THE ROLE OF ACTIVITY MOTIVATORS AND DEMOTIVATORS IN GAMIFYING LEARNING

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Abstract: While gamification is increasingly advocated as a solution to motivational problems, the understanding of how to practically design and implement gamification in learning contexts is still limited. To address this gap, in this paper we look at identifying potential motivators and demotivators of learning activities to be gamified which can be used to guide the selection of adequate gamification strategies. The driving goal is through gamification to strengthen the motivators and minimize the demotivators. We demonstrate the proposed approach in a case study.

Keywords: Motivation; Course gamification; Self-determination.

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Introduction

While motivation and engagement are considered as predictors for learners' performance [1], finding the right way to motivate students remains a challenge. Among the various approaches that have been proposed to improve students motivation [2, 3], one that has been increasingly leveraged is gamification [4]. The underlying idea of this approach is to motivate individuals by means which have been proven to be effective in game environments. These include game design techniques and principles, such as challenges, rewards, competition, progression and feedback. Although the interest in applying gamification in education is growing, given its potential to enhance and sustain students' motivation [5], little attention has been paid on how to practically gamify learning. A recent review of gamification research in education reveals a rapidly

growing body of literature, but a scarcity of research on emerging principles and practical methods for gamifying learning [5]. Most gamification-related studies neither report the guiding framework underlying the particular gamification design and what motivational factors have been targeted nor the specifics, such as by what criteria or for what particular purpose gamification features have been selected. This inadequacy has led to a slow progress in the understanding of how to practically design and implement gamified learning activities.

To address this gap, the present paper proposes to look at the motivators and demotivators associated with the learning activities to be gamified. The proposal results from the insight that the game mechanics and dynamics driving a gamified activity should come from the motivational factors characterizing the activity. The decision to gamify a particular learning activity is typically triggered by the desire to engage students in that activity, which implies enhancing their motivation for performing it. This, in turn, suggests identifying motivational and demotivational factors related to the activity, as perceived by the learners, with the goal to strengthen the identified motivators and to ease the demotivators. This goal should govern the gamification design of a targeted activity.

Gamifying Learning Activities

A common approach in gamifying learning is to focus on selecting and incorporating some game elements (typically points, badges and leaderboards) in a learning activity that targets some learning outcomes. This approach follows the pattern observed in some other fields, such as marketing, healthcare or fitness. However, motivating students to complete learning activities is more challenging than motivating customers to submit reviews, patients to take their medications on time, or adults to perform their exercises regularly. In those cases, motivators and demotivators associated with the performed activities are more amenable to influence by external factors. Learning, in contrast, is a complex, proactive, and typically, lengthy process that requires stronger inner motivation and purposeful effort. As a result, it can give rise to a variety of demotivators. In addition, some learners can engage in an activity driven by intrinsic motivation, while others can only be extrinsically motivated to perform

it. Yet, the perceived motivators and demotivators may vary significantly across different learning activities. Graded learning activities generally carry extrinsic motivation, which is lacking for some optional learning activities. Thus choosing game elements for a learning activity based on analogy with other fields may not yield the expected results. For instance, rewarding through badges is a successful strategy in Q&A sites, such as Stack Overflow. However, the Stack Overflow gamification success may not be seamlessly transferable to an educational context. The effort required for answering a question is not as high as for completing coursework throughout the semester, while the rewards for Q&A contributions are visible across the web [6].

For learners, motivation to learn stems from different sources, one of which is the performed learning activity. The motivational factors are also affected by the influences of the particular learning context. When deciding how to gamify an activity, the most significant factors include the perceived effort to be invested in it, the motivators and demotivators associated with it, and the effort needed to sustain the motivation. To account for these factors in the gamification design, we have to put the emphasis on the activity to be gamified. This reflects the understanding that, as learning activities and motivation are interrelated [2], this relationship can provide a strategy for a meaningful gamification design. A distinctive feature of the proposed approach is the attention to the potential motivators and demotivators, associated with the gamified activity. It acknowledges the fact that in addition to the positive influences that can promote or affect learner's motivation, there are many demotivational factors that have a negative impact on it [7]. Although a common phenomenon, demotivation has received inadequate attention in the field of gamification research.

According to the proposed activity-centered approach, for each game design element, the designer shall ask: "How will this strengthen the motivators or deter the demotivators for engaging in this activity?" This implies, in the first place, identifying the potential motivators and demotivators associated with the activity. Each of these may result from the learning activity itself, from the expected outcomes of the activity, or from the context in which the activity takes place. Once the motivators and demotivators are determined, the next step is to

define motivational strategies that can strengthen the motivators and weaken the demotivators. These conceptual strategies are intended to serve as guidelines for the gamification implementation. The strategies should guide the selection of game elements and rules that specify their behavior.

The proposed activity-centered gamification approach is based on the accumulated experience of gamifying a Data Structures (DS) course over a span of three semesters. In the next section we discuss the approach in the context of gamifying the Data Structures course.

Applying Activity-Centered Design to Course Gamification

The Data Structures course was gamified by using the course gamification platform OneUp [8]. OneUp provides support for instructors to create automatically checked static and dynamic practicing problems and to incorporate established game design principles and mechanics in their instructional methods. In addition, it supports learning analytics and visualization to inform students and instructors of student performance and progress. The primary goal of gamifying the course was to motivate learners to develop their knowledge by practicing with OneUp practice quizzes (called warm-up challenges). Thus the activity in the center of our discussion is *practicing*.

Motivators and Demotivators

Practice is critical for mastery in STEM subjects, however, since it doesn't count towards the final course grade, many students don't do it. Thus, one of our goals in gamifying the Data Structures course was to ameliorate this by employing gamification. While the focus was on practicing, an additional goal was to improve students' motivation and engagement in the entire course. In this context, we consider a course as a formal education unit composed of learning activities, such as attending lectures, completing assignments, participating in class discussions, practicing, taking exams, etc. According to the proposed approach, we first identified the motivators and demotivators associated with the *practicing* activity. We did this based on our long

instructional experience. From the viewpoint of practicing, students are driven in general by different subsets of motivators and demotivators. Some are intrinsically motivated by the activity, while some are extrinsically motivated, some are highly motivated while some are less motivated, with varying degrees in between. Also, different sources of demotivation can take away part of the motivation. When total demotivation experienced by a learner outweighs their total motivation, the learner will pass into an amotivational state [9]. Table 1 presents the identified motivators and demotivators. In line with relevant motivational theories [9,10], we marked the motivators as intrinsic (i) and extrinsic (e).

The frequently observed low level use of practicing tools stems from the fact that as an optional learning activity, practicing is a source of significant amount of demotivators. In particular, for many students, even for some highly motivated ones, it is difficult to maintain their motivation if practicing is perceived of low importance for the course grade. This fact was evident from using the non-gamified version of OneUp in the Data Structures course during the fall of 2017 [11], where the amount of practicing with the offered warm-up challenges was very low and after the first third of the semester there were no practicing attempts. The analysis of the identified motivators and demotivators suggests that maintaining motivation for both students showing initial intrinsic enthusiasm in practicing and those driven by extrinsic motivators, requires use of purposeful strategies. Students, who are curious and interested in practicing and prefer challenges, are likely to be intrinsically motivated. Still, for many of them, their motivation starts to fade away as coursework begins to pile up. We observed also that motivation starts to fade with time, in particular, when students practice irregularly.

Students who are demotivated by a lack of general interest in practicing are difficult if not impossible to engage in such using additional external motivators. However, demotivation caused by factors derived from the practicing activity itself could be mitigated by choosing a relevant strategy and by restructuring the practicing activity to incorporate meaningful game elements. While the sources of some motivators stem from the practicing activity itself, the sources of others stem from the expected results of practicing, for example, improved test

performance or earning high course grades, which are related to the course. A holistic approach suggests considering the motivators and demotivators for practicing in the context of the entire course.

Student Survey

The activity-centered gamification design is likely to bring about a significant motivational effect if each of the identified motivators and demotivators is perceived as actual one by (a certain group of) learners. In order to collect empirical data for estimating which of the identified motivators and demotivators are confirmed by learners and to what extent, we conducted a survey in the gamified Data Structures class and a gamified Database Management class in the fall of 2018. The survey included questions addressing the perceived motivators and demotivators associated with practicing (see Table 1).

Table 1. Identified motivators and demotivators for practice

Motivators	M1: Improve practical skills in some course topics (i)
	M2: Feeling of being challenged (i)
	M3: Feeling of achievement (i)
	M4: Checking understanding (i)
	M5: Feeling of curiosity (i)
	M6: Receiving feedback (i)
	M7: Feeling of game-like experience (i)
	M8: Pass exams (e)
	M9: Improving test performance (e)
	M10: Boosting course grades (e)
	M11: Passing the class (e)
	M12: Liking competition
	M13: Getting awards (e)
	M14: Collecting awards (e)
	M15: Demonstrating my abilities to others (e)
	M16: Showing engagement to the instructor (e)

Demotivators	D1: Practice perceived of low importance for course grade
	D2: Practice perceived unimportant for course performance
	D3: Lack of necessary skills
	D4: Lack of help
	D5: Lack of confidence
	D6: Trying without success
	D7: Challenges perceived as difficult
	D8: Challenges perceived as boring
	D9: Conflict with more preferred activities
	D10: Lack of time
	D11: Insufficient incentives
	D12: Lack of interest in trying new things
	D13: Unintuitive interface
	D14: Lack of interest in practicing
	D15: Uncontrolled procrastination
	D16: Laziness

22 students responded to the questionnaire. The responses (see Fig. 1 and Fig. 2) illustrate that all of the identified motivators are perceived as actual motivators by a varying proportion of students, from 74% (M1, M3) to 17 % (M13, M14). Similarly, the identified demotivators are perceived as actual demotivators by a varying proportion of students, from 48% (D10) to 5 % (D2, D12, D13). There are no suggested motivators or demotivators that the students didn't recognized as such. Thus, the study confirms and validates the motivational factors for the practicing activity drawn from our experience and highlights the role of the activity-engendered motivators and demotivators from learners' point of view. Note that the demotivators D15 and D16 were not included in the questionnaire, since we felt that the respondents' answers of those questions will not be of reliable accuracy.
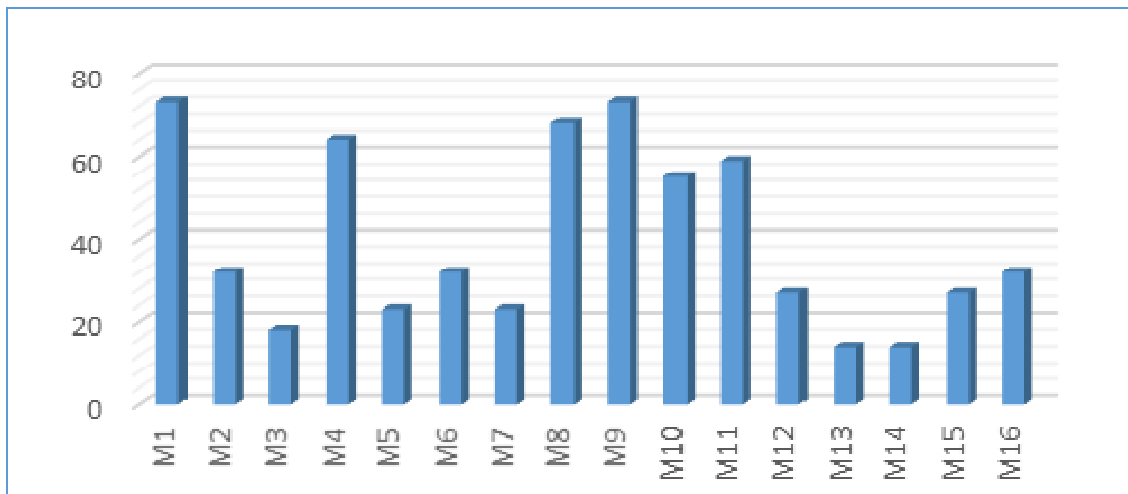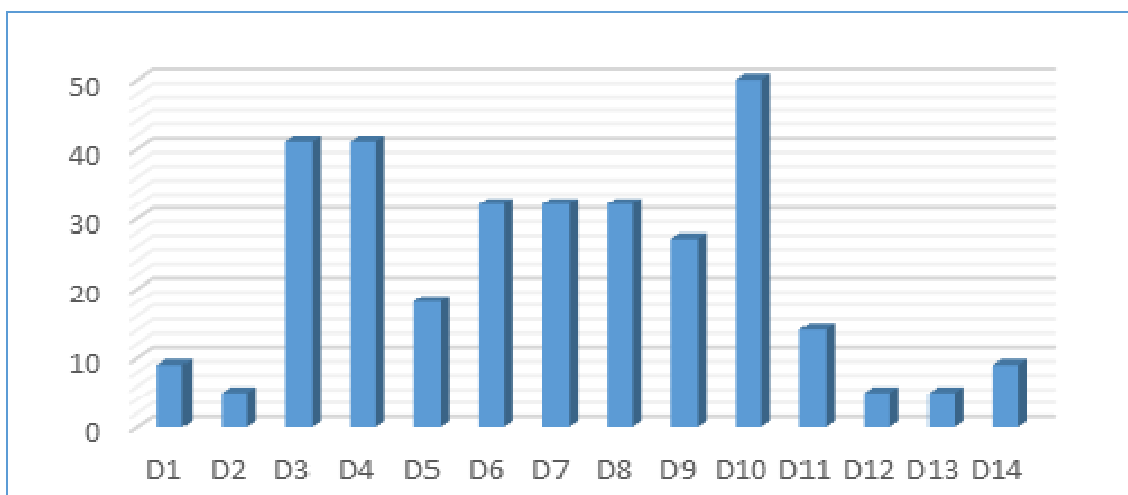
Figure 1. Responses to the practicing motivation questions

Figure 2. Responses to the practicing demotivation questions

Deriving Conceptual Strategies

The second stage of the proposed approach aims at defining conceptual strategies for strengthening the determined motivating factors and weakening the demotivating ones, in combination with providing additional sources of motivation based on gamification. The supporting insight (confirmed by the survey) is that most students are driven by similar motivators and impacted by similar demotivators. Therefore, gamifying a learning activity with both

motivational and demotivational factors in mind could increase the likelihood of a positive reception of gamification.

Our observations and experience in teaching the Data Structures course shows that the majority of students come motivated to the class. While part of them are driven by intrinsic motivation in completing class activities, most of them are driven by grades, as confirmed by a previous focus group study [12]. In both cases, maintaining the motivation requires additional motivational sources. Therefore, the intention with the strategies presented below was to keep the individual motivators alive at a sustainable level. In addition to the targeted practicing, we have generalized some of the conceptual strategies to be applicable to the entire course as well. As the course is the context of the practice activity, certain practice motivators are related to the course.

- Provide a pool of interesting problems of various difficulty.
- Provide immediate, meaningful feedback in varying ways.
- Provide visual cues relating course performance to the amount of meaningful practicing.
- Use curiosity to take students on board and use additional motivational factors to keep them practicing.
- Provide (visual) indicators for skill improvement resulted from practicing.
- Rationally reward various aspects and levels of practicing and course engagement driven by different motivators.
- Recognize different categories of achievements based on practicing.
- Provide support for tracking and predicting various aspects of course learning progress.

Generally, in each course a part of the students will stay motivated throughout the course. But for many students, their initial motivation will be gradually driven away by various demotivators. This confirms again the significance of addressing not only motivators but also demotivators for achieving positive motivational outcomes. The following motivational strategies are intended to curb some of the demotivators:

- Provide encouraging rewards to the practicing newcomers.

- Reward the initial successful practicing attempts.

- Provide rewards for student streaks of meaningful practicing.

- Reward the regularity of practicing.

- Employ gamification strategies elevating the perceived role of practicing within the course.

- Make the practicing activity more gameful.

The defined conceptual strategies were used for selecting appropriate game design elements and their desired behavior for gamifying the next offering of the Data Structures course. The game elements used in the course included: points (XP, challenge and skill points), badges, virtual currency, leaderboard, progress bar, streaks and challenge duels. The instructor of the course defined more than 80 gamification rules containing conditions under which various badges to be awarded, as well as under which students can earn virtual currency and spend it in the Course Shop for course-related benefits, such as a deadline extension or an assignment resubmission.

Conclusion

The focus of this paper is on describing an activity-centered design approach, which emerged from our work on technical and methodological support for gamifying learning that involved empirical studies over several years. Some early results of the studies evaluating the impact of gamifying learning in terms of performance, behavioral and motivational metrics are published in [11, 12]. They also serve as the basis and an initial confirmation of the adequacy of the activity-centered gamification approach described here. The main result shows that after the gamification intervention, designed by utilizing the described strategies, student practicing has intensified significantly (one-side t test: $t = -3.1574$, p-value = 0.008895) [11].

While gamification is increasingly advocated as a solution to motivational problems, the understanding of how to practically design and implement

successfully gamification in learning contexts is still in its infancy. Available sources providing guidance on how to gamify learning are scarce and fragmented. This paper attempts to bridge this gap by proposing to consider potential activity motivators and demotivators, which can inform the selection of adequate gamification strategies. These strategies shall govern the selection of game elements to be used in gamifying the targeted activity and the choice of game rules for applying them. The driving goal is to strengthen the activity motivators and minimize the demotivators. The approach is demonstrated by a case study supported by practical experience and empirical data aimed at identifying the motivators and demotivators. A distinctive feature of the proposed approach is that the entire gamification process is governed by motivational factors meaningful to the targeted learners.

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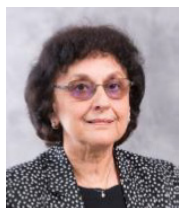
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