the most frequently applied psychological interventions (Attali & Arieli-Attali, 2015). When gamers compare their points, badges and rewards, they are benchmarking themselves (Hamari, 2013) and therefore see their own competence development, increasing the feeling of value. Point and other rewards must be meaningful in the eyes of the players to enhance the expectancy of value (Robson et al., 2016). The need for competence can be addressed with points, badges, leaderboard and performance graphs (Sailer et al., 2017).		Individuals are more likely to engage in behaviors that they perceive others are also engaged in (Sjöblom et al., 2017), meaning other students' performance in points have a function as source of information.		Points, levels and leaderboards promote the competence need only provided they are presented in a non-controlling and voluntary setting (Aparicio et al., 2012). Points only increases intrinsic motivation when the rewards is the outcome of an achievement (Doherty et al., 2017). Mekler et al. (Mekler et al., 2017) found in a controlled experiment with points and badges, contrary to other researches, that points and badges did not affect intrinsic motivation significantly. Pappas (Pappas, 2015) found in a survey that 89% of the students state that a point system would increase their engagement. Goal metrics, like points and badges function as (positive and) informational feedback, and therefore improve intrinsic motivation, as they create opportunities for players to satisfy their need for competence (Przybylski, Rigby, & Ryan, 2010). Timing of (point) rewards is key. Reward behavior as quickly as possible after good performance. In addition by rewarding a series of simples behaviors, one can shape the desired complex	Rewarding points can be used to stimulate the participation of the users (Chou, 2016), resulting in being used to use the solution. Students were found to put in more effort to complete homework to obtain achievements (Goehle, 2013). In order to keep players playing, thereby contributing to the desired outcome, it is important to provide a sense of achievement and meaningful rewards for player behavior (Robson et al., 2016).	**Mechanics: Points**

Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation (HM)	Habit (HT)	
Clear achievements, like badges, improved safety and understanding of learning goals (Gåsland, 2011). The need for competence can be addressed with points, badges, leaderboard and performance graphs (Sailer et al., 2017). Results illustrated that students use badges and rankings to evaluate their own progress and evolution in the course, as they show the students their progression and competences explicitly (van Roy & Zaman, 2018).		Virtual badges have boosted user knowledge sharing via social media websites like Stackoverflow (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2013). Using leaderboards, badges, e.g. improved the social bonding (Depura & Garg, 2012). It symbolizes membership in a group of those who own the same badge and it has an social influence on players- and co-players, especially when they are rare or hard to win (Hamari & Koivisto, 2013). Kyewski & Krämer (2018) showed that using badges that could only be viewed by the individual themselves was evaluated more positively then those that were openly shared with others. Students can be motivated to achieve badges that a friend already had achieved (McDaniel, Lindgren, & Friskics, 2012).		Points, levels and leaderboards promote the competence need only provided they are presented in a non-controlling and voluntary setting (Aparicio, Vela, Sánchez, & Montes, 2012). Results showed that users that could earn badges were significantly more likely to us the system in a more active way, contribute more and spend more time engaged with the system (Denny, 2013; Hamari, 2017). Denny (2013) found, in his study with undergraduate students in a gamified context with badges, that students had a moderate positively higher enjoyment and motivation derived from the solution. Individuals who focus on attaining specific outcomes rather than enjoying the process of attaining these outcomes could be expected to draw more motivation out of motivational features that emphasize to them the outcomes they want to attain and their value e.g. badges and medals (Hamari, Hassan, & Dias, 2018). The use of leaderboards and badges resulted in lower satisfaction, empowerment and motivation compared to the non-gamified class (Hanus & Fox, 2015). Mekler et al. (2017) found in a controlled experiment with points and badges, contrary to other researches, that points and badges did not affect intrinsic motivation	In research on gamification on consumer marketing, experts expressed that using badges could improve the loyalty, and therefore use of the solution/product (Lucassen & Jansen, 2014). Results showed that badges motivate the duration of engagement, without impacting response quality (Seaborn & Fels, 2015).	**Mechanics: Badges**

Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditi	Hedonic Motivation (HM)	Habit (HT)	
A leaderboard showed a positive influence on performance levels, suggesting that participants implicitly set goals at or near the top of a leaderboard without prompting to do so (Landers et al., 2017). The need for competence can be addressed with points, badges, leaderboard and performance graphs (Sailer et al., 2017). Results illustrated that students use badges and rankings to evaluate their own progress and evolution in the course, as they show the students their progression and competences explicitly (van Roy & Zaman, 2018).		Players can play in groups and share their ranks and high scores, which will increase behavioral intention (BI) (Baabdullah, 2018). Using leaderboards, badges, e.g. improved the social bonding (Depura & Garg, 2012). The position a user has on the leaderboard has important effects on their perception of the leaderboard and the surrounding app. Still users recommend the system with leaderboard to friends, regardless of the ranking (Jia et al., 2017).		Leaderboards can increase the players' level of engagement and can have a contributive effect on participation (Burguillo, 2010). The presence of a leaderboard can increase task-motivation and performance, which is consistent with the well-known effect of goal setting (Landers, Collmus, & Williams, 2018). Pappas (2015) found, in a survey that 62% of students would be motivated to learn if leaderboards were involved and they had the opportunity to compete with others. Social elements are even more motivating when players are able to compare themselves to others in the same context as they then are able to make more accurate self-evaluations (Ruhi, 2015). Song, Kim, Tenzek and Lee (2013) found that players with a high-achievement motivation had a better performance in a competitive setting, while players with a low-achievement motivation had a more negative mood and where less intrinsically motivated.	A leaderboard motivated some students to seek out achievements and badges, which had a marginally positive influence on the overall use (McDaniel et al., 2012). Landers and Landers (2014) executed an experiment which showed the use of a leaderboard increased the amount of time students spent interacting with their group assignment.	**Mechanics: Leaderboards**
Access to performance information will give the gamer more 'direct feedback' (Cardador, Northcraft, & Whicker, 2017). Leaderboards, performance graphs and badges positively affect competence need satisfaction as well as the task meaningfulness (Sailer et al., 2017). The visible progress in performance and completion of goals lead to an increased satisfaction (Ling et al., 2005).				Simple, virtual, statistics were successfully implemented as an accomplishment technique, boosting motivation to use the solution (Doherty et al., 2017).		**Mechanics: Performance Graphs**

Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation (HM)	Habit (HT)	
By rewarding the player with an item, they will feel that they are performing well (Domínguez et al., 2013).				Rewards improved participation and engagement (Snyder & Hartig, 2013).	Players motivated by collectables will be tempted to continue working in order to get more items. When they are hidden and come by surprise, they may serve to promote exploration of the system features (Domínguez et al., 2013).	**Mechanics: Virtual Gifts & Items**
Working in a team can positively influence the learner-learner interaction and improves knowledge sharing (Diep et al., 2016), showing direct and explicit value. "The more friends a user has in a service, the larger the effects are"(Hamari & Koivisto, 2015). Receiving recognition from (relevant) others can create reciprocal behavior, which can have a positive outcome to the (social) usefulness of the system (Hsu & Lu, 2004). Interaction between students can achieve cross-learning and affect the performance expectancy of a game (Toda et al., 2018).	Social/multi-player games can give players a sense of recognition for their effort (da Rocha Seixas, Gomes, & de Melo Filho, 2016).	Social gaming affects experiences of social relatedness, players can play in groups, and share their results and high-scores conveniently on e.g. social networking platforms (Baabdullah, 2018). Social influence, positive recognition and reciprocity will have a positive impact on how much people are willing to exercise as well as their attitudes and willingness to use the gamified service (Hamari & Koivisto, 2015). When strategies, tips and emotions (e.g. frustration and excitement) are shared, players develop strong social ties (Molinillo et al., 2018). "Data showed that group goals and activities became an incentive to use the solution and even sparked a 'fear of missing out'"(van Roy & Zaman, 2018).	A study in which students voluntary interacted with a gamified platform, showed that part of the students were not inclined to help their groupmates (van Roy & Zaman, 2018).	"Gamification elements that encompass a social element are generally experienced as more engaging than 'single player' elements" (Hamari & Koivisto, 2015). Using social media/multi-player games creates a 'we-intention' (Shen et al., 2013) and creates social norms (Hsu & Lu, 2004). Interactivity and feedback have a positive impact on the perceived enjoyment (Hsu & Lu, 2004; Lin et al., 2012; Wang & Wang, 2008). Players that are individually working on a single isolated task, generally experience little or no increase in motivation (Mekler et al., 2017).	Interaction with others has a positive impact on the convenience to play (Molinillo et al., 2018).	**Dynamics: Social Games & Teamwork**

Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation (HM)	Habit (HT)	
Dong et.al (2012) found that a gamified puzzle helps the participants to learn how to use computer software, that the learning experience was evaluated to be effective, fun, unique and engaging. New levels, tasks or players are needed in order to continuously inspire. The difficulty must grow, while rules do not need to be changed (Robson et al., 2016). Cognitive challenges can be used to satisfy the players' internal needs of problem solving (Toda et al., 2018).	Goal setting is generally more effective for simple tasks, because it is easier for a person to see the connection between the effort and the goals achieved (Landers et al., 2017).			Points, levels and leaderboards promote the competence need only provided they are presented in a non-controlling and voluntary setting (Aparicio et al., 2012). A gamified puzzle increased students' intrinsic motivation to perform in a system engineering class (Banfield & Wilkerson, 2014). Dong et.al (2012) found that a gamified puzzle helps the participants to learn how to use computer software, that the learning experience was evaluated to be effective, fun, unique and engaging. Using levels/missions in a gamified course showed an increase in engagements, enjoyment and performance (Li et al., 2012; Seaborn & Fels, 2015). Van Roy and Zaman (2018) found a positive link to motivation in giving students challenges that felt like 'a free agenda', being able to decide when, how and how often they want to interact with the platform, although this also led to certain students not contributing at all. The challenges were only effective for those students who were already motivated to do well from the very start (van Roy & Zaman, 2018).		**Dynamics: Levels, Missions, Challenges & Quests**
An avatar offers the players freedom of choice (autonomy; decision freedom and task meaningfulness) (Annetta, 2010).		In cooperative games, avatars can help to become a part of a community (Annetta, 2010).		An avatar offers the players freedom of choice (autonomy; decision freedom and task meaningfulness) (Annetta, 2010).		**Aesthetics: Avatars**

Learning Expectancy (LE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation (HM)	Habit (HT)	
By giving players all a meaningful role, a sense of relevance can be triggered (Groh, 2012; Hitchens & Tulloch, 2018), boosting the expected feeling of value.	A story is the easiest element to implement, and has no direct impact on the effort of the player (Doherty et al., 2017). When the story is linked to real-world settings and in line with the players personal interests, it will inspire and motivate, and lowers the feeling of putting in effort (Nicholson, 2015).	A shared, meaningful goal, can foster experiences of social relatedness (Sailer et al., 2017).		Meaningful stories, with narrative context, will give meaning to score more points and achievements (Malamed, 2012). Providing a unifying story throughout the game can put the learning elements into a realistic context in which actions and tasks can be practiced, something that is considered extremely effective in increasing student engagement and motivation (Clark & Rossiter, 2008; Malamed, 2012; Stott & Neustaedter, 2013).		**Aesthetics: Meaningful Stories**

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