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Original Paper

User Engagement in Gamified Online Learning System

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Abstract

The study in this research has demonstrated the effectiveness of gamification in changing user behavior and improving user engagement from a psychological perspective. To achieve that, gamification features are integrated in an Online Learning (OL) system. The study is based on self-determination theory, which states that people are motivated to grow and change when three innate psychological needs: competence, autonomy, and relevance are satisfied. Gamification features that can positively support psychological needs are identified through various literature studies and implemented in OL systems. Hence this research is based on a design-based approach in which a tool is developed to observe different behaviors and activities of the students and measure the user engagement directly from the user interactions in an OL system. The results suggest that two psychological needs: competence and relatedness are the main determinants of engagement. The findings suggest that students showed significant user engagement in a gamified OL system. Instructors, students, and researchers (working in the area for improving OL systems) are highly benefited by this research.

Keywords

gamification, self-determination theory, user-engagement, design-based research

1. Introduction

The usage of ICT (Information Communication and Technology) in education is gradually transforming the traditional classroom teaching environment into an Online Teaching (OL) environment. However, this alteration led to a lack of user interaction and collaboration among OL users. The biggest problem in OL is the lack of attention to the motivating factors involved in the learning process (Cocea & Weibelzahl, 2010). It is not overstated that disengagement and inadequate interaction between OL has led to higher dropout rates and lower retention rates. Hence, to successfully

generate effective learning outcomes, learning must be fun and engaging and students must be self-motivated to learn. Games and game elements can motivate people and increase their involvement in the learning system. Inspired by the game, one of the successful interventions to the current OL approaches is using gamification and use of game-like elements (Klock et al., 2015). The effectiveness of gamification in changing user behavior and improving user engagement can be explained from a psychological perspective. One of the learning theories used for this purpose is *Self-Determination Theory (SDT)* (Ryan & Deci, 2000), which summarizes three basic internal psychological needs: *competence, autonomy, and relatedness*. This demonstrates that satisfaction of these three needs can foster intrinsic motivation, and consequently influence people's behavior as well as improve user engagement. Dixson (2010) suggests that it is not the activity, but the level of interaction provided in online courses that affects student engagement. So, all activities need to be interactive in nature. Hence the study in this research implements several game-based elements in an instructional design to encourage and self-motivate students to use OL system. The visualization tool is developed to identify the user engagement in the system.

Previous studies show that researchers have focused mainly on SDT, flow theory, and goal-setting theory. Huang and Hew (2018) developed a theory-driven gamification design model, i.e., Goal, Access, Feedback, Challenge, and Collaboration (GAFCC). The theoretical bases of GAFCC model are goal setting theory (Locke & Latham, 2002), self-determination theory (Ryan & Deci, 2000), flow theory (Csikszentmihalyi, 1978), behavioral reinforcement theory (Skinner, 1953) and social comparison theory (Festinger, 1954). SDT is the most referenced theory in gamification studies (Ryan & Deci, 2000). This is a theory of human motivation and personality that focuses on people's inherent growth tendencies and innate psychological needs. Innate psychological needs are the basis for self-motivation. According to SDT, to foster well-being and health, three basic needs must be satisfied: *autonomy*, *competence,* and *relatedness. Autonomy* literally means “self-rule” (La Guardia & Patrick, 2008) and being volitional and acting in such a way as to represent one’s integrated sense of self. *Competence* refers to the tendency to experience challenge and mastery in one’s activity. *Relatedness*, or the “need to belong,” refers to the tendency to be oriented toward forming strong and stable interpersonal bonds (La Guardia & Patrick, 2008). For example, while playing a game, mastering level and overcoming optimal level challenges adjusted to the player makes the player feel *competence*. Being able to choose a different path, or to create a different adjustment in the game or voluntarily quitting the game makes the player feel *autonomous*. The social environments within the game or around the game caters to the players' *relatedness*. Players' interaction with other people, cooperation and competition creates the *relatedness*. Thus, these insights have often been applied to gamification by selecting and using game design elements that can lead users to feel the same kind of motivation when interacting with any system. *Intrinsic motivation* is defined as “*the doing of an activity for its inherent satisfactions rather than for some separable consequence*” (Ryan & Deci, 2000). This means that when someone is intrinsically motivated to engage in an activity, it is simply because of the fun, interest, and

enjoyment from the activity itself, and not because of any external rewards or punishments. Various findings on SDT have led to the postulate of three innate psychological needs: *competence, autonomy, and relatedness*, which when satisfied yield enhanced intrinsic motivation (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013; Zhang et al., 2011). Nevertheless, if this need is not satisfied, motivation will be diminished. However, intrinsic motivation also has some drawbacks. Not everyone is intrinsically motivated in the same way in all activities. If someone is motivated in a particular task, that person may not be motivated in another task, and another person may not be motivated in that previous task in which others are motivated. Similarly, sometimes intrinsic motivation arises within an individual, and sometimes it exists in the relation between individuals and activities. Like in many other domains such as health, well-being, sports and education, research have shown that games can also satisfy the innate physiological needs of human beings (Deci & Ryan, 2012; Ryan et al., 2006). Various studies show that by providing the choice for different customizable avatar selection, gifting and donation of virtual goods, team engagement, and different choices, people can have an experience of autonomy; feelings of competence can be supported by dynamic difficulty mechanism, heroic meter that show challenges level and badges; social games, social interaction foster feeling of relatedness. Games can be considered as a good example to interpret SDT, shown in Table 1 (Brod et al., 2013). Gamification can be used to raise both extrinsic and intrinsic motivation to users through various game design elements. Need satisfaction of *autonomy, competence and relatedness* are proved to be mediators to improve intrinsic motivation and engagement outcomes.

Table 1. Game Elements by Self-Determination Theory

Autonomy	Competence	Relatedness
profiles, avatars, configurable interface, alternative activities, privacy control, notification control	positive feedback, optimal challenge, intuitive controls, progressive information, points, badges, leaderboards	teams, community, messages, chat, connection to social networks, cooperation

2. Methods

The following research methods are applied in this research:

2.1 Design Based Research (DBR)

This is a research design method that is used for intertwining different theories in a learning environment. Anderson and Shattuck (2012) suggested the definition of DBR, presenting the following merits of DBR that support scientific research. DBR is applied in a real educational context, as it provides a sense of the validity of the research and uses the results to effectively assess, inform and improve practice in the same contexts or other possible contexts. It begins with the study of relevant

literature, study of theory, and the application of practice from a different perspective to assess the true situation of the current context. Following the study of previous literature and theory, a method or process is designed to overcome some problems or to create an improvement to existing settings. Examples of some interventions may include a specific type of learning activity, a type of assessment, or technical intervention in a current learning process. In keeping with DBR, firstly the various game design elements that are suitable to integrate in the OL system are identified. Then those gamification elements are integrated in one of the courses in the OL system. In this study, moodle is used as an OL system. This innovation was grounded in the literature on SDT and gamification.

2.2 Selection of Gamification Technique

Game mechanics like points, badges, leaderboards, virtual gifts, feedback, levels, content unlocking, and avatar are selected in this study. Some game elements are provided in the moodle system by default and for some game elements, different plugins are identified and installed in the system.

2.3 Gamifying Moodle Platform

The challenge of gamifying moodle is in applying the right elements in a most effective way. The elements should increase user motivation and should not harm learning experience. The most mentioned gamification elements are points, badge, and leaderboard and some other elements like progression bar, avatars, time limit and unlockable contents have also been proposed in some studies. Points, badge, and leaderboard system is a reward-based gamification, which is only a part of gamification, and a whole gamification experience can only be achieved with the integration of other gamification elements like avatars and feedback. The following are elements used to gamify the moodle system in this study:

- *Points*: It is used to reward user activities such as logging in websites, watching lectures, doing exercise, completing assignments, asking, or responding to a question in a course forum etc.
- *Badges***:** It has been assigned to users when they reach some milestones such as completing the whole course, answering quizzes correctly, taking lessons, voting responses in forum, or being ranked among top ten students of a lesson or entire course, view some lecture videos, watching some case study etc.
- *Leader boards:* It is used to display ranking of students i.e., when students are active through different activities, they gain a point, and they are ranked in a leaderboard with their peers.
- *Progress Bars:* It is used to display and monitor the users' personal progress throughout the course. Through progress bars, users can view their current progress at any time, and know the number of efforts needed to complete the course. The progress bar is shown in different forms in the system such as: when the user is reading through lesson activity, when they are gaining points and when they are going through quizzes.
- *Levels:* It is displayed on the user's profile just like a badge. It is also displayed on the leaderboards. A badge is provided when the user reaches a certain level.

- *Unlockable Content:* It is provided as additional features as well as additional learning materials or bonus exercises. A bonus material will be provided to a user when the user reaches certain grades in the quiz. If they get less number in a quiz, another bonus lesson is provided as an additional supplement. Furthermore, for example to watch avideo, the user must complete another activity and then only that video will be activated.
- *Avatars:* In the moodle environment, by adding a selection of avatars (where users choose from a list of badges or upload pictures by themselves), a sense of ownership and deeper attachment to the moodle platform will be created, and consequently users will not abandon course readily. Whenever a user completes a quiz during learning, they are asked to change their profile image as avatar with the badges.
- *Time Limit:* Once a user starts a quiz, it cannot be paused and should be completed within a certain amount of time. When time is up, the quiz will no longer be accessed again. Users are allowed to attempt a quiz only three times a day. After three attempts, the user must wait for at least 24 hours to attempt again. While attempting the quiz, even if the user scores a few marks, they are given some points for trying.
- *Feedback:* It is provided through points, badges, and leaderboards, and after each activity is completed, feedback is provided as a status of the activity.

3. Results

The following are the results obtained from this study.

Table 2. Correlation Between Engagement Variables

	Score on the Assessment	Level Reached	Badges Acquired	Leaderboard View
Score on the Assessment	1	.784**	.782**	.437**
Level Reached	.784**	1	.695**	.498**
Badges Acquired	.782**	.695**	1	.350**
Leaderboard Viewed	.437**	.498**	.350**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2 illustrates those three variables (*level reached, badges acquired,* and *leader board viewed*) are significantly correlated with the dependent variable i.e., *score on the assessment*. Therefore, we define engagement through four variables (*level reached, badges acquired*, *leader board* and *score on the assessment*). Based on those significant relations, engagement can be defined as follows:

Engagement (E) $= \{1, when, (score)\ OR\ (gamification) \rightarrow high 0, otherwise \rightarrow low$

Engagemen t(E) represents the student's engagement level (high or low), value of engagement(E) ranges from {1,0}. Additionally, score denotes students who achieved scores on the assessment (*score on the assessment* ≥ 3, which were evaluated out of 5), gamification denotes students who have reached certain level (*level greater than 5, which is out of 10*), badges acquired denotes students who have acquired 50% of badges and number of times student viewed leaderboards during the course (*total number of leader boards viewed* ≥ average number of leader boards viewed by students). After establishing the engagement label, all the data were labeled in the user engagement tools.

Engagement Analysis Dashboard

After labeling of engagement, a web application is designed to help instructors to provide real-time information. The prototype of the dashboard of the developed application is shown in Figure 1.

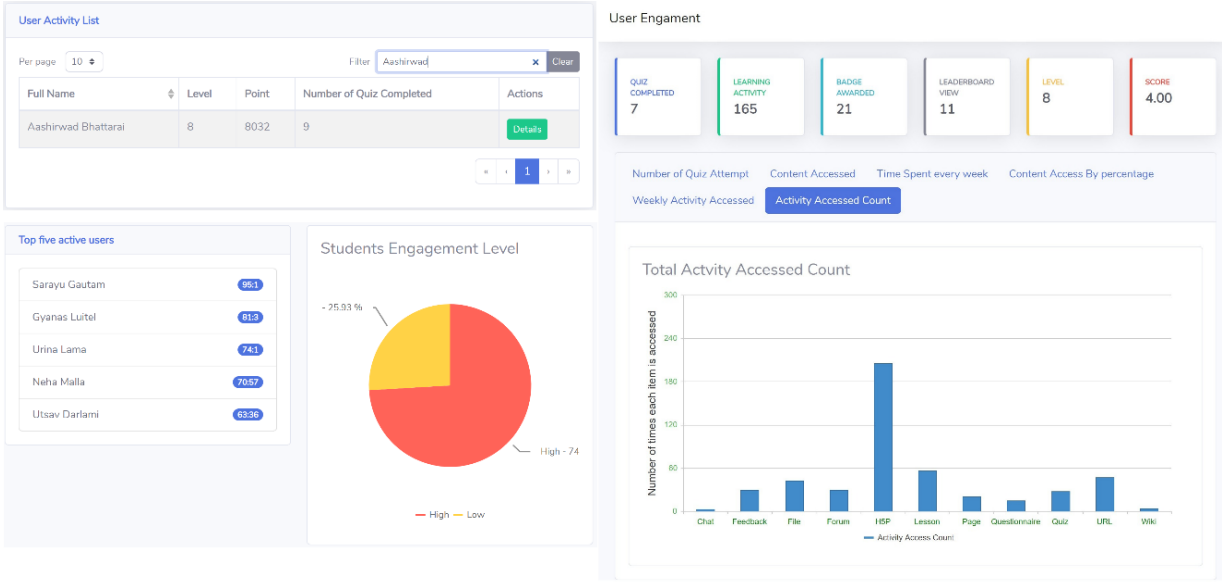

Figure 1. Engagement Analysis Dashboard

The user engagement tools consist of two components: *(1) Visualization of the interaction of all users* and *(2) Visualization of the activity of a single user*. In the visualization part, the activity chart shows the number of times a student has logged in to each activity, number of items completed by each student, number of quizzes completed, number of discussion activity completed, user's activity in a week and time spent per week.

Number of Quiz Completed

Figure 2 shows the results of the number of students who have completed the quiz activities of each week. The graph illustrates the high rate of user engagement in quizzes.

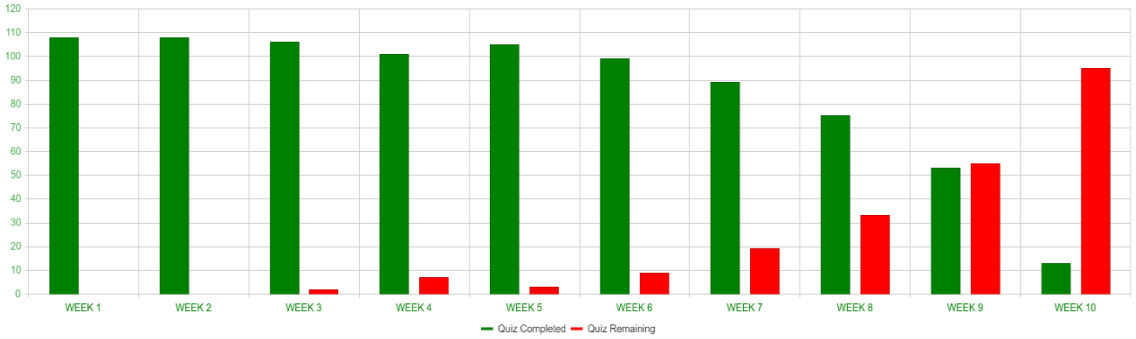

Figure 2. Student Interaction with Quiz Activity

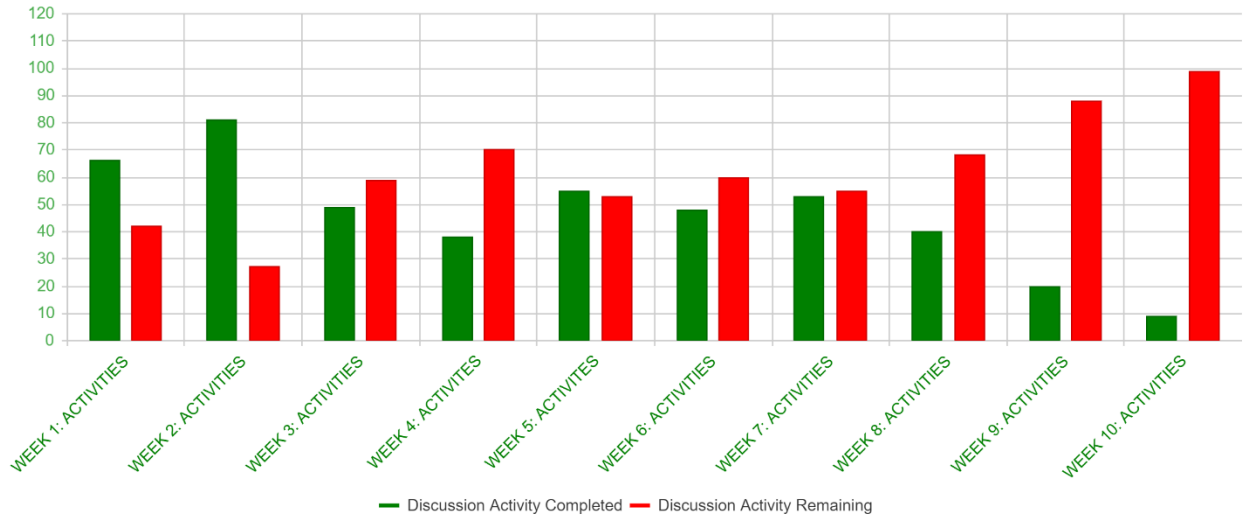

Figure 3. Interaction in the Weekly Discussion Activity

Figure 3 shows the results for the number of students who have completed the discussion activities of each week. The diagram illustrates the medium rate of user engagement in the discussion activity. The number of students completing the discussion activity and the number of students not completing the discussion activity is distributed almost equally in some cases.

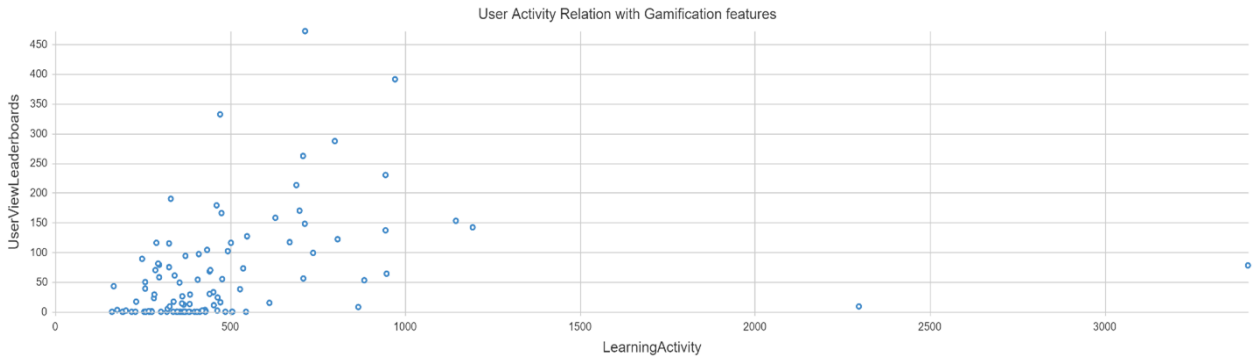

Figure 4. Interaction of User with Leader Board

Figure 4 shows the user's interaction with the leaderboard. When students appear at the top of the leaderboard, they are motivated to participate in activities in the system. Further, they are motivated to be at the top of the leaderboard and engage in more and more activities. The figure 4 suggests that only a few students seem to be not interested in seeing their rankings on the leaderboard as they are shown as less interactive with the activity, whereas students having higher interaction with the learning activity have a high number of leaderboard views.

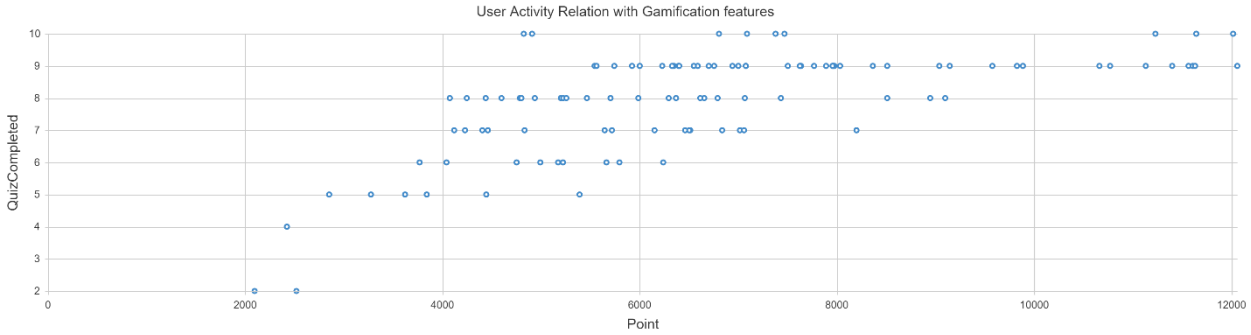

Figure 5. Interaction of User with Points and Quiz

Figure 5 shows user interaction with points and quiz. As the number of points increased, students were found to complete more quizzes. Students who seem to have a smaller number of quiz completion also have fewer points in comparison to the students completing more quizzes.

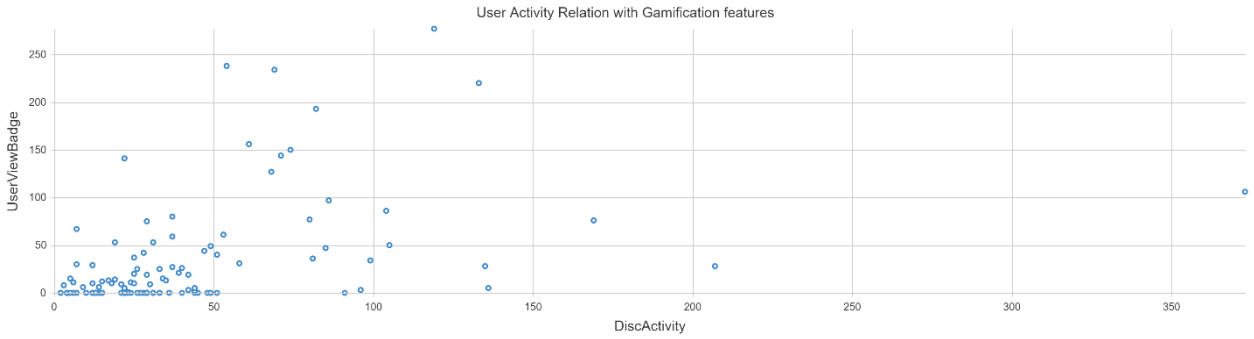

Figure 6. Interaction of Discussion Activity with Badges

Figure 6 shows the interaction of students participating in discussion activities with badges. As a greater number of discussion activities are completed, students seem to have a higher number of badges. The Figure 6 suggests that students who have a less interaction with discussion activity have a lesser interaction with badges.

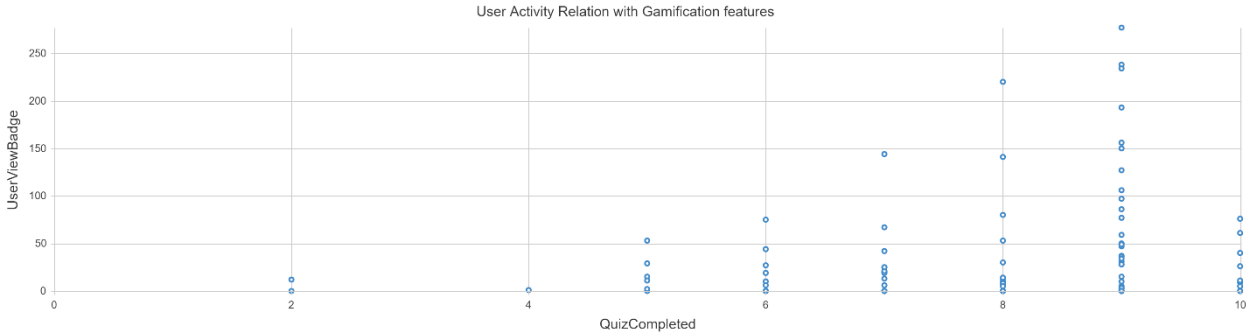

Figure 7. Interaction of Quiz Completion and Badge View

Figure 7 shows the result of interaction of quiz completion and badge view. As the number of quizzes are completed, students seem to have a higher number of badges. Students who have a smaller number of quiz completion were found to have a lesser interaction with badges.

4. Discussion

This research has successfully demonstrated the concept of integrating various gamification elements in the learning content. The results of this study are very useful to the researchers doing research on gamification as this study addresses the issue of how different aspects of gamification affect different motivational outcomes. This study is based on self-determination theory and psychological need satisfaction which is an appropriate concept to investigate the effects of different aspects of gamification. This research also explores the effects of game design elements that are integrated in actual education contexts, and it further supports understanding the level of student's engagement in an OL context. The study also demonstrates how the integration of game elements could be helpful for the instructor to motivate their students to achieve their course related goals. The user engagement tool developed in this study helps the instructors to monitor the assessment of each student in real-time and assist them to make decisions about the disengagement of the students and the declining motivation of the students during the learning process. The visualization also allows the instructor to redesign the instructional materials with respect to the student's interaction. Various gamifications features have a remarkable effect on motivating students to participate more in the learning system.

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References

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher*, *41*(1), 16-25. https://doi.org/10.3102/0013189X11428813

Brod, G., Werkle-Bergner, M., & Shing, Y. L. (2013). The influence of prior knowledge on memory: A developmental cognitive neuroscience perspective. *Frontiers in Behavioral Neuroscience*, *7*, 139. https://doi.org/10.3389/fnbeh.2013.00139

Cocea, M., & Weibelzahl, S. (2010). Disengagement detection in online learning: Validation studies and perspectives. *IEEE Transactions on Learning Technologies*, *4*(2), 114-124. https://doi.org/10.1109/TLT.2010.14

Csikszentmihalyi, M. (1978). Intrinsic rewards and emergent motivation. *The Hidden Costs of Reward: New Perspectives on the Psychology of Human Motivation*, *24*(3), 205-216.

Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning*, 1-13.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, *7*(2), 117-140. https://doi.org/10.1177/001872675400700202

Huang, B., Hew, K. F., & Lo, C. K. (2019). Investigating the effects of gamification-enhanced flipped learning on undergraduate students' behavioral and cognitive engagement. *Interactive Learning Environments*, *27*(8), 1106-1126. https://doi.org/10.1080/10494820.2018.1495653

Klock, A. C. T., Da Cunha, L. F., de Carvalho, M. F., Rosa, B. E., Anton, A. J., & Gasparini, I. (2015). *Gamification in e-learning systems: A conceptual model to engage students and its application in an adaptive e-learning system*, 595-607. https://doi.org/10.1007/978-3-319-20609-7_56

La Guardia, J. G., & Patrick, H. (2008). Self-determination theory as a fundamental theory of close relationships. *Canadian Psychology/Psychologie Canadienne*, *49*(3), 201. https://doi.org/10.1037/a0012760

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, *57*(9), 705. https://doi.org/10.1037/0003-066X.57.9.705

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, *30*(4), 344-360. https://doi.org/10.1007/s11031-006-9051-8

Skinner, B. F. (1953). Science and human behavior. *Simon and Schuster*.

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, *23*(3), 263-280. https://doi.org/10.1037/a0032359

Zhang, T., Solmon, M. A., Kosma, M., Carson, R. L., & Gu, X. (2011). Need Support, Need Satisfaction, Intrinsic Motivation, and Physical Activity Participation among Middle School Students. *Journal of Teaching in Physical Education*, *30*(1), 51-68. https://doi.org/10.1123/jtpe.30.1.51