

Gamification: metacognitive scaffolding towards long term goals?

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Abstract. The ability to self regulate is a key skill in learning. This is especially relevant for open learning environments such as MOOCs. Metacognitive scaffolding refers to computer based support is used to teach and engage users in metacognition and self regulated learning. These techniques have been found very useful in supporting students in e-learning environments. Studies in game based learning suggests game playing engage players in metacognition as well as self regulated learning. We see great potential in applying Gamification as a form of metacognitive scaffolding to improve self regulation in learners. Gamification can also provide a framework to personalise self regulated learning support. In this paper, we present our ideas and guidelines for applying Gamification as metacognitive scaffolding. We will illustrate through examples of how they can be applied and discuss how these concepts can be the foundation for future work.

Keywords: metacognition, self regulated learning, gamification, personalisation

1 Introduction

Our research focus on how we can help people better achieve *Sisyphian* goals which demands consistent, repeated effort over long periods of time [13]. We introduce the concept of gamification as a form of metacognitive scaffolding to address these challenges.

Metacognition refers to the knowledge and control an individual has over their thinking and learning activities [3]. It represents a huge body of work grounded in psychology since the 1970s [7]. It includes what people know about their own abilities, what influences their performance and their knowledge of tools and strategies. Self regulated learning refers to setting learning goals, attempt to monitor, regulate and control their cognitive and metacognitive processes in the service of these goals [19]. It is learning guided by metacognition. Metacognitive scaffolding refers to providing scaffolding or computer based support to enhance metacognitive awareness and self regulated learning [1, 17]. Many studies have indicated that people who engage in metacognitive processes and exhibit higher metacognitive awareness, achieve higher performance over the long term than those that do not [16, 1].

Gamification can be described as ‘*use of game design and game thinking in a non game context*’ [6]. The idea is to apply game elements that have proven successful in engaging players and encouraging desired behaviour to applications where entertainment is not the main objective. Studies show game players exhibits a number of metacognitive and self regulated learning behaviours including planning and goals setting, self monitoring, evaluation and strategy use [8]. While we have seen many examples such as fitbit, endomondo¹, [10] using Gamification techniques, the focus and objective of these approaches are on engagement and motivation for a specific desired activity or behaviour (e.g., increased physical activity, regular exercise) rather than developing self regulation skills towards long term goals attainment. While studies found evidence of self regulation and metacognition in game players [14, 8], we have yet to find cases for the combination of solidly grounded theories associated with metacognition and self regulated learning with emerging uses of gamification.

The key distinction and motivation of our position is for learners to be successful, it is important for systems to also engage and develop user in self regulation and metacognition as a skill rather than focus on a particular short term task or activity. Over three decades of research in metacognition and self regulation have shown that such development will lead to better performance and goal attainment over the long term [1]. In this paper, we will present ideas and guidelines for applying gamification as metacognitive scaffolds as a different perspective or focus. We will illustrate our ideas through examples of such scaffolding towards long term goals. Finally, we will offer concepts and ideas for future research in this largely unexplored area.

2 Related Work

Metacognitive self monitoring involves evaluating ones knowledge of cognition including monitoring performance, knowledge and understanding. Self reflection refers to the process of comprehending and reasoning on the result of self monitoring. Planning include in goal setting, activating relevant background knowledge, selecting appropriate strategies, time management and resources allocation. Research suggests that experts in a particular task or domain are more self-regulated compared to novices largely due to effective planning that occurs prior to beginning a task [15]. Self evaluation and assessment refers to appraising the products and regulatory processes of one’s learning. This can include performing self tests and assessments.

Studies in games based learning or educational games has examined their effect on a player or learner metacognition and self regulation. A recent study designed to engage students in learning software programming asked students to program virtual characters using Java to compete within a game environment. This study found students actively engage in analysing each others strategies, review, discuss and reflect on game results and performance. They also engage

¹ endomondo.com

in self evaluation and perform drills and practices [8]. The results of an survey on players in StarCraft and online Chess, both online games played by millions, show a large percentage of players engage in metacognitive and self regulated learning processes such as self evaluation, monitoring performance, practising and studying other player's strategies [8]. This indicates a great potential to scaffold metacognitive processes using gamification.

Previous approaches in Gamification focus on motivation and engagement for a particular task. Commercial fitness service providers such as fitbit routinely use achievement badges and challenges as motivation and engagement. However, they have been limited in teaching or fostering self regulation. For example, many systems ask users to set goals but do not focus on improving the quality and user's goal setting skill. MOOC providers such as KhanAcademy² adopt Gamification techniques such as badges and points to motivate and engage users to participate in different courses and challenges. These techniques do not focused on teaching or engaging users in self regulated learning or invoking the metacognitive processes.

We propose to design Gamification applications with a view of enhancing metacognition and self regulation skills. Indeed there are gamification examples that can be considered limited metacognitive scaffolding. For example, Health-Month³ use the concept of short term (i.e., monthly) achievable goals as a platform for achieving behaviour change and goal attainment. They use Gamification techniques to engage users to set goals, monitor their progress and set new goals. This is a form of metacognitive scaffolding as it engage users to set goals as well as scaffolding them to monitor and self evaluate. Over time, this approach has the potential to improve a user's goal setting and planning ability.

It is important to note here that gamification is a developing field of study and is not without criticism [9]. A number of pitfalls has been highlighted including overuse of extrinsic rewards. The emerging view in the community is these challenges are symptoms of poor design and application which can be overcome [9]. It is then important that we present key guidelines in game design and applying gamification.

Gamification practitioners recommend to design with different player personalities in mind [18]. A common notion is there are four player types within games: explorers (discovery), achievers (winning), socialisers (interaction, social) and killers (dominating others) [2]. Game design should align intended outcome with the personality and profile of the target users. With respect to rewards and motivation, it is recommended to align rewards with three basic motivation or needs grounded in self-determination theory [5]: autonomy (choice, self control), competence (feel effective, challenged) and relatedness (interact and connect with others). It is necessary to take into consideration how gamification design impact these needs. A final concept to lay the foundation is the theory of "Flow" [4]. It posits that we can achieve optimum user engagement, as long as

² khanAcademy.org

³ healthmonth.com

the users are continually challenged by tasks that are not too difficult but still feel challenged.

The MDA (mechanics, dynamics and aesthetics) framework [11] is frequently used in game design [18] as a foundation for understanding games. MDA describes games and their behaviour from three perspective or "views" of the game. They are mechanics, dynamics and aesthetics. **Mechanics** are rules and game artefacts that users act on or manipulate such as scores, badges, leader-boards, rewards and levels. **Dynamic** refers to how the mechanics act on each other and can be thought of as behaviour or actions users engage in. Examples include sharing, collaborating, competing and cheating. **Aesthetics** refers to the resulting user experience from engaging with game mechanics and dynamics.

3 Gamified Metacognitive Scaffolding

In this paper, we will present our ideas for applying gamification as metacognitive scaffolds through a metacognitive "view" of the game mechanics (rules and artefacts) dynamics (interaction, behaviour) and aesthetics (user experience, feel) as described in the MDA framework. We will demonstrate the concepts through a hypothetical user 'Alice'. She is a young professional who commits to self development and learning in her profession through MOOCs and e-learning as well as maintaining long term health and fitness through regular physical activity and exercise.

Self monitoring and reflection. Rewards and reward schedules are powerful techniques that can engage users in self monitoring and reflection. For example, at variable intervals, the system send Alice questions (in the form of a quiz) and she is rewarded based on the *accuracy* of her knowledge in her own activities and performance. E.g., how regular does she participate in a MOOCs course, how well does she compare against her peers. This can encourage her to self monitor more closely, develop a habit and maintain this behaviour over time [18].

Planning and strategy. Game elements can be designed to engage users to practice planning, consider what resources they need and how to apply them, suggest strategies to follow and generally improve these skills. An example of this can be to use challenges and rewards specifically for planning and strategy use. E.g., achievement badges for setting goals and plans and completing within the plan. Rewards for sticking to her planning. Compare her planning with peers and providing feedback on her goal setting and planning abilities. There is opportunity here to personalise the techniques to use. For example, a system could make use of indicators of self efficacy or confidence when analysing Alice's planning. The objective is to scaffold her in the metacognitive processes of planning and goal setting rather than just doing as much as she can to complete a challenge.

We can also scaffold users to develop **Strategy** use. The guideline here is to design rewards that allow and / or highlight different paths to success. An

example mechanic can be to highlight alternative strategies e.g., by showing the strategies of other learners or top performers [8]. Reward Alice on trying new and different strategies. E.g., badges that shows the number of learning strategies she used. A key consideration is to avoid the perception where success is defined by innate or natural abilities and confront the users need for competence [5]. For example, if the challenge is for Alice to achieve the four minute mile, which is within the domain of elite athletes, she may develop the perception or belief that there is little chance of success [4]. Instead, provide challenges that is personalised such as relative improvement (e.g., percent increase) or achieving a personal monthly goal.

Self evaluation and assessment. While existing approaches such as fitbit and KhanAcademy offers mechanics such as achievement badges and levels, they are mainly intended to show progress and motivate further activity. When applying gamification as a metacognitive scaffolding for self evaluation and assessment, the objective is the encourage users to engage in these tasks. Examples can be to reward based on frequency of self assessment, apply self evaluation quizzes and use of comparisons.

Collaboration and Group dynamics. Gamification is a powerful tool for engaging users in social dynamics including exploration, collaboration and competition (e.g., foursquare, fitbit). Game dynamics that engage users in team or group related activities have been found very successful in engaging users thus promising to apply toward metacognition. Examples include team score, achievements. Mechanics can be designed to engage users to share and discuss strategies, reflect on their achievements as individuals and as a group, socialize for motivation and encouragement [12].

Game Aesthetics. A key challenge for helping users achieve their long term *Sisyphian* goals is the need to be motivated and be persistent over the long term. We suggest that metacognitive game mechanics and dynamics needs to achieve game aesthetics that convey feelings of autonomy and competence [6]. For example, the game dynamics that encourage Alice to regularly engage in strategy use, planning and monitoring, can foster the feeling of competence as she is made aware of tools and strategies. In addition, by increasing her metacognitive skills through scaffolding we help foster feelings of autonomy and self efficacy term [5].

4 Discussion

When designing a systems that implements these ideas and guidelines, we must also consider the dynamic and aesthetic outcomes of the game as a whole not just from a metacognitive perspective. For example, game mechanics of leaderboards, badges and points may invoke self monitoring and reflection. At the same time these mechanics have the potential to demotivate some type of players [2].

A challenge worth noting is while some behaviour such as goal setting are easier to detect others such as self monitoring, mood, engagement requires more sophisticated measurement techniques. Also, not all MOOCs are the same and differ in instructional design significantly. Future work is needed in this area to identify what gamification design and self regulated learning scaffolding techniques are appropriate for different designs.

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