LudiMoodle: Adaptive Gamification to Improve Learner Motivation

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by Élise Lavoué (Université Jean Moulin Lyon 3)

The LudiMoodle project aims to adapt game elements integrated into the Moodle learning environment to help motivate learners.

The gamification field has been growing over the last decade. Most studies that have investigated the use of gamification in education have highlighted its benefits in terms of learner performance and motivation. However, these studies have generally focused on short-term effects, and do not differentiate between the impact of each game element according to the context or the learner profile. More recent studies, considering the impact of each game element separately, have shown that their impact depends on the learner profile [1] (e.g., motivation, player type, personality traits), with some game mechanisms being detrimental to specific learners [2]. For instance, in a previous study, we showed that amongst the most engaged learners (i.e., learners who use the environment the longest), those with adapted game elements spend significantly more time in the learning environment [3].

In this context, the LudiMoodle [L1] project aims to acquire new insights into the impacts of specific game elements, including: timer; leaderboard; progress; avatar; badges and scores, on learner motivation when using a digital learning environment (Figure 1). The project will provide (i) researchers with a model for the adaptation of game elements to the learner profile; (ii) instructional designers with a generic plugin to gamify resources offered in the Moodle learning environment; and (iii) teachers with recommendations to gamify their courses in a way that motivates learners with different profiles and motivation.

The project is led by the University of Lyon [L2]. It involves the education authority (Rectorat) of Lyon [L3], researchers both in computer sciences (LIRIS lab [L4]) and educational sciences (ECP lab [L5]), instructional designers from the University Lyon 3 [L6] for the design of digital learning resources in close collaboration with teachers, as well as the Edunao [L7] company dedicated to the development of the game elements. Ground experiments are conducted in middle schools of the Lyon Educational District. Teachers are involved in the design of game elements during participatory design sessions to create meaningful and motivating game elements.

The four-year project began in January 2017. We ran a first experiment in March-April 2019 over ten course sessions that involved 258 fourth grade pupils in four middle-schools, in a mathematics course. Learners used individual tablets that displayed exercises and they were guided in the digital environment. The six game elements were randomly assigned to learners, one game element per learner, to answer two research questions: (i) How does gamification influence learner motivation? And (ii) Which factors influence the impact of game elements on learner motivation? We used questionnaires to assess the initial level of motivation of the learners before the course and the level of motivation at the end of the course. We also asked learners to fulfill the Hexad [L8] questionnaire to identify their player type. Finally, we collected all interaction traces with the learning environment to identify their performance (correct and incorrect answers) and engaged behaviours (e.g., number of exercises, time spent on an exercise, time spent to answer a question).

The first results show that learners' intrinsic and extrinsic motivation decreased during the experiment. These results are not surprising since game elements were randomly distributed amongst learners and may not fit their motivation for the course and preferences for game mechanisms. We also observed an increase in learner motivation in the students that were least motivated initially. A deeper analysis showed that two factors influenced the impact of game elements on learner motivation and performance: (i) the initial level of motivation at the beginning of the course and (ii) the player profile, achiever and player dimensions being the most important. An analysis per game element also showed that (i) each game element influences different dimensions of motivation (either intrinsic, extrinsic or amotivation); and (ii) the impact of each game element depends on a different combination of factors including the initial motivation and certain dimensions of the player profile.

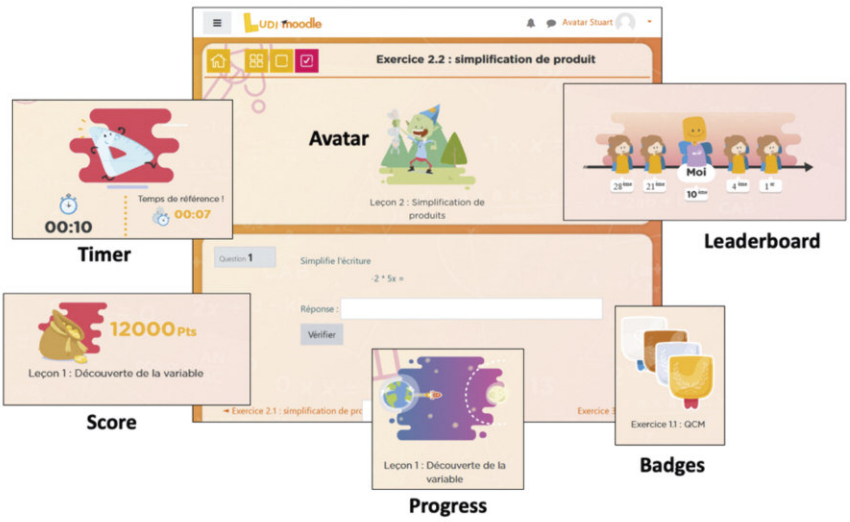

Figure 1: Game elements developed within the LudiMoodle project for the Moodle learning platform.

A second experiment is planned for March-April 2020 to identify the impact of adaptive gamification on learner motivation. An adaptation engine will be integrated into the digital learning environment. Static adaptation rules will be defined according to the factors identified in the first experiment, to propose game elements adapted to each learner's profile at the beginning of the course. We will also define a dynamic adaptation process to suggest game elements according to engaged or disengaged behaviours observed during the course via learners' interaction traces with the learning environment. At the end of the course, we will compare the impact of adapted game elements on learner motivation compared to game elements attributed randomly. We will also compare the impact of adapted game elements depending on the type of adaptation (static vs. dynamic). We believe these studies will provide new insights into the impact of adaptive gamification on learner motivation, and recommendations for designers and teachers to adapt game elements to learners.

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Links:
[L1] https://ludimoodle.universite-lyon.fr
[L2] https://kwz.me/hKy
[L3] http://www.ac-lyon.fr/
[L4] https://liris.cnrs.fr/en/team/sical
[L5] https://kwz.me/hKH
[L6] https://kwz.me/hKE
[L7] https://www.edunao.com/en/home/
[L8] https://www.gamified.uk/user-types/

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[2] S. Hallifax, et al.: "Adaptive gamification in education: A literature review of current trends and developments", EC-TEL 2019, Springer, pp. 294–307.
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Can Tangible Robots Support Children in Learning Handwriting?

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A large body of research suggests that robots could indeed be useful for supporting children in learning handwriting. However, few studies have investigated the role and use of tangible robots in teaching handwriting to children with attention and/or visuo-motor coordination difficulties. Over the course of multiple iterations, globally involving 17 typically developed children and 12 children with attention and visio-motor coordination issues within one school and two different therapy centres, we have designed a robotic activity to teach the grapheme (shape) and the ductus (the way to draw) of cursive letters.

Research shows that having richer sensory information enhances visual perception and visual-motor coordination [1]. To let children experience a range of sensory information during letter learning, teachers use techniques such as drawing letters in sand-filled boxes or touching the letters carved in a piece of wood. The same principle is adopted by therapy centres for the development of language skills, such as the "draw on your back" game. During the game, a child and a therapist take turns in drawing a letter on the other's back with their finger and guessing what is drawn.

Similarly, robots can be used as tangible tools enhancing sensory information, as we demonstrated in a previous study that used the Cellulo robots to help preschoolers learn the grapheme and the ductus of letters [1]. Cellulo is a palm-sized, haptic-enabled robot developed at EPFL [L1] [2] that can move and be moved on "maps", i.e., printed sheets of paper covered with a dotted-pattern that enables accurate localisation (Figure 1 shows children interacting with their robots on letter maps). Cellulo robots are versatile, easy to set up and well-suited for classroom activities. They are controlled by an application running on a computer or a tablet and feature various interaction modalities; many such robots can also be simultaneously used as a "swarm" in an activity [3].

Our goal, inspired by interactions with teachers and therapists, was to design a modular, highly engaging, highly adaptable robot-assisted activity to help children with attention and/or visuo-motor coordination issues in learning the grapheme and ductus of cursive letters.

Through several iterations within a school and a number of therapy centres, we designed an activity composed of three sub-activities targeting different aspects of letter handwriting learning. The setup envisions multiple kids sitting at a table, each with a Cellulo and a map displaying the grapheme of the letter, as shown in Figure 1. The sub-activities are:

1. "Watch the Robot": Cellulo autonomously moves along the letter's grapheme on the map, following the ductus. The child only watches the robot and the letter's phoneme is played at the beginning and end of the robot's writing, to strengthen the link with the corresponding grapheme and ductus.
2. "Feel the Robot": We ask the child to put their hand on Cellulo while it moves along the letter's grapheme to passively feel the motion of the robot. Experiments with children with visio-motor coordination difficulties highlighted the importance of this activity: the child has to adjust the