Student Motivation and Engagement in STEM Courses: Exploring the Potential Impact of Gamification

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ABSTRACT

Gamification in education still lacks systematic studies assessing its impact on learning. This poster will present the design of our empirical studies on the effect of various combination of game elements on student motivation and engagement in CS courses.

CCS CONCEPTS

• **Applied computing** → *Learning management systems*.

KEYWORDS

Computing Education, Gamification, Student Engagement

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1 EXTENDED ABSTRACT

Although we are witnessing an increasing use of gamification in educational contexts, there is insufficient clarity on whether and how gamified learning increases student motivation and engagement. The majority of empirical studies on educational gamification have found more positive than negative effects on motivation, but its effectiveness for learning remains inconclusive due to limitations of the study design and analysis strategies [1].

The need of a more systematic study to validate existing evidence and provide guidance for further exploration motivated our research on understanding if and how gamification can deliver its promise in the context of STEM learning, and specifically, for computer science learning. This poster will describe our approach, which includes a set of empirical studies targeting the effects of

individual game elements and combinations thereof on student motivation and engagement in the context of two Computer Science courses (Data Structures and Data Science).

The studies are based on the use of OneUp, a course gamification platform previously developed by the authors. OneUp supports game elements including avatars, XPs, progress bars, badges, leaderboards, virtual currency, unlocking content, and learning dashboards. Being highly configurable, it enables previously impossible research on the efficacy of not only individual game elements but also various combinations of elements on student engagement and motivation.

An important feature of our research design is that it is guided by Self Determination Theory [2], a well-validated psychological theory for understanding motivation and behavior change. This enables better understanding of the reasons for the success or failure of different gamification interventions in certain contexts.

The OneUp platform has been developed and applied in computer science classes over the past three years. Data collected has shown promise for increased interest and engagement of students using OneUp. An example from a Spring 2018 Data Structures course showed students responding very positively to a set of statements including "I felt more effective in learning using OneUp" and "Using OneUp helped me prepare for tests."

The poster will present, in addition to the approach used, specific results obtained to date. The strength of the OneUp platform is its configurability. Thus, the same platform can be used for many topics in a course and for topics in a variety of courses. An important factor in the use of OneUp is the development of a large set of challenges (questions or problems). Materials for use in the Data Structures course have been developed, and materials for Discrete Structures and for Data Science are in development. The poster will also describe our plans for collecting large sets of questions for use in these courses and for preparing computer science faculty to build suitable sets for other courses.

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