Using a Head-to-Head Electrical Troubleshooting Championship Contest to Improve Student Engagement and Knowledge

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Introduction

The use of competition in a classroom setting, has been documented to produce positive outcomes in student development (Burguillo, 2010). Specifically, competition can have strong effects on attention and memory (DiMenichi & Tricomi, 2015). Additionally, through the application of Team Based Learning (TBL), students spend more time in group work during class time. TBL allows for more time spent on real world application through assignments called Team Activities (Michaelsen & Sweet, 2008). Competition between teams can be added to a TBL structured course to encourage teams to perform at a higher level (Parmelee et al., 2012). This innovative idea sought to create activities that challenged students at a higher cognition level. Troubleshooting aligns with higher order thinking because it requires student to "be able to see relationships between systems, using this information to solve problems and predict outcomes" (Hobbins et al., 2019, pg. 670). Furthermore, troubleshooting is considered to be a high level of thinking due to its evaluation and analytical nature. Individuals who are proficient at troubleshooting can quickly identify and correct the issue at hand. In an effort to combine higher levels of cognition and student engagement, the instructor of a spring 2020 electricity course had students compete in a head-to-head troubleshooting game.

How it works

Team-Based Learning utilizes a rigid structure that both the students and instructor follow. The instructor created weekly modules on Canvas that included pre-readings, videos, and PowerPoints that students completed prior to attending class. During the Tuesday lectures, the students completed an Individual Readiness Assurance Test (IRAT). Upon completion of the IRAT, students joined their teammates to complete the Team Readiness Assurance Test (TRAT). After all teams have completed their TRATs, the instructor facilitated a short clarifying lecture prior to the conclusion of class. The students then attend the laboratory portion of the class on Tuesday afternoons where the teams worked through two wiring exercises per laboratory. Once the teams successfully completed the wiring exercises, they were instructed to insert up to three "electrical bugs" in both of their wiring exercises to stump the team they were facing. The teams competed in the face-to-face electrical troubleshooting contest during the Thursday lecture timeslot. The team who successfully identified and fixed the bugs first won the weekly competition. If neither of the teams were able to identify and fix the bugs at the end of the 50-minutes, they were recorded as a tie. A stopwatch was used to record the time it took for each team to complete the competition each week to serve as a tiebreaker at the end of the regular season. The team records were compiled over the first ten weeks, with the top four teams advancing to the playoffs, while the remaining teams participated in the loser's bracket.

Table 1

Head-to-Head Electricity Game Steps

Steps	Action	Description
Step 1	Complete Pre-class work	Instructor would create weekly modules that students will complete prior to class

Step 2	IRAT's & TRAT's conducted	Students would come to class and complete the IRAT's, TRAT's, and clarifying lectures. (Tuesday)
Step 3	Students would 'bug' the wiring boards	At the end of the weekly laboratory activity, the students were tasked to "bug" their team's wiring boards. (Tuesday Laboratory)
Step 4	Team Assignments	Each team is assigned an opposing team for each week in a face-to-face competition format.
Step 5	Team Activity	At the beginning of the team activity, the instructor would start a stopwatch. The team that solved the problem the quickest would win that round. (Thursday).
Step 6	Regular Season	The competition would last for a total of ten weeks following steps 1-5.
Step 7	Playoff's	The last two weeks teams would compete in a playoff bracket.
Step 8	Championship	The top teams would be decided.

Implications

The instructor viewed the competition as a success in encouraging student engagement. The instructor noticed that students continued conversation about the team activities beyond class time. Student also seemed more engaged as the competition continued on. Students were highly involved with the competition itself and the troubleshooting activities. The "bugging" of the boards required additionally knowledge to try and confuse the other students. This encouraged higher order thinking because it made students aware of all of the aspects of the system (Hobbins et al., 2020).

Future Plans & Recommendations

We plan to incorporate competition-based team activities in other agricultural mechanics courses. Competition-based team activities could be consistent, (i.e., the head-to-head electricity game) or week/topic dependent. For example, for the small engines course taught at the same university various head-to-head competitions were conducted over the topics of tool & equipment identification, precision tool applications & engine system exercises. Students competed for most correct answers overall and/or fastest time completed. We recommend the use of competition to encourage student participation at higher levels of cognition. Additionally, the use of consist competition-based exercises promotes student creative and higher order thinking in real application exercises. These competition-based exercises can be implemented with or without TBL, however we have seen that it can be applied to TBL seamlessly. For the electricity course specifically, we recommend students use a multi-meter to show an open circuit prior to the introduction of electricity to the system. This ensures students understand how to use the safety equipment and prevent potential injury.

Resources Needed

There was no additional cost associated with this project. The only resources needed are the traditional tools and components associated with an electricity course. This course's laboratory activities only included those based in residential wiring. The boards, components, and wire can be reused after every lab to eliminate additional costs.

References

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