Motivation in Gamification: Constructing a Correlation Between Gamification Achievements and Self-determination Theory

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Abstract. This paper presents an analysis of the general concept of motivation and how it is fostered in gamified solutions for learning, particularly in the context of self-determination theory. The analysis leverages academic literature on the topics of motivation, player engagement, basic psychological needs, and the ability of video games to potentially satisfy these needs. Specifically, the paper contributes to the field of game-based learning by (1) proposing a correlation between gamification achievements and basic psychological needs, as derived from self-determination theory, (2) analysing an already effective game-based learning platform (SOLOLEARN) for mechanics that do – and that do not – contribute to the basic psychological needs of individual users.

Keywords: Gamification · Self-determination theory · Adaptive gamification · Gamification design

1 Introduction

In recent years, one may observe a rapid increase in adopting gamified solutions for non-gaming contexts (i.e., the use of gamification and game mechanics for purposes other than entertainment) [1]. Repurposing of such gamification techniques is typically aimed at supporting and enhancing a user's motivation, creating engagement for specific activities of everyday life, and fostering the training of specific skills. More specifically, the diversity of domains in which gamification is adopted is noteworthy; from personal improvement to learning, from business training to marketing. As a result, the target audience of gamified solutions is highly diverse too. As gamification deals with motivation, it has to be taken into account – when designing gamified solutions – that distinct people are usually motivated by different things in different ways, and therefore, by distinct game interactions (i.e., as resulting from distinct game mechanics like rewards, achievements, etc.).

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Indeed, many scholars have investigated the nature and origin of human motivation, highlighting a difference between the motivation that arises from the individual, compared to that which is fueled by the desire to achieve an external goal [2–4]. Behaviourists considered behaviour as the result of the stimulus-response relation [2] and the studies carried out by Skinner introduced the concept of reinforcement [3], as a fundamental element that fosters the acquisition and performance of a specific behaviour. As studies about the psychology of motivation developed, it was indicated that reinforcement was typical of extrinsic motivation. White [4] in 1959 stated that behaviour is driven by *innate psychological tendencies*, in particular, *competence*. Activities and behaviour performed to satisfy these psychological tendencies are considered by White as intrinsically rewarding and satisfying [2].

Leveraging White's work, Ryan & Deci analysed intrinsic motivation [5] and identified the psychological needs that, according to self-determination theory (SDT), are the basis of a users' intrinsic motivation[1]. At its core, SDT proposes that three main intrinsic needs are involved in self-determination of an individual; needs which motivate the self to initiate behavior and specify nutrients that are essential for psychological health and well-being. These needs are considered to be universal and innate, and concern the need for competence, autonomy, and social relations (relatedness). Ryan *et al*., building upon the foundation provided by SDT, extensively investigated how motivation is fostered in video games, and concludes that players may indeed experience gameplay as an intrinsically rewarding experience [6]. Follow-up studies by Przybylski *et al.* [7] and Ryan *et al.* [8] strongly argued that the video game medium, because of the experiences that it often creates for its users, may perfectly fit and satisfy the three basic psychological needs of SDT: autonomy, competence and relatedness [7, 8].

As we will show in the remainder of this article, one may safely assume that the basic psychological needs that are essential for creating intrinsically motivating video game experiences, are indeed similarly important for creating intrinsically motivating gamified learning experiences. In the upcoming sections, we will specifically contribute to the field of game-based learning by (1) proposing a correlation between gamification achievements and basic psychological needs, as derived from self-determination theory, (2) analysing an already effective game-based learning platform (SOLOLEARN) for mechanics that do – and that do not – contribute to the basic psychological needs of individual users. This study represents the first step of a broader research that intends to investigate if adaptivity in gamification, based upon the satisfaction of the basic psychological needs can improve the effectiveness of gamified solutions.

2 SDT and Motivation in Video Games

According to self-determination theory (SDT), personal growth and well-being of people are dependent on the satisfaction of three basic psychological needs [5], namely autonomy, competence and relatedness. Focusing specifically on video game experiences, studies have examined the ways by which video game engagement shapes psychological processes and influences well-being [7], and have indicated that both the appeal and

[1] The topic of intrinsic motivation itself is explored in more detail by cognitive evaluation theory (CET); one of the six sub-theories of which self-determination theory (SDT) is composed [5].

well-being effects of video games are based in their potential to satisfy basic psychological needs for competence, autonomy, and relatedness [8]. The question that Ryan *et al*. attempts to answer is "Why do so many people spend so much time engaged in video games?" The first answer is that videogames are typically fun – unsurprisingly – but, more specifically, the engaging power of videogames lies in the experiences they provide [7]. The research carried out in order to apply SDT – and in particular SDT's sub-theory called cognitive evaluation theory (CET) [5] – to the domain of video games, illustrates that when autonomy and competence are supported through gameplay, video games were significantly more enjoyable and satisfying for players [9]. Subsequently, the study reveals that games with substantial social components such as Massive Multiplayer Online Role Playing Games (MMORPGs) were also able to satisfy the basic psychological need for relatedness.

It is important to note that, of course, other perspectives on video game motivation exist. A highly influential model that is applied to games in the communications domain, is the uses and gratifications theory [11], upon which Sherry and Lucas [12] have built a statistically validated taxonomy of reasons that individuals hold for engaging in video games (i.e., competition, challenge, diversion, fantasy, social interaction, arousal). However, an essential point to make about taxonomies that are focused on a player's individual goals for engaging in video games, is that SDT has a long tradition of showing that people's goals, even when fulfilled, do not always yield need satisfaction, and therefore do not always predict persistence or well-being outcomes [13].

Autonomy. The first of the three needs identified by the SDT and analyzed in relation to games is Autonomy [5], namely the sense of willingness in accomplishing tasks: the more the interest in the activity derives from personal interests, the higher is autonomy [5, 8]. This basic psychological need is fostered in video games, for instance, by providing choices, by using rewards as informational feedback or by giving non-controlling instructions. On the other side, all mechanics that implies lack of choice, control or freedom are perceived negatively and can undermine intrinsic motivation [8]. In regard to video games, the choice of playing a specific game, or to play a game at all, is already a manifestation of autonomy. But, at a deeper level, autonomy must be fostered through gameplay design choices: game designed to allow flexibility (and therefore the chance for the player to strategize), to offer the possibility to make significant choices over tasks and goals, and to assign rewards structured to provide feedback, are more effective in fostering autonomy than games that don't include those design elements.

Competence. The second basic psychological need analyzed in SDT is Competence, that is fostered by the chance to acquire new knowledge, skills or abilities, by the possibility to receive positive feedback and to participate in optimally structured challenges [5]. In games, the need for competence is largely satisfied: most gameplays are based on player's competence to accomplish game missions.

Relatedness. The third basic psychological need discussed in SDT is Relatedness, namely the feeling of being connected with others and to be relevant in the community [5]. This need is often satisfied in games where the multiplayer option is present or, even mostly, in MMORPGs, founded on the simultaneous interaction among players.

3 SDT and Motivation in Gamification

Focusing more specifically on gamification and game-based training, it is important to note a major distinction to video games. To reiterate, Ryan *et al.* [8] observes that the SDT basic psychological needs may be satisfied by video-game playing, and therefore can be considered predictors of enjoyability and engagement during the gaming experience. However, the choice to start playing a video is typically autonomous, and as such, intrinsically motivated – yielding an experience that is distinct to one that is initiated by force, coercion, or other external stimuli [7, 9]. This suggests a substantial difference between typical gamification & game-based training, and video games for two reasons. First, participation in gamified activities is not always voluntary, since performing these activities is often mandatory (*e.g.*, in learning contexts). Second, users that engage in gamified activities may not experience the activities as play (but, *e.g.*, as training); thereby imposing substantial constraints on the subjective experience – and by implication, need satisfaction – of the player.

Considering that activities targeted by a gamification strategy often cannot be changed, as they generally are part of, *e.g.,* a predefined training programme, a natural avenue for enhancing the effectiveness of gamified training programmes is to more directly target need satisfaction of the individual user [5]. Analogously to how user retention and general satisfaction in video games is often facilitated by considering individual differences between players – *e.g.*, via dynamic difficulty adjustment (DDA) [15] and experience-driven procedural content generation (EDPCG) [16] – one may investigate to what extent individual preferences for the satisfactions of distinct psychological needs can be modeled automatically from training interactions, and to what extent such a model can be used to automatically adapt gamification strategies to the individual user.

As a first step towards this overarching goal, we will now explore how distinct types of gamified achievements may be related to SDT psychological needs, and how these relationships can be exploited to the designer's advantage.

3.1 Gamification Achievements and Need Satisfaction

Here, we explore the relationship between gamification achievements and basic psychological needs – as derived from self-determination theory – and propose a (general) correlation table based on academic literature (Table 1). Taking input from SDT basic psychological needs, Kapp defined a taxonomy of achievement in games and gamification [17]. We build upon this taxonomy as a starting point to construct an analysis which includes the most commonly used achievements in gamification and show their expected impact on the three basic psychological needs of SDT.

For each achievement area of impact, we will now discuss the expected impact on the three basic psychological needs of SDT. The discussion is summarized in Table 1; different achievements impact distinctly on the three basic psychological needs: in some cases, they are satisfied (+), in others they have negative impact (−) and in still others no specific impact may be expected (NA).

- *Evaluation* achievements, and more specifically measurement ones, are strongly related to users' performance in accomplishing a target activity. On one side, this

Table 1. General correlation table of gamification achievements in relation to SDT basic psychological needs. Different achievements impact distinctly on the three basic psychological needs: in some cases, they are satisfied (+), in others they have negative impact (−) and in still others no specific impact may be expected (NA).

Area of impact	Achievement type	SDT Basic psychological needs		
		Autonomy	Competence	Relatedness
Evaluation	Measurement	−/+	+	NA
	Completion	*Cf.* completion contingent achievements		
Completion	Performance contingent	–	+	NA
	Non-Performance contingent	NA	NA	+
Goal orientation	Performance oriented	NA	+	NA
	Mastery oriented	+	+	NA
Predictability	Expected	+	+	NA
	Unexpected	NA	NA	NA
Functionality	Cosmetic	+	NA	+
	Functional	+	+	NA
Flexibility	Achievement as gift	–	NA	+
	Achievement as currency	+	+	NA
Clustering criteria	Incremental	NA	+	NA
	Meta-achievements	–	+	NA
Competitiveness	Competitive	+	+	+/−
	Non-competitive	NA	+	+

type of reward is perceived as strongly controlling, but the evaluative nature of the achievement, necessitating competence to be awarded, softens its controlling side [8, 13, 17, 18]. Evaluation achievements are very close in their function to positive feedback [18], considered effective in fostering intrinsic motivation. Completion achievements, namely achievements awarded just for participating in an activity, are examined in the *Performance* area of impact.

- *Completion* includes the two types of achievements that aim at giving to the player feedback just for participating in an activity, without evaluation. As measurement achievements, performance ones are awarded for completing activities that require competence, hence the perception of control is balanced by the need for competence [8, 13, 17, 18]. On the other hand, non-performance achievements are perceived as strongly controlling and therefore not fostering intrinsic motivation [8, 13, 17, 18].
- *Goal Orientation* area of impact is referred to the reasons why users are involved in target activities included in a gamified solution. *Performance contingent achievements*

are similar to evaluation achievements and are awarded in relation to how well a player performs in a single task [17]. On one side, this is perceived as controlling, but the evaluative nature of the achievement softens the controlling side [8, 13, 17, 18]. M*astery oriented achievements* are awarded in relation to the effort the player puts in a task with the main objective to get better at it, in the long period [17]. The will to improve one's skill is mostly autonomous, and the final objective is competence, for this reason mastery-oriented achievements are mainly perceived as supporting motivation [8, 13, 17, 18].

- *Predictability* is the area of impact that makes explicit the relation between task performance and achievements. *Expected achievements* are directly related to the target activity, and therefore can be perceived as controlling [18], while *unexpected achievements* are totally unrelated to the target activity, and hence considered having no impact on intrinsic motivation [18].
- *Functionality* area of impact does not consider the nature of the reward, but rather the use of the reward that can be done within the gamified system. Established that both *cosmetic* and *functional* achievements are material achievements [18], they can have different roles within the gamified system. *Cosmetic* achievements can be exhibited, and as a consequence have meaning in the social context of the activity, enhancing relatedness [8, 13, 17]. *Functional achievements*, on the other hand, given their potentially strategic role in the gamified system, offer to users the chance to strategize, and therefore take advantage of competence.
- *Flexibility* area of impact is similar to the *Functionality* one. *Achievements as gifts* are awarded as a consequence of a target behavior, which may reasonably be expected to be perceived as controlling [18]. On the other hand, achievements as currency give to users the chance to use that currency according to their own will, fostering autonomy [8].
- *Clustering criteria* area of impact includes achievements that, although perceived as controlling [18], require competence to be awarded [8, 13, 17, 18].
- *Competitiveness* area of impact achievements can be *competitive* or *non-competitive*. Both of them have impact on competence, required to carry out the target activity, but have a slightly different impact on relatedness [8, 13, 17].

4 The SOLO LEARN Case Study

To provide an illustrative example of how the general correlations that are summarized in Table 1 can be utilized, we here present a case study of the popular and effective SOLOLEARN training platform for learning how to code[2]. We will show that – while SOLOLEARN is rated by gamification scholars among the best gamified applications for learning [19] – it still falls short in catering for specific psychological needs. In the case study, we will highlight potential venues for improvement, which indeed can reasonably be assumed to be applicable for other gamified applications for learning.

SOLOLEARN is a mobile application for learning coding skills, with elements of gamification as support for users' motivation. Specifically, here we examine SOLOLEARN Pro Version's training structure and achievement system, analyzing it

[2] Application website: https://www.sololearn.com/.

in light of the investigated correlation between achievements and SDT basic psychological needs (cf. Table 1). We decided to analyse The Pro Version of the application because it includes all the gamified features available for learners.

- *Evaluation achievements:* In SOLOLEARN there are no *measurement achievements*. The user performance is not evaluated in any way. *Completion achievements*, on the other hand, are extensively used (*cf. Completion*).
- *Completion* achievements: In SOLOLEARN all achievements are *performance-contingent*, meaning that there is no evaluation of the performance, but competence is required in order to solve exercises correctly. Users have to complete small exercises in order to gain experience points, that can then be used to level up and to buy hints. Solving exercises requires competence, but there is no difference in the amount of experience gained, based on the evaluation of the performance. Exercises have just two status: correct and incorrect. *Non-performance contingent achievements* are used in some cases in order to encourage the user to perform basic tasks: for instance, it is possible to obtain a badge just for verifying the email address or to complete a course.
- *Goal Orientation:* In SOLOLEARN it is possible to set daily learning goals. Different types of goals are available, depending on the amount of time users chose to spend studying, (from 5 min to 60 min per day). Even though the application's final objective is supposed to be the mastery of the subject, there is no sense of progression in the learning path toward it, since all achievements are performance-contingent and there is no evaluation of performance nor increasing exercises difficulty.
- *Predictability:* All achievements in SOLOLEARN are *expected*.
- *Flexibility:* The main achievements in SOLOLEARN are badges and experience points. Considering their characteristics, badges can be considered as *achievements as gifts*, while experience points can be considered as *currency*, since they can be spent to buy hints during exercises, even if the only choice available is whether to spend them or not.
- *Functionality:* In SOLOLEARN, badges can be considered as *cosmetic achievements*, since their role is just to show others (and oneself) the goals achieved in the application, set by the application itself. Experience points, as previously stated in Flexibility, can be considered as *functional achievements*, since they can be spent to buy hints. In spite of that, it has to be considered that there is just one way to spend experience points, therefore the level of strategy applied can be considered to be low.
- *Clustering criteria:* In SOLOLEARN experience points seem to be not incremental, since it is not possible to infer the amount of experience points gained for each exercise correctly done. On the other hand, badges, occasionally, require the user to perform the same task incrementally (*e.g.* at first 5 times, then 10 and so on). There are no *meta-achievements* in the application.
- *Competitiveness:* Experience points and badges can be achieved both performing individual exercises/tasks, at the end of every learning fragment, and competing with other players answering questions about the course topics.

4.1 Autonomy in SOLOLEARN

In SOLOLEARN, as in many different gamified applications or activities, the majority of achievements may reasonably be expected to be perceived as controlling, and therefore,

not fostering autonomy [18]. Furthermore, the only choice given to the user is the topic to be studied. Badges are predefined and are obtained through the same sequence of activities by all users; it is not possible, for instance, to decide how to achieve a specific goal: it can be achieved only in one way, and it is the same for everyone. Furthermore, it has to be considered that not everyone has interest in reaching the same objectives or goals. As investigated by Ryan *et al.*, in fact, there are not only different reasons behind the choice to pursue a specific goal [13], but also a different preference for them, according to the individual value assigned to the goal itself [13]. While previous motivation theories considered motivation and amotivation as the only two states possible, SDT states that the quality of motivation depends on the degree of autonomy or control that impact on the behavior[3] [13].

Usually, gamification reward structure, as it is also in SOLOLEARN, leverages above all on external and introjected extrinsic motivation, since the rewards are totally separated from the activity itself. These are the extrinsic motivations with the lower level of autonomy, and therefore the less effective in fostering autonomy.

4.2 Competence in SOLOLEARN

Competence is usually the basic need mostly taken into account in learning gamified apps, and this is also true for SOLOLEARN, it having as primary objective to support users in acquiring new knowledge. However, we argue that for the adopted gamification mechanics in SOLOLEARN this is not the case.

That is badges are used as feedback to acknowledge competence, in some way, but most of the time they are used just as milestones in a highly controlling manner. To have gained a badge for completing a learning unit, for instance, doesn't mean necessarily to have acquired knowledge (or competence): as discussed, no measurement achievement is adopted. Furthermore, the effort undertaken by users is not taken into account: do I deserve/would I like the same badge of a person that had less difficulty than me to learn something (or to accomplish a given task)? And vice versa. Considering the different perception of a task being boring or interesting (*cf.* [13, 17, 18]), the level of satisfaction perceived for receiving that same feedback, or reward, probably will be different and, consequently, the level of motivation in proceeding through the learning path can be expected to decrease.

[3] Autonomous behaviors are shown to have a highly positive impact on motivation [13], compared to controlled behaviors. What is indicated is that the amount of motivation derived from a person's being autonomous or controlled can be exactly the same, but what really changes is the quality of the motivation [13] and this difference has a significant impact at a functioning level [13]. Two persons can indeed perform the same task with the same engagement, but for different reasons: one motivated by interest, engagement and enjoyment, the other one because of the fear of punishment or to satisfy other people [18]. The result will maybe be the same but there is a substantial difference. Motivation can thus be intrinsic or extrinsic, according to the locus of causality [13]: while with intrinsic motivation, both in achieving the fixed goal or in performing a specific behavior, the reward is the enjoyment of performing the activity itself, extrinsic motivation foresees an external reward, that is separated and has no necessary correlation with the activity itself [5].

The other gamified element in SOLOLEARN that has an impact on competence need-satisfaction, is the chance to start a challenge, and to confront another player using a specific knowledge as "weapon" for the confrontation. This is a good way to test the acquired competence but can have a side effect in discouraging the losing user. Also, the consequences of the challenge should be interesting for the player, otherwise it risks becoming just a meaningless confrontation to obtain a badge.

What has been said about objectives and goals in regard to the autonomy basic psychological need, is true also for competence but with a lower impact on the effectiveness of external and introjected motivations [17].

4.3 Relatedness in SOLOLEARN

Only limited functionality is included in SOLOLEARN that may cater for the need of relatedness. In SOLOLEARN it's possible to interact with other people, in an asynchronous way, for instance by posting code projects and receiving comments from other users, by discussing with peers about micro-unit topics and by starting one-on-one challenges about a chosen topic. By accomplishing tasks referred to interaction with others, users can also obtain experience points and specific badges. While this for sure helps people to feel related with each other, on the other hand compel to interact also with people who do not typically display a strong need for relatedness, or that would like to relate to others in different ways, like cooperate for a common purpose for instance, rather than competing. This choice is not available.

5 Conclusions and Future Work

This paper presents an analysis of the general concept of motivation and how it is fostered in gamified solutions for learning, particularly in the context of self-determination theory. The analysis leveraged academic literature on the topics of motivation, player engagement, basic psychological needs, and the ability of video games to potentially satisfy these needs. Specifically, the paper contributes to the field of game-based learning by (1) proposing a correlation between gamification achievements and basic psychological needs, as derived from self-determination theory, (2) analyzing an already effective game-based learning platform (SOLOLEARN) for mechanics that do – and that do not – contribute to the basic psychological needs of individual users. While the findings are drawn from a case-study with the SOLOLEARN environment, they may reasonably be expected to apply to other game-based learning environment too.

Furthermore, it could be beneficial to highlight that, in order to design an effective reward system, it is recommended to distinguish boring tasks from interesting ones [13, 17, 18]. As stated by Deci, Koestner & Ryan [18], indeed, tangible achievements, in contrast with positive feedback, are effective when the task performed is considered boring by users [13, 18]. This can be considered a limitation, since gamified activities target an heterogeneous audience, especially in the case of learning activities, a task is not interesting or uninteresting to everyone in the same way.

For future work, we will investigate to what extent individual preferences for the satisfactions of distinct psychological needs can be modeled automatically from training interactions, and to what extent such a model can be used to automatically adapt gamification strategies to the individual user.

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