

Ramirez-Salgado, A., & Antonenko, P. (2023,October). *Balancing Collaboration and Competition in Gamified Engineering Education*. [Paper]. Association for Educational Communications and Technology (AECT) annual convention, Orlando, FL, United States.

**Title:** Balancing Collaboration and Competition in Gamification

**Short Description (75 words):** Gamification increases engagement in education, but balancing competition and collaboration is crucial. Educators can establish clear rules, define different rewards, and create diverse teams to achieve a balance. This study used hardware boards to gamify instruction on binary numbers and logic gates, with teams earning points for tasks and working together on a group challenge. Students were highly engaged but had some anxiety about time limits. All teams were engaged, and cooperation was successful.

**Division:** Learner Engagement?

**Presenter Mode:** In-person

**Suggested Audience(s):**

- Researcher
- Practitioner

**Keywords:** Gaming, gamification, and Simulation. Motivation

**Session type:** Concurrent Sessions

**Audience Engagement:**

To ensure an interactive discussion of our study and results, we will engage the audience by incorporating QR codes with Mentimeter polls and wordclouds.

**Abstract**

Gamification has become increasingly important in education because it can enhance engagement, motivation, and learning outcomes (Su & Cheng, 2015). By incorporating game-like elements into educational activities, students are more likely to be actively engaged and immersed in the learning process (Su & Cheng, 2015). However, it is important to balance competition and collaboration in order to create a learning environment that encourages both individual achievement and teamwork (Deutsch, 2011). Although competition can be motivating, it can also lead to negative behaviors and discourage collaboration (Plass et al., 2013). Collaboration, on the other hand, can foster teamwork but may not challenge students to push themselves to their fullest potential (Plass et al., 2013). Furthermore, research indicates that the inclusion of competition tends to motivate male students (Brotman & Mensah, 2012), whereas opportunities for collaboration tend to pique female students' interest, resulting in more engagement and persistence (Goldstein & Puntambekar, 2004). To balance competition and

collaboration in gamification, educators can (1) establish clear goals and rules that require individual achievement and teamwork, (2) define different levels of rewards for collaboration and competition, and (3) create diverse teams that encourage collaboration while allowing for friendly competition.

In this study, we utilized physical hardware boards as an educational technology to develop a gamified instruction that aimed to enhance students' understanding and retention of concepts related to binary numbers and logic gates. The gamified instruction was designed to foster both competition and collaboration among the students. The study was conducted with seven high school students, six girls and one boy, who were randomly divided into three teams (two pairs and a triad) using an automated educational technology tool that allowed for the entry of the names and the generation of diverse teams.

Each team was then challenged to complete a series of tasks related to binary numbers and logic gates using the hardware boards. Points were awarded to the team that completed each task correctly and in the least amount of time. This process was repeated for a set number of challenges, with the team that accumulated the most points being declared the winner. This competitive aspect of the gamified instruction aimed to motivate students who are driven by competition to perform quickly and accurately.

In addition, the teams were also given a group challenge that required them to work together to complete a defined number of tasks within a limited time frame, regardless of which individual team was winning. This aspect of the gamified instruction was designed to encourage students who are motivated by collaboration to work together in a friendly and fun environment towards a common goal. Fig.1 exemplifies the point system balancing competition and collaboration in the gamified instruction. If we take Fig.1 as a snapshot of a particular moment during the gamified instruction, we can see that team one is currently in the lead with ten points. The group challenge still has forty seconds remaining, and all three teams have that amount of time to complete it.

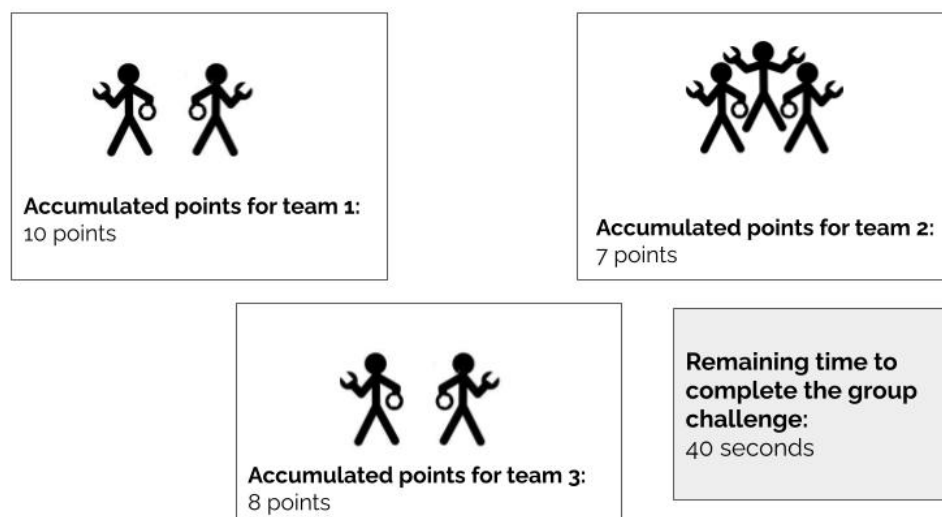


Figure 1. Point system balancing competition and collaboration.

During the implementation of the instruction, one researcher guided the activity while the other researcher observed the participants using a comprehensive observation protocol that encompassed behavioral, affective, and cognitive domains. Within the protocol, particular attention was paid to the affective domain to assess the effectiveness of the gamified approach. The focus was on observing the students' level of interest and their positive and negative attitudes. Additionally, an open-ended questionnaire was administered to the students at the end of the activity to gather their feedback on what they liked and disliked about the gamified instruction.

The results showed that the students were highly engaged with the point system, but the time limit for the group challenge caused some anxiety. Despite one team being declared the winner, the points within the groups were very close, indicating that all teams were vigorously involved in the activity. The observer noted that the students smiled and displayed positive body language whenever they successfully completed a task. Despite the time limit creating some pressure, the group goal was accomplished, demonstrating that the cooperation was successful and the primary educational objective was met.

## References

- Brotman, J. S., & Mensah, F. M. (2012). Urban high school students' perspectives about sexual health decision-making: The role of school culture and identity. *Cultural Studies of Science Education*, 8(2), 403–431. <https://doi.org/10.1007/s11422-012-9451-x>
- Deutsch, M. (2011). Cooperation and competition. *Conflict, Interdependence, and Justice: The Intellectual Legacy of Morton Deutsch*, 23–40.
- Goldstein, J., & Puntambekar, S. (2004). The brink of change: Gender in technology-rich collaborative learning environments. *Journal of Science Education and Technology*, 13, 505–522.
- Plass, J. L., O'Keefe, P. A., Homer, B. D., Case, J., Hayward, E. O., Stein, M., & Perlin, K. (2013). The impact of individual, competitive, and collaborative mathematics game play on learning, performance, and motivation. *Journal of Educational Psychology*, 105(4), 1050.

Su, C., & Cheng, C. (2015). A mobile gamification learning system for improving the learning motivation and achievements. *Journal of Computer Assisted Learning*, 31(3), 268–286.