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6 TrackEngage: Tracking student engagement in learning resources and its correlation to their performance

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Abstract

An important factor in the academic performance of Laboratory based science students is attendance on the basis that practical experience and engagement in teaching activities are necessary to develop skills and competencies. Student attendance also has wider implications for science schools as they are increasingly challenged in providing laboratory based practical teaching in the face of increasing student numbers. The relationship between attendance and academic performance has been studied previously, but mainly limited to classroom-based lectures rather than laboratory activities and self-directed learning. The aim of this study was to evaluate the relationship between student attendance at laboratory practical sessions and class based activities and their engagement in learning resources with their overall academic performance. The hypothesis that students who engaged in more teaching and learning resources performed better in the overall module grade was proven, with the highest correlation found for lecture attendance to the end-of-semester examinations.

Keywords: *RFID attendance system, self-directed learning, Webcourses & Moodle*

Introduction

Student attendance has a minimum requirement in a number of science based practical modules, both in the Dublin Institute of Technology (DIT) and the Institute of Technology Blanchardstown (ITB). This has led to staff developing their own laborious non-robust recording methods for student attendance such as sign in and roll calls. Student numbers have grown substantially, and a number of modules are co-taught with other courses (90+ in some modules). Also there has been a large evolution in teaching and learning methods employed in the classroom in recent years such as problem based learning and group work, which require student participation and therefore attendance. Most of the modules currently delivered use Webcourses (DIT) or Moodle (ITB) as a teaching support tool with staff investing a lot of time and effort.

This project investigated student engagement in these teaching resources through monitoring their attendance at lectures and laboratory practicals and their use of Webcourses. It also surveyed their self-directed learning (SDL) activities and the student engagement in these resources was correlated to module performance. To complete this project an efficient and robust recording system of student attendance (easy to use, cost effective and rapid) based on their student cards was developed. A protocol to capture student interaction with Web based teaching and learning resources was created. These tracking tools were difficult to procure due to Information Service restrictions and lengthy approval processes involved in student data capture. Therefore the project tools were only piloted on one lab based module in DIT. The strongest correlation was observed for lecture attendance with directly linked assessment and overall student performance in this module (final grades) followed a similar trend to the level of engagement. The robust attendance recording system and engagement tracking protocols were successfully developed and tested and this will allow for future complete trials in both Institutes.

Outline of Project

The study was conducted within the School of Food Science & Environmental Health, Dublin Institute of Technology. The undergraduate module chosen was in Semester 2 (12 teaching weeks) in the penultimate year of a four-year degree course in science.

The study received institutional research ethics committee approval with the requirement for individual student consent for participation and this was freely given by the 29 participating students. The module comprises a combination of laboratory based activities and classroom-based learning activities with a range of learning resources including lecture and laboratory notes, reading material and recommended links available on-line through Webcourses.

The School regulations advise students that 'Permission to sit examinations is normally dependent on attendance of at least 80% in practical classes and 60% in Lectures'. There are no methods or specific criteria described for recording student attendance or an outline of the consequences of their poor attendance. Although students are strongly encouraged to attend laboratory sessions across the whole School, attendance is typically recorded ad hoc.

Student attendance was defined as attendance at a weekly three-hour laboratory session and a one-hour weekly lecture. The attendance for each student was calculated by comparing the number of activities the student attended with the number of activities delivered in the semester (Deane and Murphy 2013). The outcome of interest was the overall module grade (100%) and its components (exam 60% and portfolio 40%) obtained by each student. The assessment modalities used to determine the module grade were i) an end-of-semester written examination (one and a half hours in duration) consisting of two sections, Section A based on lecture material and Section B on laboratory relevant material (60% of the overall grade) and ii) a module portfolio and presentation (40% of the overall grade). The pass grade for this module was 40% and above.

Various options for recording student attendance exist (López Fernández et al. 2013) and these were investigated through consultation with Information Services, IT Suppliers and other institutes of education, and ranged in practical use, data capture abilities, price and compatibilities. Each student card has a Radio Frequency Identification (RFID) tag so it was decided to capture student attendance using a Springcard Prox & Roll RFID scanner (Figure 6.1). This relatively cheap (~€200), small device (8cm in diameter) is lightweight (116g) and connects via a USB port to any computer. Students tag on as they enter the classroom or Laboratory and successful tagging is instant and registered with a green light (Figure 6.1) and beep. This RFID data was then sorted and converted to Excel compatible files using purpose developed software *ANSEO*.

Maintaining paper records of student attendance is an onerous task that takes up class time and adds to the management burden. There are many other disadvantages to paper based recording systems including students not signing in, unreadable signatures, students signing in another student, and data management. Students who are inclined to skip classes know that manual attendance (i.e. calling roll, etc.) can be manipulated in their favour (Hingorani et al. 2013). This RFID reader and capture software is very easy to use and efficient as the student tags in as they are walking in to the room and it is visibly registered with a green light and an audible beep that makes the system difficult to manipulate.



Figure 6.1: Springcard RFID scanner connected via USB port which flashes green on successful student card tag on

A protocol based on work developed in DIT (<http://webcoursesanalytics.wordpress.com>) was used to harness student engagement data from Webcourses (DIT). An easy to use protocol was outlined based on Graphical Interactive Student Monitoring Tool for Moodle (<http://gismo.sourceforge.net/>) to harness student engagement data from Moodle (ITB). A wide range of information can be easily accessed and various reports compiled on engagement at individual student or group level. The interaction of individual students with Webcourses on a daily or component basis can be profiled. Data and reports can readily be exported to Excel. An example of such reports is presented in Figure 6.2 which shows that the highest Webcourses combined activity is on a Tuesday, the day before the lecture and laboratory sessions.

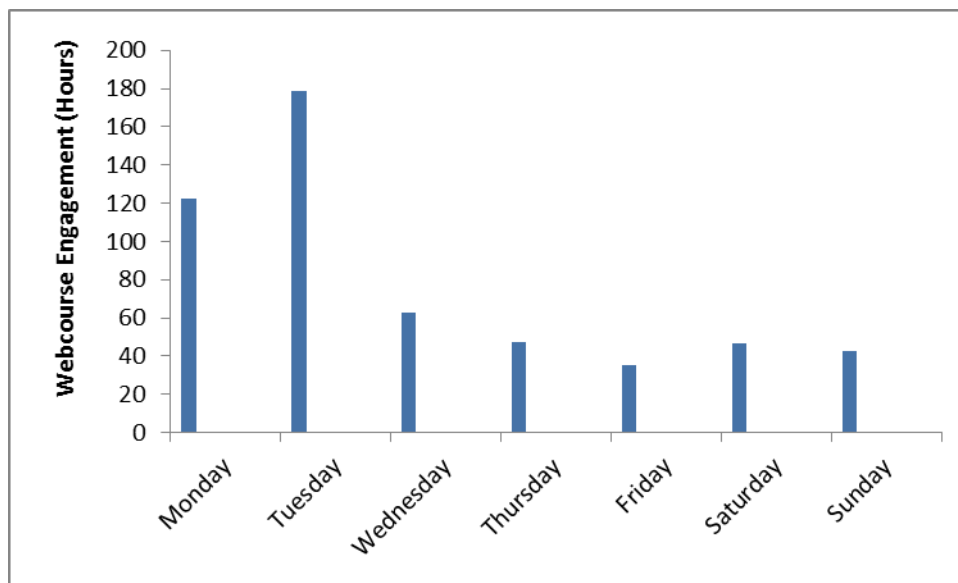


Figure 6.2: Student engagement with Webcourses on different days over the 12 teaching weeks of the semester

The 29 students in the DIT pilot module were surveyed to audit their module engagement and collection of data on self-directed learning. The data for the teaching and learning engagement was measured in hours and correlated against student performance. This data included a) lecture attendance, b) laboratory practical attendance, c) Webcourses engagement, d) self-directed learning and e) total student engagement in the module. The grades for the module (examination, continuous assessment and overall grades) were statistically correlated with teaching and learning engagement components (a-e) using Statgraphics Centurion XV.I and plotted in Microsoft Excel 2010 (Crede, Roch and Kieszynka 2010). The component and final grades were obtained from the School records following the end-of semester assessments.

Laboratory attendance remained $\geq 80\%$ for the entire 12 teaching weeks (Figure 6.3). Students are aware of the 80% attendance requirement as this would have been reiterated over their five previous course semesters (September 2012-January 2015).

However, lecture attendance (Figure 6.3) rapidly declines over the semester. Many studies have investigated this absenteeism and the range of reasons include family, social and work commitments, illness, faking illness, family emergencies and faking family emergencies (Cleary-Holdforth 2007). However, the reasons suggested by students in this study were: the 9am start of this Lecture and also the fact that it was in another building than their 10am Laboratory session (~7 minute walk), the availability of lecture and support material online and the increasing workload as the semester progressed.

This cohort of 29 students had an overall high module performance (final grade) of between 56-82%. This grade was clearly linked to module engagement. As student engagement in module teaching and learning resources increased so did the students' overall grade, although statistically some correlations were low (Figure 6.4). This trend was evident for overall lecture and laboratory attendance, Webcourses interaction and self-directed learning activities (Figure 6.4).

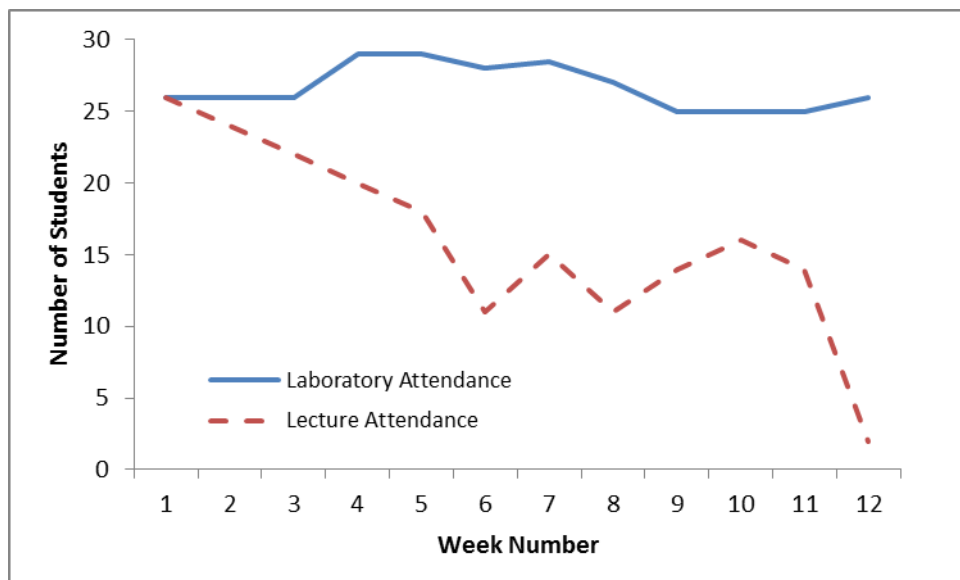


Figure 6.3: Laboratory and lecture attendance for 29 students in the pilot module over the 12 teaching weeks of the semester

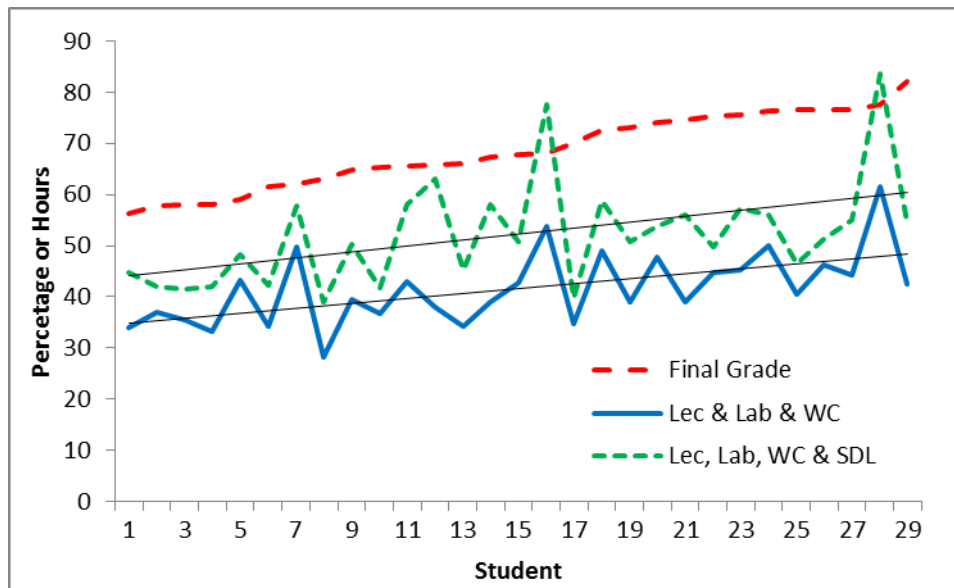


Figure 6.4: Overall student (n=29) performance (final module grade, %), laboratory (Lab) and lecture (Lec) attendance, Webcourses engagement (WC) and self-directed learning (SDL) for the pilot module (expressed in hours of engagement)

The final exam paper (worth 60%) is divided into two Sections (A and B). Section A examined material covered in the laboratory sessions and Section B examined material from lecture sessions. The final Section A grades of 32-82% (mean 53 with a standard deviation of 14) was attributed to normal distribution as the high attendance in the laboratory sessions and section grades had a low correlation (Figure 6.5A).

However, the correlation between Lecture attendance and grades in Section B (25-90%, mean 66% and standard deviation 15) were very highly correlated (0.891, Figure 6.5B). Traditionally attendance at classes has been thought to be a prerequisite to good academic performance and many studies have shown a similar positive correlation between them, regardless of the course subject or level of student (Cohall and Skeete 2012). This has significant implications for student and staff within the Institute and the development of this engagement tracking system can be used for reflection and review of course delivery and interaction (i.e. timetable of events, lecture delivery methods, availability of notes etc). Students 'at risk' due to low or lack of engagement could be easily highlighted early in the semester/module delivery and a trigger set in Webcourses or to staff for intervention.

Evaluation

There were substantial delays to this project due to Ethics Committee and Information Services approval for both student data capture and novel technology. As a result, the full project plans could not be realised and therefore evaluation involved a reduced trial of the tracking system in Semester 2 with 29 students in only one pilot module.

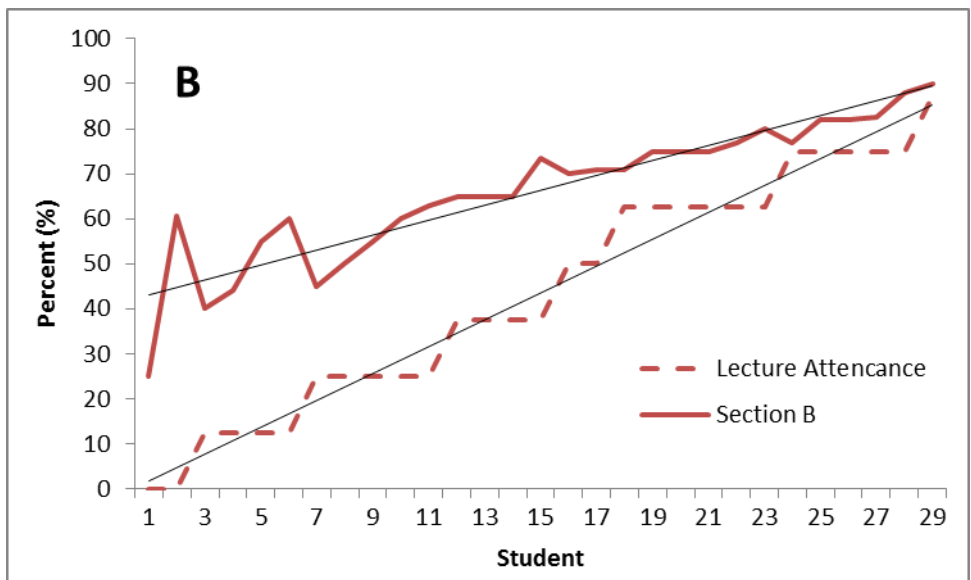
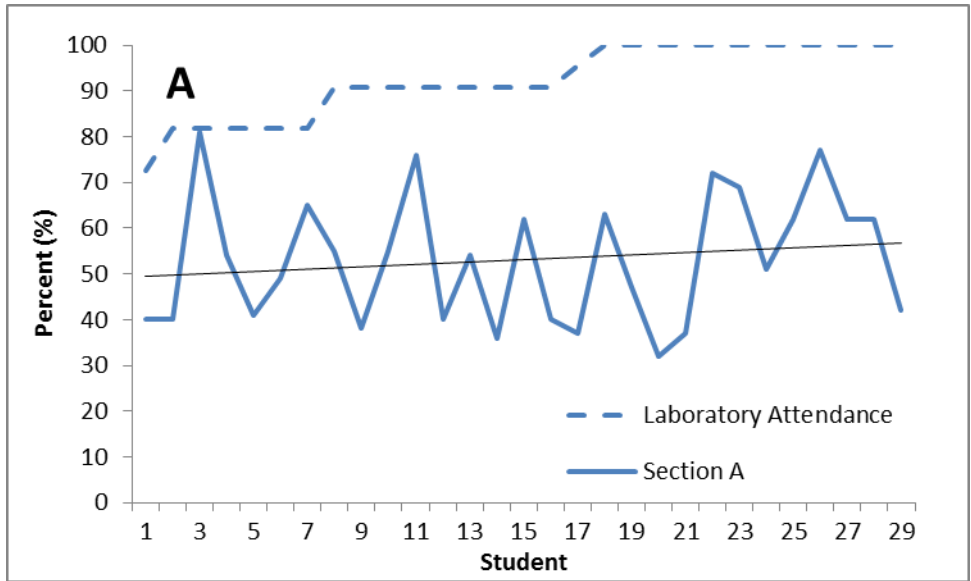


Figure 6.5: Student ($n=29$) performance in:
 A: Section A of exam linked to increasing laboratory attendance and
 B: Section B of exam linked to increasing lecture attendance for the pilot module

Conclusions

- The RFID attendance recording system developed is very cheap, easy to use, with a robust output and could very easily be scalable across courses and schools within each partner Institute.
- Laboratory attendance remained above the course required figure of 80%.
- Lecture attendance dropped significantly over the semester.
- There was a clear link between student engagement in learning resources (laboratory and lecture attendance, Webcourses and self-directed learning) and module grades.
- Lecture attendance was highly correlated to related examination assessment.

Recommendations to the DIT

1. Recording Student attendance is a requirement for various reasons (practicals, PBL, etc.) and DIT must support staff in implementing an effective user friendly system (easy to use, cost effective and rapid). This however, will need full support of Campus Planning, the Information Services department and College finance departments.
2. Protocols to track student engagement have been developed and successfully trialled and their use by staff would allow for reflection and review of course delivery, management and interaction.
3. Reliable data on correlation of engagement with performance has implications for the General Assessment Regulations.
4. Students 'at risk' due to low or lack of engagement could be highlighted early in the Semester and intervention taken.

Proposed future work

- Complete the planned trials of this project to a second practical module in DIT and two modules in ITB.
- Include a larger student cohort in the next trial and investigate two cohorts of students from different courses that are co-taught in the module.
- Gather more information on student demographics (gender, age, nationality, extracurricular activities, and student status, etc.) to create student profiles and assess for possible correlation to engagement (Cohall and Skeete 2012).
- Roll out the successful tracking system to other courses in the School of Food Science & Environmental Health (DIT) and School of Informatics & Engineering (ITB) and eventually Institute wide use.
- Disseminate the project findings.

Future Dissemination plans

- Presentations at School meetings.
- Present findings to students.
- Organisation and running of workshops for interested staff.
- Teaching and Learning Conferences i.e. NAIRTL, HEA STEM or PeEcon.
- Two peer reviewed papers, i.e. the *International Journal of Technology Enhanced Learning* and *Journal of Educational Multimedia and Hypermedia*.

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Web Links

<http://gismo.sourceforge.net/>

<http://webcoursesanalytics.wordpress.com>