

TrAcademic: Gamifying Introductory CS Practicals

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Objectives

1. Provide practical material for introductory CS students
2. Help alleviate problems caused by “Experience Gap”
3. Allow more experienced students to assist those with less experience
4. Foster engagement and develop community among CS students

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.

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”.

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.

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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. Non-gamified data was taken from manual headcounts^a.

▶ Attendance

	Non-Gamified Practicals	Gamified Practicals
Minimum Attendance/Tutorial	0	18
Maximum Attendance/Tutorial	15	50 ^b
Average Attendance: Students/Hour	4	27
Average Attendance: Students/Week	26	243

Table 1: Table caption

▶ Participation

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.

With the gamified practicals:

- ▶ 57% of students received at least 1 experience point
- ▶ 18% solved at least one challenge question
- ▶ 13% received at least 1 teaching point.

The Leaderboard

Username	★ Experience Points	👤 Teaching Points	‡ Challenge Points	Total Points ▼
Alice	13	7	3	23
Bob	5	7	6	18
Carol	5	8	1	14
Dave	13	1	0	14
Edith	3	8	0	11
Frank	5	1	5	11
Gary	6	0	4	10
Helen	4	5	1	10
Ingrid	3	5	2	10
Jack	7	1	0	8

Figure 1: The TrAcademic Leaderboard

^aAs the manual data was not acquired as part of a rigorous study, numbers given are best estimates from incomplete data.

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

^bThe maximum attendance was limited by the room capacity