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Exploring the Effects of Leaderboards on an Online Professional Development Course for Teachers

Aime Michelle LAZARO[a*] & Marlene DE LEON[b]
[a]*STI Education Services Group, Inc., Philippines*
[b]*Ateneo de Manila University, Philippines*
*aime.lazaro@sti.edu

Abstract: This study investigates the effects of leaderboards on an online teacher professional development (TPD) course and examines: (1) module completion of the game and the non-game groups in terms of section views/visits, time spent and overall completion including optional activities; and (2) the learning gains for each individual participant and for the whole group based on pre- and post-test scores. An experimental research method was used for this study. The mediating process of Richard N. Landers' theory of gamified learning was used as a framework for the experiment while the self-paced online TPD course was structured in keeping with the four-stage model of David Kolb's experiential learning cycle. The results of this study support the mediation effect of leaderboards on learning gains by increasing section views/visits (↑ 9.6%), time spent (↑ 23.8%), and completion of optional activities (↑ 137.5%) in the game group compared with the non-game group. Further, the game group posted higher average of gains (↑ 20.5%) and gain of averages (↑ 26.1%). The game group's higher output count for completion of optional activities also points that the leaderboard functioned as an extrinsic incentive and promoted performance quantity, without impairing intrinsic motivation.

Keywords: leaderboards, teacher professional development, learning management system, theory of gamified learning, experiential learning cycle

1. Introduction

Leaderboards are one of the most common gamification elements used in e-learning (Saleem, et al., 2022) and are also found to improve academic performance under certain conditions (Landers & Landers, 2014). This study investigates the effects of leaderboards on an online teacher professional development (TPD) course and examines if there are differences in learner behavior and outcomes between teacher-participants in the game and non-game versions of the online TPD course. The following questions were explored:

1. Are there differences in module completion (i.e., module visits, time spent, and overall completion including optional activities) between the control and experimental groups?
2. Are there differences in learning gains between the control and experimental groups?

Two theories were used for the implementation of this study: (1) Landers' theory of gamified learning (2014) for the implementation of game elements in the online TPD course; and (2) Kolb's experiential learning theory (1984) as the basis for the instructional design and module development for the online course. This method of utilizing two theories follows the recommendation that gamification efforts in the context of training will be most effective when it is implemented alongside instructional design principles (Armstrong & Landers, 2018).

2. Methodology

An experimental research method was used for this study. Participants were randomly assigned to either the game (with a leaderboard) or the non-game (without a leaderboard) conditions of an online TPD course. Kolb's four-stage model served as guide for the development and structure of the online modules.

Ninety-one faculty members from a private school were enrolled in either one of the self-paced online TPD course that ran for five (5) weeks through the school's learning management system (LMS). The pre-test and post-test were administered via the online TPD course. User log files based on the LMS analytics report were collected to determine learner behavior in terms of section views/visits, time spent and overall completion including optional activities. The LMS records student activity within the LMS on a per day report and this includes details such as how many times a student visits or views a section (either an assignment or a content page) and the duration of that visit or view while the student is actively engaging with course content.

The 30-item pre- and post-test scores of the participants were examined. The scores were summarized and analyzed to compare the results between both conditions (game and non-game). A two-sample t-test with a p-value ≤ .05 was used for the statistical analysis. User log files on student activity in the LMS in terms of section views/visits, time spent, and overall completion including optional activities were also gathered and analyzed.

3. Results and Discussion

For this study, Richard N. Landers' theory of gamified learning (2014) was used as a framework to test the effects of gamification efforts on learner behaviors and the effect of these behavioral changes on learning. More specifically, the mediating process of the theory was explored by implementing the use of a leaderboard in an online TPD course. The result of this study supports the mediation effect of leaderboards on learning gains by increasing section views/visits (↑9.6%), time spent (↑23.8%), and completion of optional activities (↑137.5%) in the game group compared with the non-game group.

The effectiveness of the gamification effort may have also been influenced by implementing it alongside an instructional design model, in this case Kolb's experiential learning cycle (1984) following the recommendations of Armstrong & Landers (2018) and Yamani (2021). Based on the results, both the game and the non-game groups posted increases in their learning gains, with the game group having higher gain of averages and average of gains. Additionally, the leaderboard might have served as an extrinsic incentive (Mekler et al., 2017) and contributed in further moving the learning cycle forward (Behrendt & Machtmes, 2021).

While there are no significant differences in the pre-test scores between the game and non-game conditions, the t-test result for their post-test scores yielded a p-value of 0.05, indicating a difference between their post-test scores. The game condition had a higher post-test group mean of 24.26 while the non-game condition had a group mean of 21.44. Additionally, the game group also posted a higher gain of averages (0.58) and average of gains (0.53) than the non-game group's gain of averages (0.46) and average of gains (0.44).

4. Limitations and Recommendations

The findings and results reported in this study, nonetheless, must be interpreted with caution considering several limitations.

The primary constraint to the generalization of these results is the sampling selection and size. A similar study can be conducted with a larger sample size.

The second limitation concerns the type of leaderboard implemented for this study. The built-in leaderboard in the school's LMS only features the absolute type of leaderboard

that publicly displays names and ranks but is only limited to the top 10 of the class. There is also no option to make the leaderboard anonymous. Hence, for researchers who are exploring leaderboards as a game element, it may be worthwhile to also conduct experiments considering the various types of leaderboards (i.e., absolute vs. relative and/or anonymous vs. public). Additionally, a comparison of the effects of "points only" and "points plus a leaderboard" should also be considered as this might yield more meaningful data about the game elements.

The third limitation is about other possible mediating variables considering Lander's gamified learning theory. This study did not use mediation analysis and only explored the mediating effects of leaderboards on learning gains by influencing module completion in terms of section views/visits, time spent, and overall completion including optional activities.

5. Conclusion

This study achieved its purpose by implementing a controlled experiment to examine Landers' theory of gamified learning and explore the effects of unique and theoretically combined game elements on learning behaviors and learning outcomes. Further, by adopting the principles of Kolb's experiential learning cycle for the online TPD course structure, additional guidelines were established in implementing the study.

The results of this study contribute to the field of gamified learning by empirically testing Landers' theory using an experimental design and by investigating the effects leaderboards on online TPD course completion and learning gains of teacher-participants. Moreover, the implementation of this gamification study alongside instructional design principles provides a model for designing (1) gamification within course structures in an LMS and (2) online TPD courses.

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