TrAcademic: Experiences With Gamified Practical Sessions for a CS1 Course

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ABSTRACT

This paper discusses preliminary impressions and results of using the TrAcademic system to gamify practical sessions in an introductory CS course at the University of Toronto Scarborough. Students were awarded points for attendance, completion of problems, and assisting other students in the session. Points were not counted towards the course grade, but were displayed on a public leaderboard. As a result of this simple change, practical attendance increased by over 500% from the previous offering, and both students and teaching assistants found the gamified practicals improved both engagement and retention.

CCS Concepts

•Social and professional topics → Computing education; Computer science education; CS1;

Keywords

CS1, Computer Science Education, Gamification

1. INTRODUCTION

Introductory Computer Science courses often struggle with an "experience gap". Some students enter the course with a great deal of experience and coding practice, while others may have never written a line of code in their life. The central problem then becomes: How do we create a course that challenges and interests the more experienced students without alienating those just starting out? Furthermore, how do we promote engagement and foster a sense of community among these widely disparate ability groups?

Students making their first foray into programming need practice problems; small pieces of work at an appropriate level of difficulty that will let them practice and hone their fundamental skill set. However, assigning large numbers of simple problems can cause more advanced students to get bored and lose interest in the course. Early stage students benefit greatly from having contact time with individuals

who can offer guidance and support, which can be difficult to achieve in a large course. Finally, the best way to improve retention in students is to have them teach the material to someone else. All of these factors point to a single approach: gamification.

2. THE TRACADEMIC SYSTEM

In our "Introduction to Computer Science" course, in the fall of 2015, we introduced the TrAcademic system, which allows instructors and TAs to award points to students in a variety of categories:

- **Experience Points:** Awarded for participation and engagement with the course.

- **Challenge Points:** Awarded for completion of more advanced problems, usually requiring a group effort.

- **Teaching Points:** Awarded for assisting in the educational development of peers.

The points are recorded and displayed on a public leaderboard, as shown in Figure 1. The accumulated points have no bearing on the mark for the course, they are purely for "bragging rights".

Points can be awarded for any aspect of the course (e.g., class participation, online discussion forum assistance, completion of additional challenge components of assignments), but this paper focuses on the the usage in, and impact on practical sessions.

Students in the course were required to attend 3 hours of lecture and 1 hour of tutorial per week, which are traditional, instructor lead sessions, held in standard lecture halls/classrooms. Practical sessions were held on a 'drop-in' basis, with 9 hours of lab-based time available per week. In prior years, students had access to a repository of questions, and were encouraged to try them for practice, and to work with a TA during the practical sessions for additional assistance. Attendance was low, and most of the students who did attend only did so to get help with their assignments and exercises. Very few students reported attempting the practice questions, and the TAs would regularly complain that only a very small percentage of the students would show up, and those were mostly students hoping to get hints on how to complete assignments.

In the session being studied, the repository of questions was replaced with a weekly practical sheet of 10-20 questions ranging in difficulty from very simple to `challenge` questions (questions designed to only be possible by particularly dedicated students, and even then often requiring group work).

Figure 1: The TrAcademic Leaderboard

The TrAcademic system was integrated into the practicals, with points being awarded on the following criteria:

- Upon demonstration of the completion of a set number of questions (usually 5, which could be chosen by the student), the student would be awarded 1 `experience point`.

- If a student or group of students completed a `challenge question`, they would be awarded 1 `challenge point` per team member, awarding of the point was contingent upon all team members being able to successfully demonstrate understanding of the solution to the TA.

- Any student who was observed to help another student or group of students, either by their own volition or at the behest of a TA was awarded 1 `teaching point`.

To facilitate the awarding of points, the TrAcademic system has a web-based interface where points can be awarded via either typing a student's name, or swiping their student card through a magnetic card reader on a tablet. This allows the TAs to award points quickly and discreetly, in a portable manner.

3. RESULTS

In its first term in operation, we assessed the impact of the TrAcademic system on the practical sessions through two forms of analysis: Attendance and completion data drawn from the software, and TA feedback.

3.1 Practical Attendance

In the previous year's practical sessions, attendance was not formally taken, but TAs were asked to periodically report attendance during their allocated times. Attendance was skewed greatly to sessions immediately prior to term tests and assignment deadlines. Several sessions had no students attend, and the highest attendance was 15 students during a single hour. The average across the entire term was 4 students/hour, or 36 students/week.

With the addition of the TrAcademic system, attendance was much higher and more evenly distributed. There was still a spike in the sessions immediately before test dates and assignment due dates, but while the highest attendance was

50 students (admittedly this may have been limited by the capacity of the room), the lowest attendance was 18 students in an hour. The average for the term was 27 students/hour, or 243 students/week. An increase of over 500%[1].

3.2 Problem Completion

While we don't have exact numbers on student that attempted practice questions in previous iterations of the course, an informal poll of the TAs indicated that they believed less than 25% of all students had attempted all of the practice questions and less than 10% had completed all of the practice questions. These opinions seem to be verified by the fact that a question taken verbatim from the practice questions appeared on the final exam, and the average was actually slightly lower than other similar questions. However, with the TrAcademic system, we found that 57% of students received at least 1 experience point for completing the minimum number of questions in at least one week. 18% solved at least one challenge question, and 13% received at least 1 teaching point.

3.3 Teaching Assistant Evaluation

At the end of the course, the teaching assistants completed a short survey about their experience in the course. All 21 TAs completed the survey, 7 of whom had TAed the course before. All of the TAs agreed or strongly agreed with the statements: "The practical sessions were helpful for the students", "The TrAcademic system encouraged students to attend practicals", and "The TrAcademic system encouraged students to help one-another".

Of the 7 returning TAs, 100% strongly agreed with the statement: "The new practical system is an improvement over the old system of practice questions".

4. CONCLUSION

The initial evaluation of the TrAcademic system shows great promise. Gamifying the practical sessions appears to have increased attendance and participation, and improved overall engagement. Further study is required to formally assess the degree of effect, but initial results are promising enough to warrant further study.

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[1]It should be noted that between these two terms overall course enrolment increased by 15%