UNIVERSITY OF Hull

Fundamentals Statics and Stress 15/16 Mastering Engineering

Gail Capper | Pearson

OVERVIEW

- **Achievement: the statistics on this course show that students who performed better on Mastering, performed better in both coursework and exams.**

  This allows a level certainty around who will perform less well at the end of the course. Although an assumption, it is possible these students ultimately become those most likely to fail the course or even drop out if the pattern is repeated in all courses. Spotting struggling students earlier allows for additional teaching and learning support to be put in place for them before they fail the course.

- **Spending more time on the resource showed a positive correlation with gaining better course marks.**

- **In answer to the question** *'How likely are you to recommend MasteringEngineering to another student?'* **Mastering Engineering scored 8.2 out of 10**

- **Participation was consistently high, both in Semester 1 & 2, at 90% and 81% respectively.** Most students complete work on a Sunday (due date) or a Tuesday (practical session in lab). Late completion is not common.

- **Factors contributing to participation: assigning credit, regular deadlines, in-class support, monitoring engagement and an engaged teaching team.**

  Credit and deadlines assigned is likely to have resulted in students mainly completing work on a Tuesday (in a computer lab class with lecturer support) or a Sunday (deadline 11.59pm). The teaching team therefore supported and motivated students which compelled engagement with an assignment. Teachers also made contact with disengaged students (those who did not complete the assignment) by e-mail on a weekly basis.

- **Students who found assignment questions more difficult performed less well on the course overall.**

  The insight from Mastering difficulty rating would provide the opportunity for just-in-time interventions in those cases. For example, perhaps all students finding the course more difficult than the average are offered an additional revision class.

- The student survey question with the highest level of agreement was:

  - 'It is easy to access Mastering Engineering account'
  - 'It is easy to access Mastering Engineering assignments'
  - 'Navigating course content is logical in Mastering Engineering'.

- The student survey question with the lowest level of agreement was:
  - 'The feedback that I get on MasteringEngineering assignments in this course helps me understand how to improve'
  - 'I am able to access Mastering Engineering from my smartphone/tablet'

Introduction

Mastering Engineering was introduced into this course in 2011-2012. Over the last 15 years, class size was 170 at its largest and is now about 100 students. The course team identified a number of challenges they wanted to address to make the course more successful:

- the course had traditional, paper assignments (**time-consuming**)
- students weren't in tutorials (**knowledge gaps**)
- students didn't know the material (**knowledge gaps/ failure to progress / low achievement**)
- students' pass rate and average course marks were dropping (**decreasing achievement**)
- decreasing achievement was only clear once students took their final test at year end (**unable to provide timely feedback or support**)

Mastering Engineering presented a way to solve these challenges with various aims in mind:

- Engaging and motivating students (**increasing attendance and therefore knowledge level).**
- Modern and worthy of tuition fees (**student satisfaction**)
- Accessible outside the classroom (**flexible learning**)
- Allowed for even more practice (**increased practice, increased knowledge, increase achievement**)
- Allow a snapshot in time of student performance and identify areas students were finding difficult to understand (**improve support and feedback**)
- Automating marking (**manage increasing class sizes**)

Catherine's view is that students like the resource, they work harder and understand better.

Implementation

The course usually has around 100 students over two semesters. Each semester is worth 50% of the total course mark. In 2015-16 there were 82 students on the course. The resource is integrated fully into each week with a homework assigned and then discussed in tutorials. It is used for practice and summative assessment in the following way.

1. Week 1: **0%** of the course mark
2. Week 2: **0%** of the final course mark
3. Weeks 3-7: Homework each worth **1%**, totalling **5%,** discussed in tutorials the next week.
4. Week 8: Assessment **worth 10%**
5. Written Coursework (not on Mastering) **worth 10%**
6. Exam **worth 25%** of the final course mark.

Lecture 1 (Tuesday, new concepts and introduce problems set for the week)

Problem Class (Tuesday start problems in PC Lab, support on hand)

Lecture 2 (Tuesday go over last week's problems)

Work Due (Problems due Sunday 11.59pm)

Non-engagers e-mailed (Monday results checked, identify problem questions and can change lectures accordingly)

Methodology

In 2015-16 there were 82 students on the course. Of these students 4 were no longer enrolled or inactive and removed from the analysis. Students completing half the course or failing to take the exam were not included in statistical analysis. Including their data would have skewed the results.

The study originally began in Summer 2015 with Catherine Dobson (module leader) and data was collected at the end of the course in Summer 2016. Student surveys were sent out in Spring 2016 to gain some insight into student thoughts. Approval was gained from the department in order to view the student gradebook in Mastering Engineering and from the ethics committee before exam results were shared. Students were asked if they wanted to opt out of the research by e-mail which no-one did. Data was protected in line with Pearson policies throughout.

Quantitative data was collected from the Mastering Engineering Gradebook including assignment and assessment results, difficulty levels and time spent online. In addition, aggregated data was collected from the Pearson systems to build a more complete picture of completion dates/times and the use of learning aides such as 'hints'. Information was also provided in a Learning & Teaching presentation made by Catherine Dobson at the University of Hull.

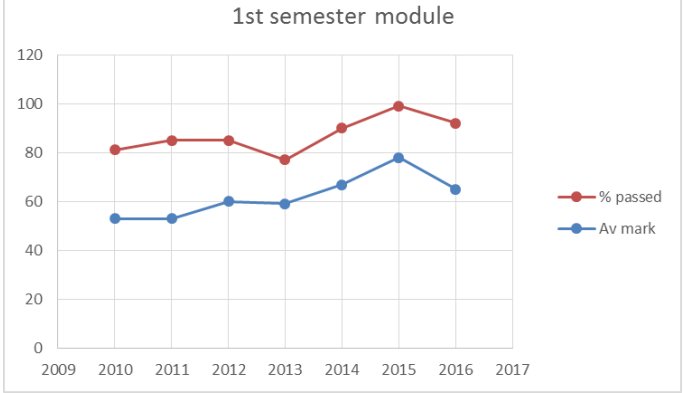
Qualitative data was collected through a student survey with 19 questions. We received 5 responses which have been included in this report, but which cannot be deemed representative. Verbatim comments have been reported thematically. In addition, Catherine Dobson was interviewed about the resource and her insights were used.

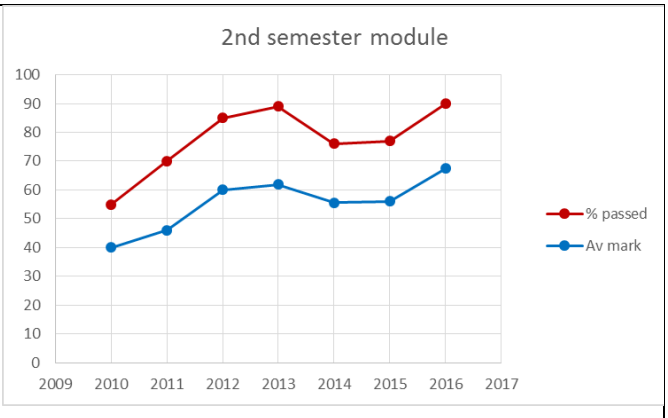
Study Purpose

Catherine was particularly keen to understand more about:

- **Study Area Activity**: students appear to wait until the last day of the course to ask about this when they want to revise. Unfortunately, Mastering holds very little information on self-study activity.
- **Activity**: the time spent on the resource and when students work e.g. Sunday for a Monday tutorial?
- **Achievement**: Compare across the various forms of assessment in Semesters 1 & 2.
- Consider links between activity and achievement.
- **Engagement**: identify ways of targeting support effectively during the course.

Historical Data provided by Catherine Dobson





Notable dates:

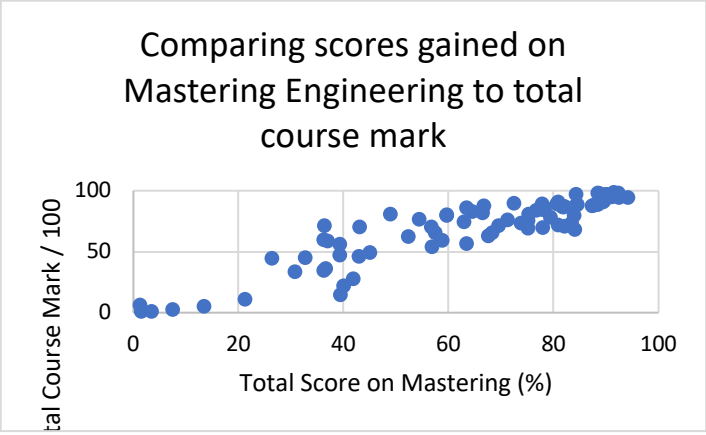
2010 – old course
2011 – weekly pen and paper worksheets
2012 – introduction of Mastering
2015 – introduction of weekly credit for work

Findings

Achievement

Overall achievement on Mastering Engineering was good with an average score of 61.6% for all work on the resource.

The chart below shows how Mastering scores relate to final course marks which combine the Mastering Engineering Assessments (30%), Coursework (20%) and Exams (50%) over both semesters. Students need 40% to pass. The trend shows that students who perform well on Mastering also perform well at the end of the course.



This is useful when thinking about **targeting early support** for students who are struggling – before they write coursework or complete an exam.

After statistical analysis there are some ways to see early indicators of success for students and enable ways to effectively target additional support where needed:

Early Indicators of Success

1. The better a student did on Mastering, the better they did in their Exam
2. The better a student did on Mastering, the better they did in their Coursework

Strong – medium correlation Exam Semester 1: r=.80, p<.01; Exam Semester 2: r=.41, p<.01
Strong, positive correlation Coursework r=.73, p<.01

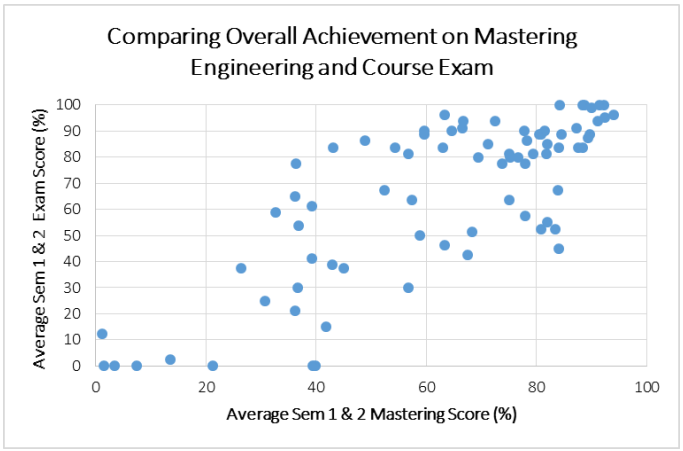
3. The more difficult a student found the assignments, the lower their course mark

Inverse, weak relationship Difficulty r=-.32, p=.004

4. Students who spent more time on Mastering performed better on the course

Significant medium relationship Time r=.40, p<.01

1.



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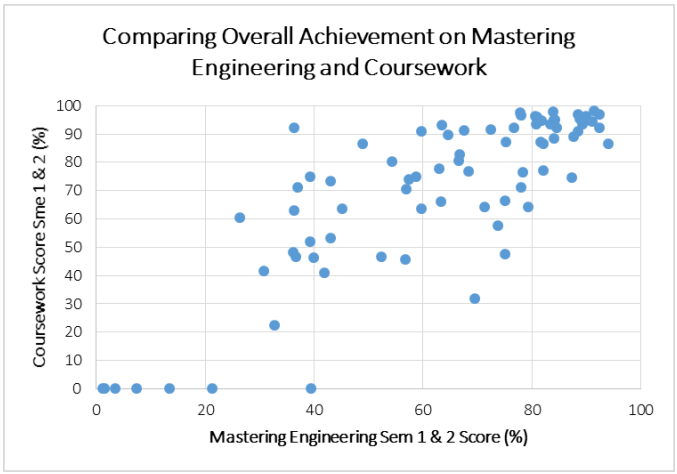

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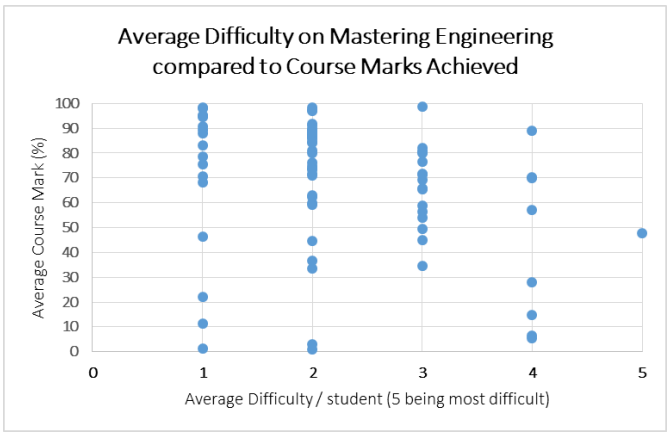

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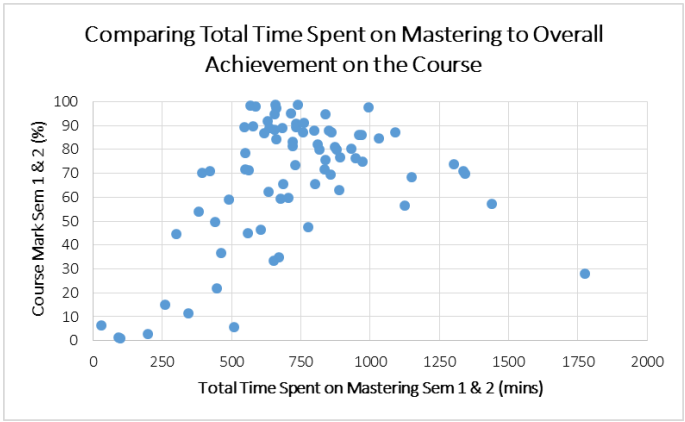


Findings & Implications

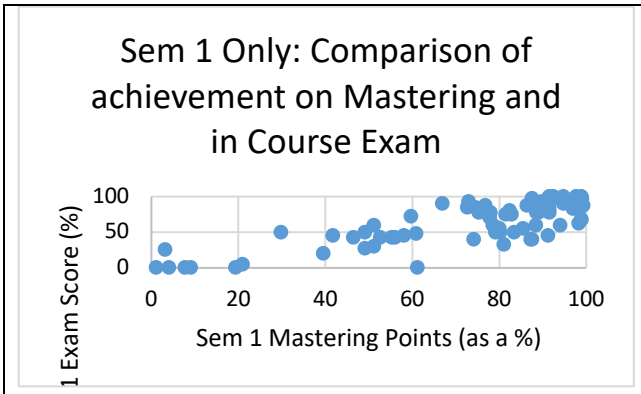
Those who perform better on Mastering achieve better marks. This is shown by the course marks (which include Mastering scores) but also from the coursework and the exam charts. Mastering Engineering accounts for 30% of the course marks. A student can still pass the course even if they fail all Mastering assignments (40% is the course pass mark).

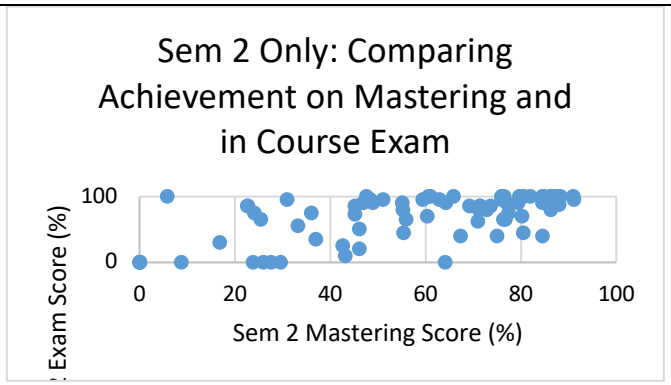
Did achievement vary by semester?

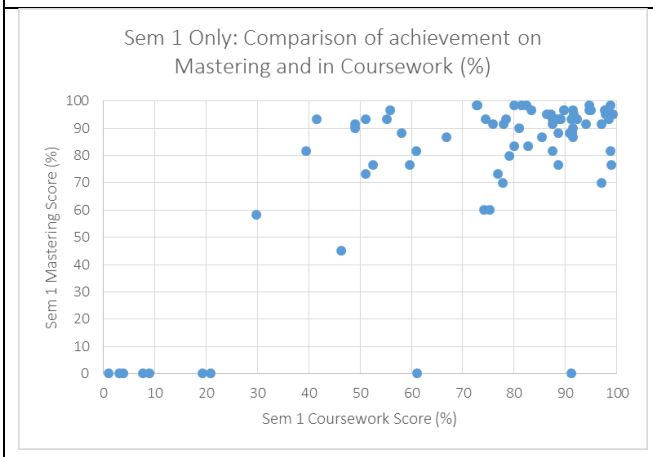
Average achievement for each ***assessed*** element is detailed below and green indicates the highest score.

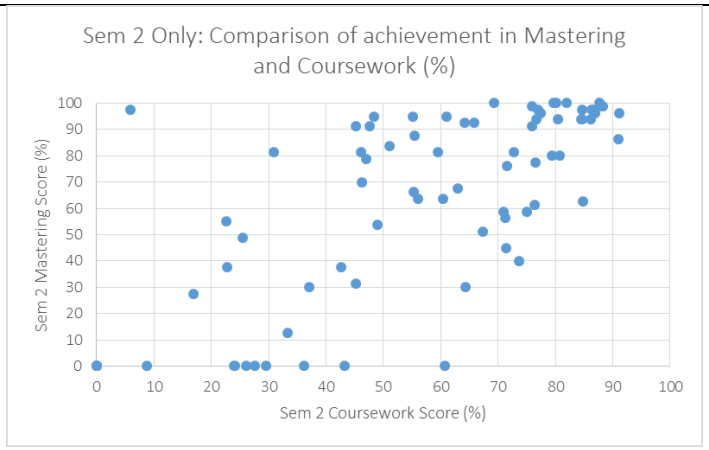
	MEng Assessment (%)	Written Coursework (%)	Exam (%)
Semester 1	73.4	77.8	63.7
Semester 2	68.3	62.7	67.9

Achievement on Mastering was differently distributed in Semester 1 and Semester 2. In all cases there was a wider spread of scores for Mastering in Semester 2. This is true in both coursework and exam. The exam in Semester 2 only had one question and so we would expect a different distribution of results from one question.







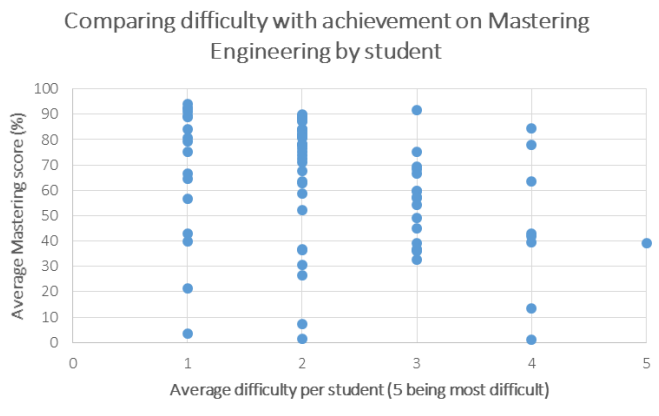


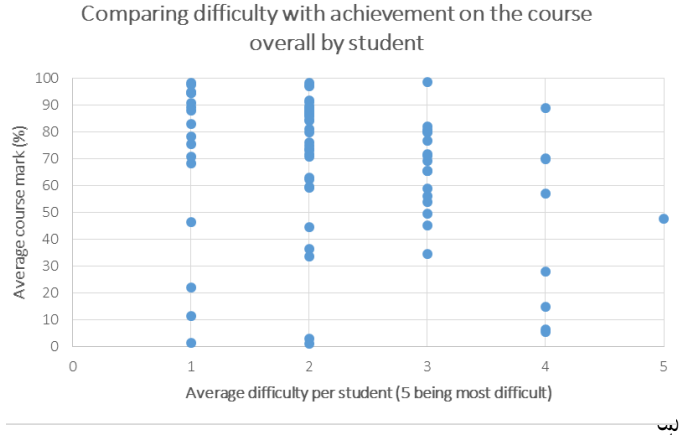
How did individual difficulty ratings affect achievement?

More students completing Mastering assignments with a level 1 or 2 (low) difficulty rating received an average Mastering mark above 60%. More students completing Mastering assignments with a level 1 or 2 (low) difficulty rating on average received a course mark over 70%.

Findings & Implications. Difficulty ratings allow us to make some assumptions about the ultimate success of a student on the course because the more difficult a student found the assignment, the lower their course mark (r=-.32, p=.004)

Target support. Early support for students with difficulty rating above average i.e. more difficult than average is to be encouraged as they are most likely to receive lower exam and course marks.



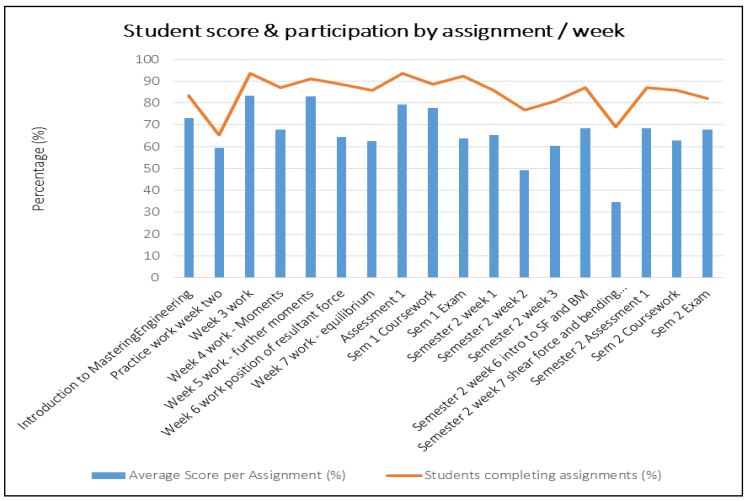


Participation & Activity

Participation in this course was outstanding - high and consistent. On average 85% of students submitted each assessment. **In Semester 1 it was 90%, in Semester 2 it was 81%.**

Semester 2 saw participation decrease by 9% though it remained outstanding against a benchmark of 56% found on 3 other courses running 2015-16*.

*Average participation for a Mastering Engineering course of one semester based on a small sample of 3 other UK courses, all integrated differently, not all for credit, with an average 123 students is 56%



Findings & Implications. This course assigned credit and had a clear structure, an engaged teaching team who monitored, supported and discussed online work.

Support Engagement. Structure, credit, engaged teachers and follow up in class are all likely to have contributed to consistently high participation levels. This has been found in other studies where participation has been maintained at a high level and/or scores have been high, such as Lancaster MyAccountingLab and Swansea Law piloting REVEL. These courses did not have credit, but had structure, engagement and monitoring.

Activity / Engagement

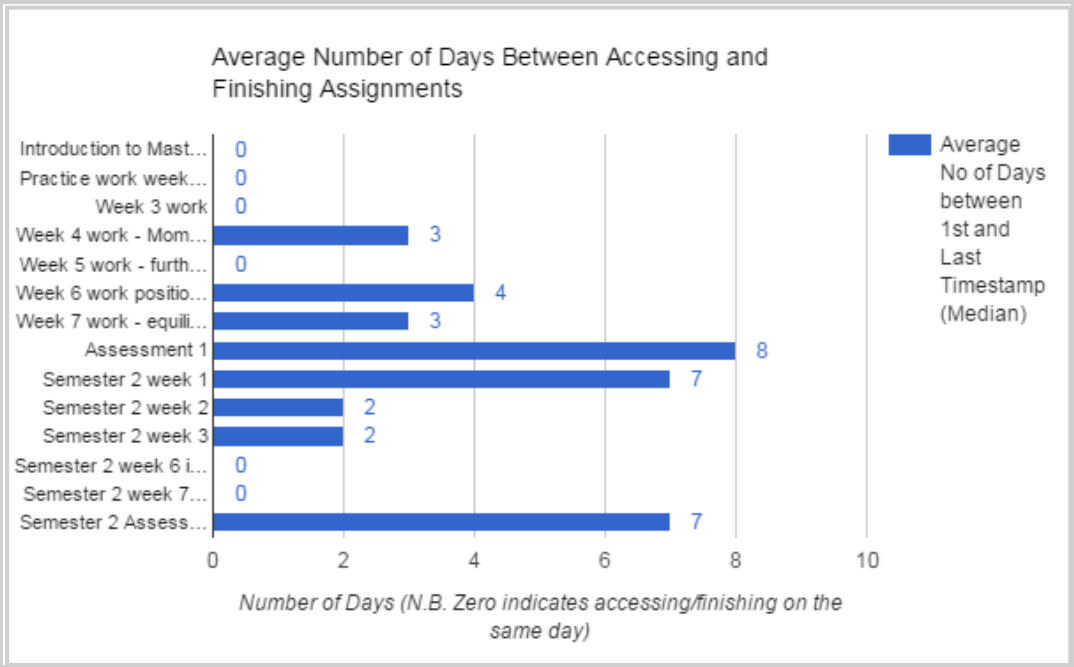
The aim of this section is to uncover any trends in student access and activity in order to inform engagement strategies.

1. Assignments were, on average, submitted within 3 days of the first time students accessed them* (this is most likely to have been in the problem class on a Tuesday). Not all assignments are completed quickly, but none took over a week to complete apart from the first assessment. This is likely to be a reflection on the clear course structure over a 7 day period.

   The number of days taken to complete an assignment or assessment may be a reflection of many things. Some of these might be worth understanding better from students themselves e.g.:

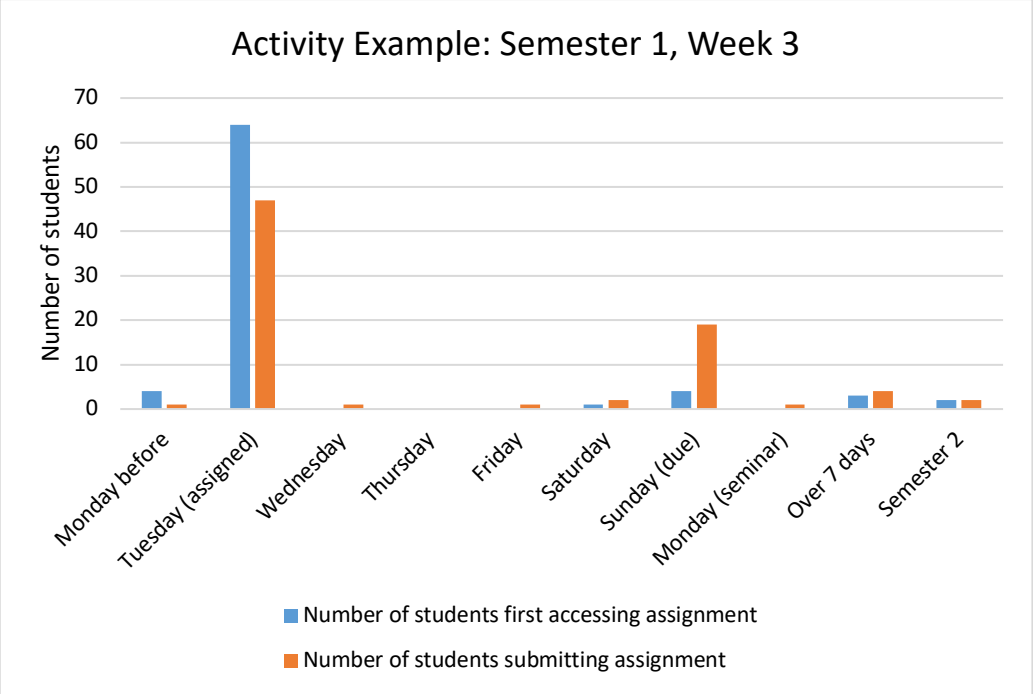
   - the importance attributed to the work (assessments worth 10% for example)
   - other student commitments / deadlines
   - student understanding of the deadline, for example, in the first week of Semester 2 (7 days).

*The time between accessing an assignment and submitting is shown below as an average for all students.

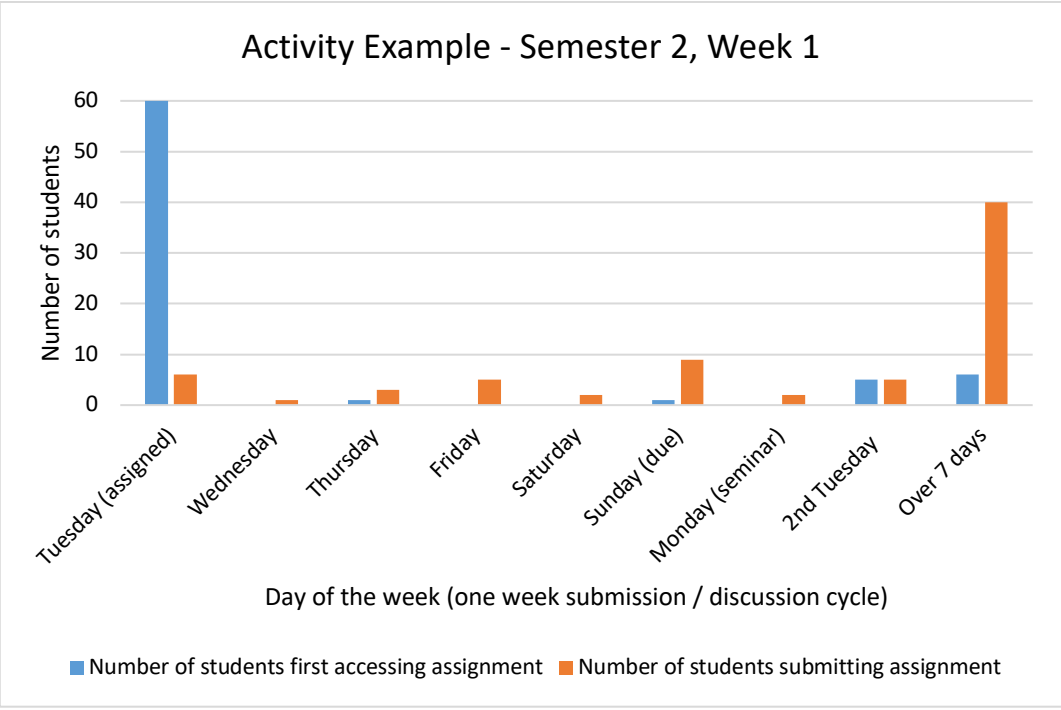


2. When did students do their work? It may differ by week but taking some examples helps us to make commonalities more transparent.

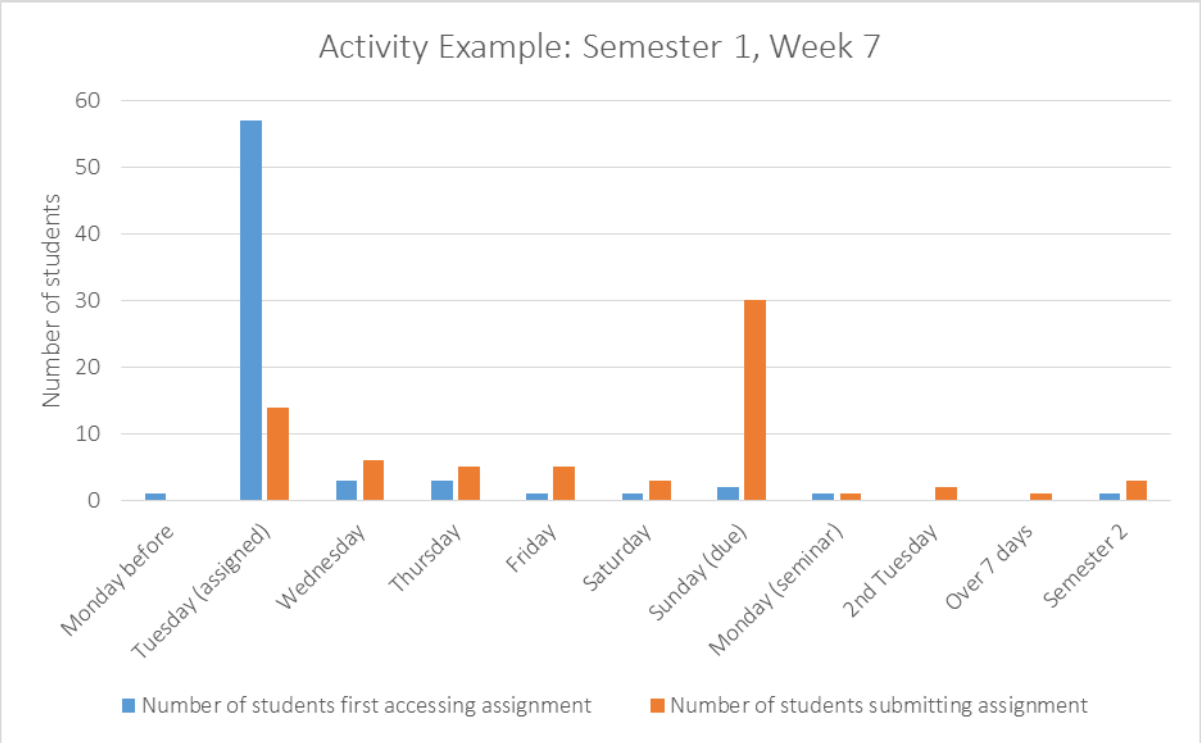
   Example 1: Students complete in their problem class (Tuesday) or on the day work is due (Sunday).



Example 2: longest assignment completion. Students on average took an unusually long time to complete this with a slight peak on Sunday when work was due. This is such an unusual week that it maybe worth discounting.



Example 3: Typical week. Average 3 days to access and submit assignment. Quite average participation and scores this week.



Findings & Implications. It is common to see work completed on a Sunday due to the deadline set (Sunday 11.59pm). Students are seen to be motivated by deadlines in other studies too e.g. Exeter MyAccountingLab. Sunday allows students the free time to complete their work and is a fair, considerate and practical day to select.

Most students complete work on a Sunday (due date) or a Tuesday (practical session in lab). Late completion is not common, assuming one 'unusual' week in example 2. It may be a week worth reviewing for next year in case there was any difficulty for students.

Student Experience

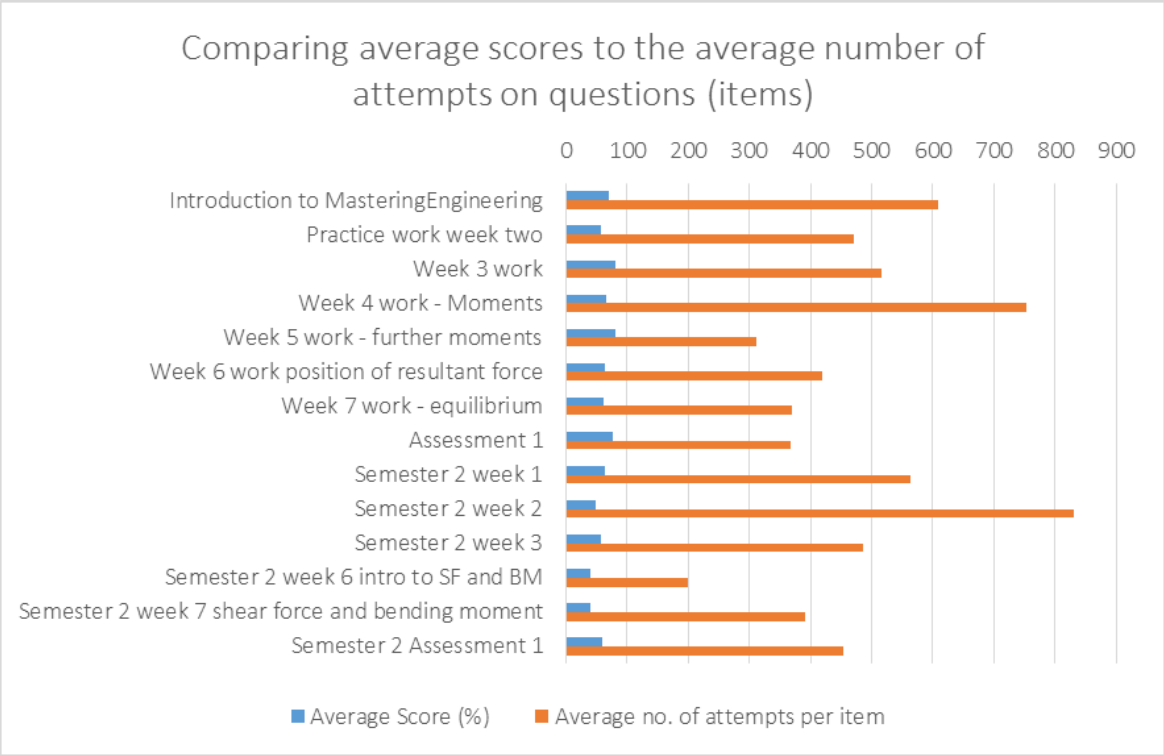
Some definitions:

Number of attempts: number of times a student tries to do the assignment. All assignments contained a different number of questions (items).
Items: A question in an assignment.
Hints: Students can ask for hints to help them solve the problem (where possible)
Solution Checks: Checking the correct answer (where possible)

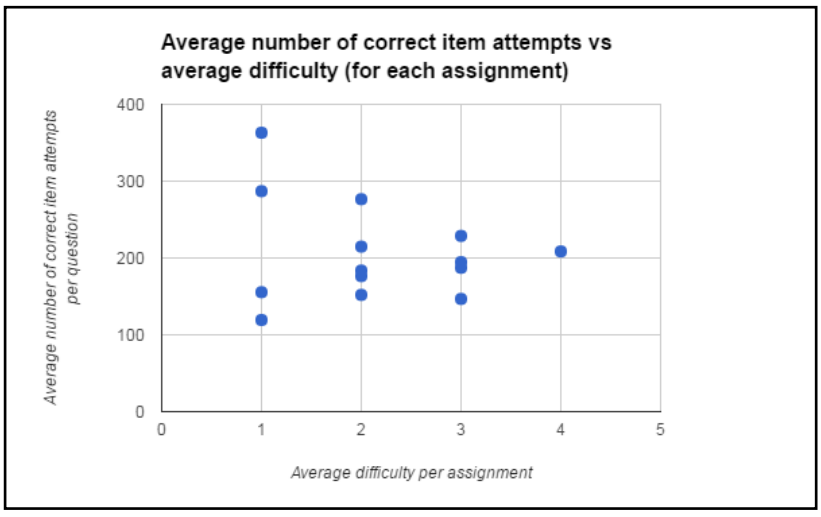
1. There is no obvious connection between the average number of attempts and the average score achieved. Average attempts did decrease slightly in Semester 2.

   More attempts may be a sign of good engagement with the course e.g. Week 1 to 3 and Assessment 1 have the highest number of attempts.

   This is a fairly typical view of engagement in the first 3 weeks and for credit-based assessment.



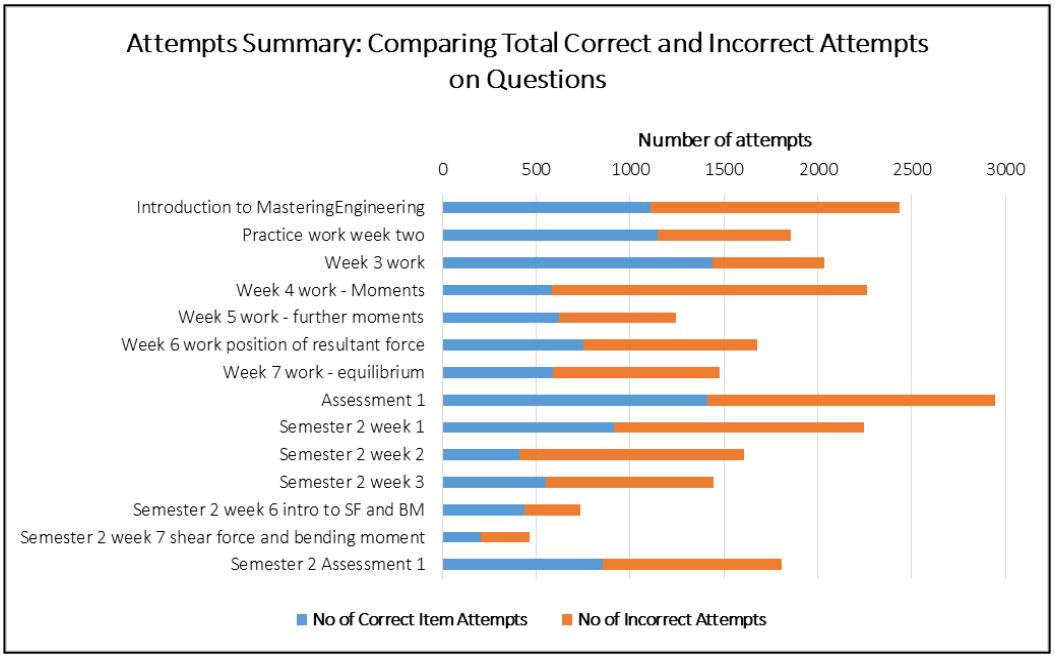
2. There was no clear link between the average difficulty of an assignment and the number of item attempts overall. Difficulty did not motivate or demotivate by that measure.

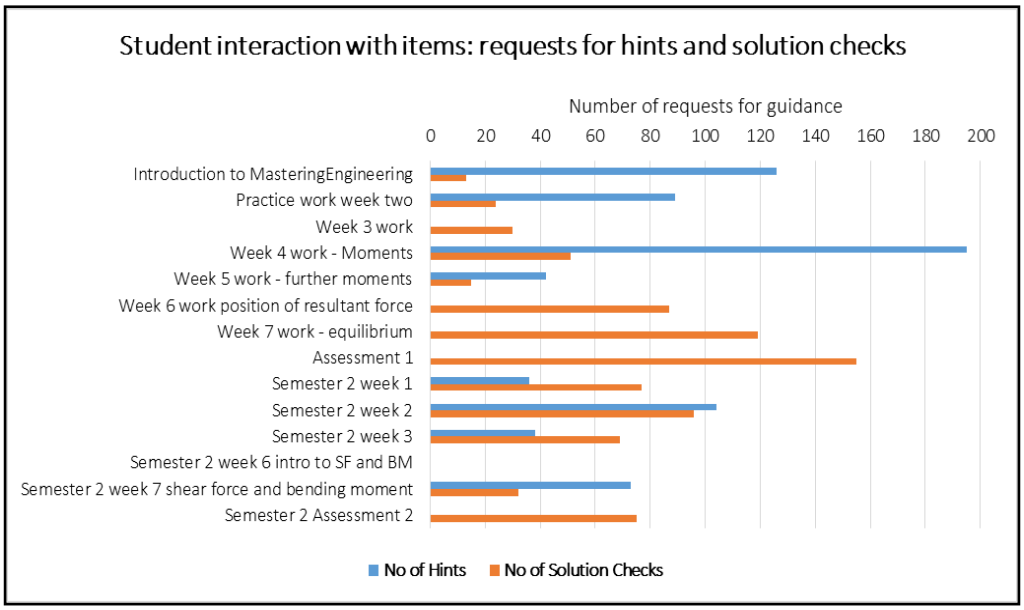


3. If we also look at the occurrences of student requests for guidance we can see that Week 4 created the most requests for hints. There were also a high proportion of incorrect attempts to correct attempts. This appears to have been a difficult week for students. Scores from Week 4 remained good, just under 70%.

   Solution checks increased over the year. It peaked at Assessment 1.

   *all attempts on all questions, all assignments had a different number of questions.





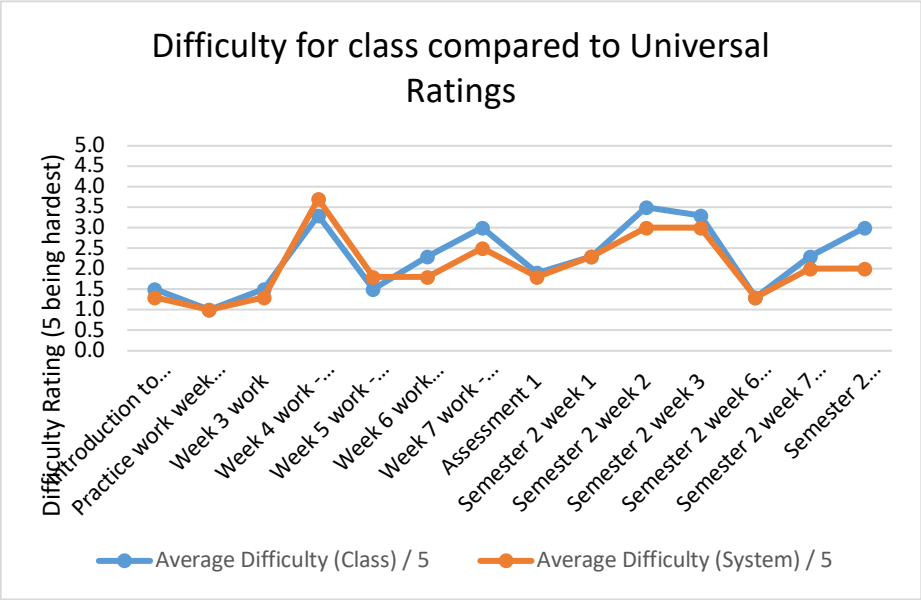
Findings & Implications

- The number of times a student attempted an item had no obvious connection to achievement but might reflect overall engagement with the week.
- Requesting hints and solutions demonstrates a measure of engagement, it might also act as a guide to content students find difficult which could be revisited in seminars
- The difficulty of an item did not seem to demotivate (or motivate) a student.

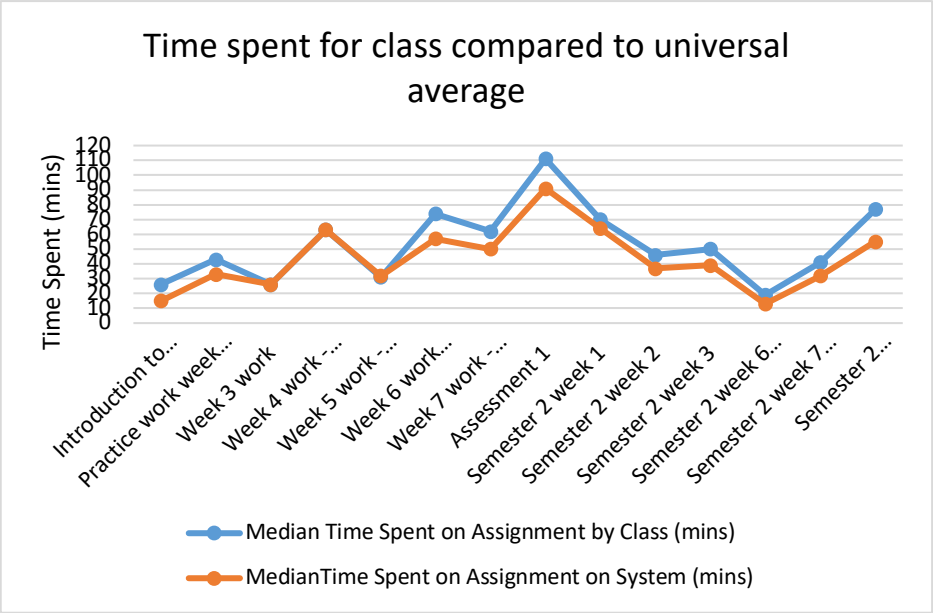
Class Comparisons

Mastering Engineering is able to assess the difficulty of material (1 is least difficult up to 5 most difficult). It learns through all the answers it receives and produces a universal rating for each question. By taking the class average and comparing student performance to these worldwide averages, we are able to benchmark student performance in the class.

In this case, students were on par with worldwide averages. The biggest difference was of 1 rating point for Semester 2, Assessment 1.



Students were on par with the pattern for universal averages for the time spent on assignments. More time was spent on the Assessments in Semesters 1 and 2. More time was also spent on Week 6, Semester 1 (position of resultant force).



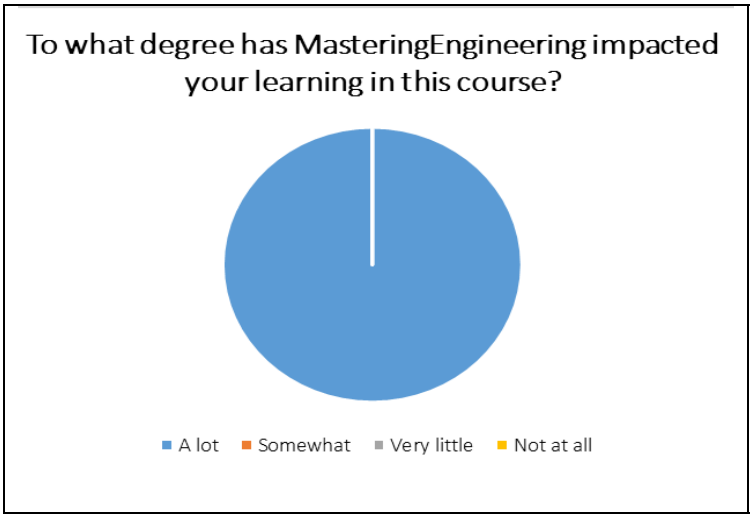
Student Survey

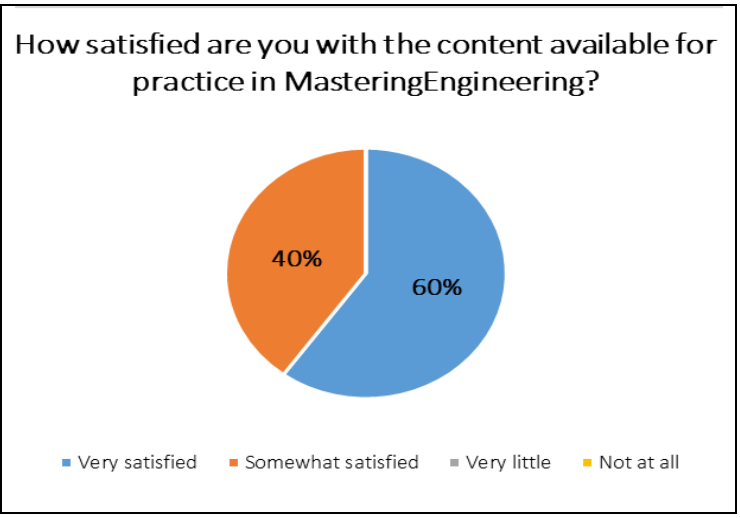
Response to the survey was extremely low at just 5. This was self-selecting. The verbatim comments received have been summarised in a thematic way despite the low response rate.

Satisfaction

In general, how comfortable do you feel using technology (computer, iPad). Using a scale from 1 to 10, how would you rate your level of comfort with the use of technology? **Score: 9.8/10**

How likely are you to recommend MasteringEngineering to another student? **Score: 8.2/10**





The themes which emerged from verbatim comments about the benefits of using Mastering Engineering can be summarised as:

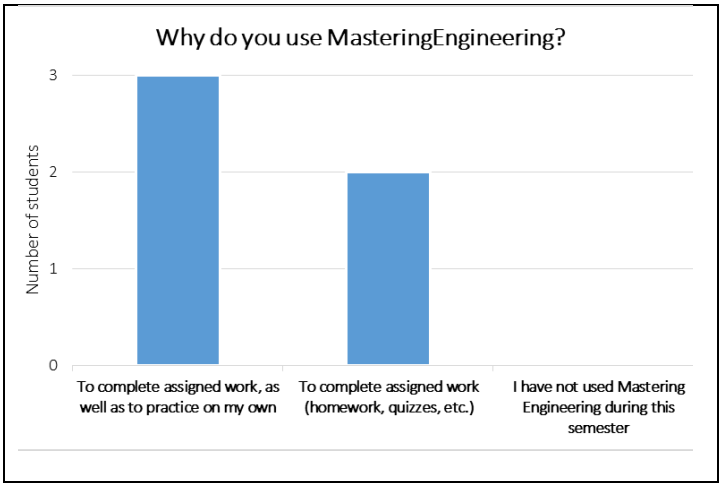
- opportunity for additional practice (3)
- its relevance to the course (3)
- user-friendly (2)

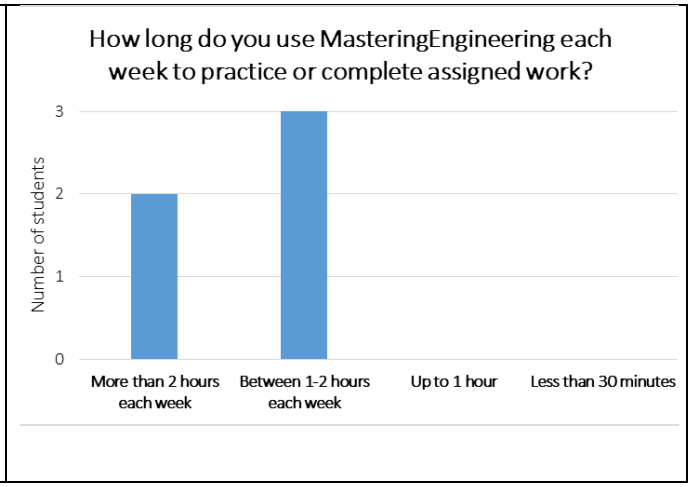
Themes emerging from verbatim comments about the challenges included:

- the use of American notation (2)
- feedback (1)
- drawing interface (1)

Access, Usage, Engagement

Were you able to access your MasteringEngineering assignments? All students said 'Yes'.



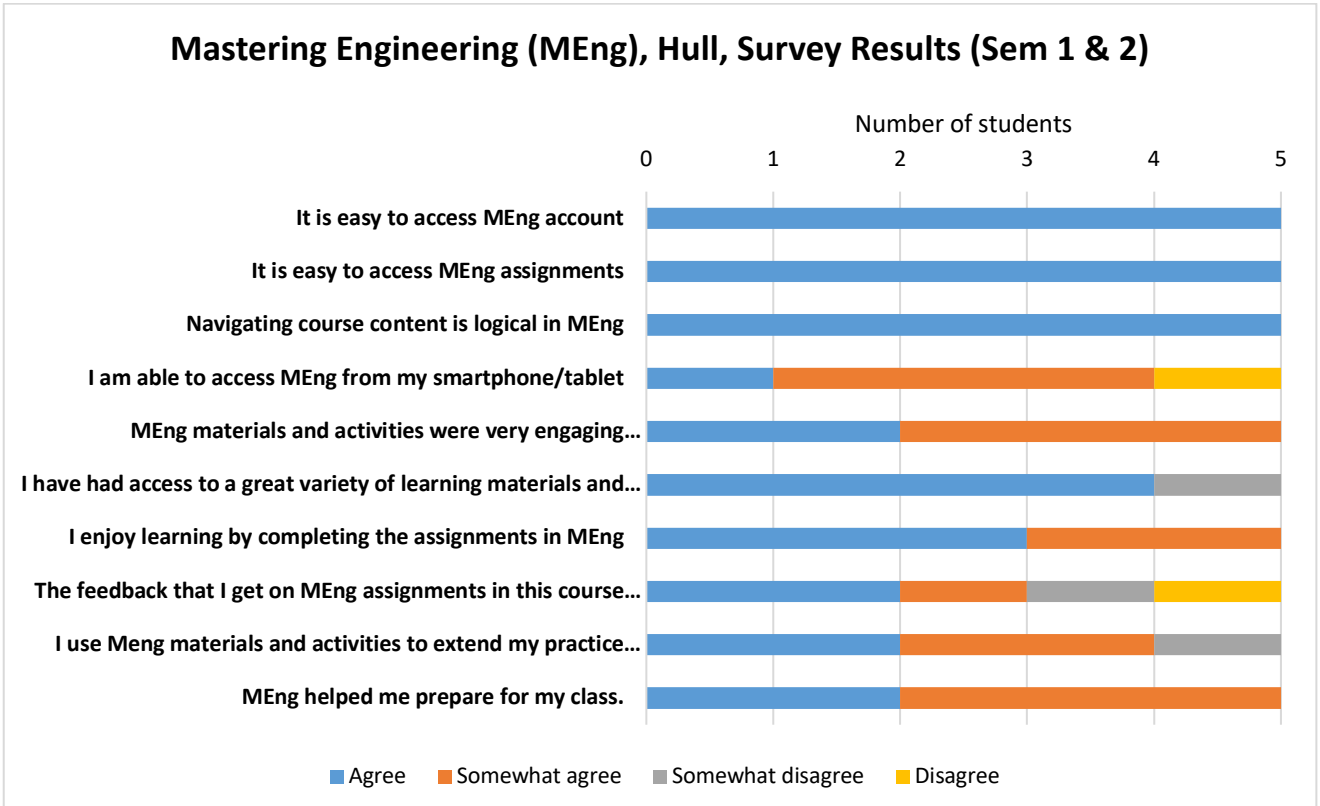


The student survey question with the highest level of agreement was:

- 'It is easy to access Mastering Engineering account'
- 'It is easy to access Mastering Engineering assignments'
- 'Navigating course content is logical in Mastering Engineering'.

The student survey question with the lowest level of agreement was:

- 'The feedback that I get on MasteringEngineering assignments in this course helps me understand how to improve'
- 'I am able to access Mastering Engineering from my smartphone/tablet'



Recommendations

1. Targeting student support. Monitoring student achievement on Mastering assignments helps teaching teams to target additional support to a specific set of students before the final coursework or exam. Students scoring less well on assignments would benefit from additional support in advance of course exams and coursework where they tend to score less well than students gaining higher marks on Mastering.

2. Targeting student support. Offering support to students who have relatively high difficulty ratings for assignments actively supports the students who perform least well on the course overall.

3. Motivation / engagement. Sharing the finding that those who spend more time on Mastering Engineering also perform better on the course assists the teaching team in motivating Semester 2 engagement.

4. The course structure, the credit assigned and the support of the teaching team is very effective in engaging students.

5. Activity: The structure appears to work well as most students appear to have time on a Sunday to complete their work. Support in class encourages activity on a Tuesday.

6. Content: Reviewing the number of incorrect attempts on a question (an item) and the number of hints opened in a question may show content which was more difficult or complex for students.

Appendix

The full list of questions included in the student survey are listed below:

In general, how comfortable do you feel using technology (computer, iPad). Using a scale from 1 to 10, how would you rate your level of comfort with the use of technology?
Were you able to access your MasteringEngineering assignments?
Please indicate the level of agreement or disagreement with the statements below: [It is easy to access MasteringEngineering account.]
Please indicate the level of agreement or disagreement with the statements below: [It is easy to access MasteringEngineering assignments.]
Please indicate the level of agreement or disagreement with the statements below: [Navigating course content is logical in MasteringEngineering.]
Please indicate the level of agreement or disagreement with the statements below: [I am able to access MasteringEngineering from my smartphone/tablet.]
Why do you use MasteringEngineering?
How long do you use MasteringEngineering each week to practice or complete assigned work?
MasteringEngineering materials and activities were very engaging throughout the course.
I have had access to a great variety of learning materials and assignments in MasteringEngineering.
I enjoy learning by completing the assignments in MasteringEngineering.
The feedback that I get on MasteringEngineering assignments in this course helps me understand how to improve.
I use MasteringEngineering materials and activities to extend my practice time until I completely understand my lessons in this class.
MasteringEngineering helped me prepare for my class.
How satisfied are you with the content available for practice in MasteringEngineering?
What have been the benefits to you of using MasteringEngineering?
How likely are you to recommend MasteringEngineering to another student?
To what degree has MasteringEngineering impacted your learning in this course?
What have been the challenges (if any) in using MasteringEngineering?