Pearson

Mastering Engineering

University of Hull, UK

How to embed and deliver effective online assessment in a changing HE landscape

Version 2

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Context:
2015-2020 Study

About the resource

Mastering Engineering is a digital learning resource designed to work alongside specific print or eBooks. It provides a variety of different question types which can be studied independently or assigned by the lecturer as formative or summative assessment. Tutorials guide students through engineering concepts in multi-step problems, which also provide feedback specific to students' errors. Optional 'Help Me Solve This' hints break down the problems into smaller steps. The Mastering gradebook records key data, such as automatically graded scores and lecturers have access to diagnostic charts providing unique insight into class and student performance.

Key Findings

Dr Catherine Dobson originally introduced Mastering Engineering into the Fundamentals of Mechanical Engineering module at the University of Hull in 2011/12. Given the length of time Mastering has now been in use, we have designed a study which draws together previous and current findings. By using an in-depth study conducted in 2015/16 and new research compiled in 2019, the full study details impact on leaners and investigates trends over four years of Mastering Engineering use on the same module.

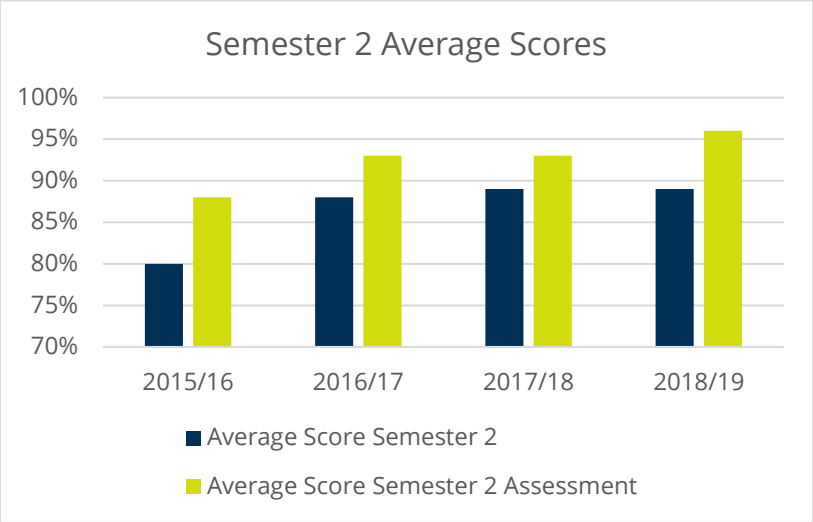
The full study can be found online at https://www.pearson.com/uk/educators/higher-education-educators/success-stories.html.

Statistical analysis from 2015/16 demonstrated that:

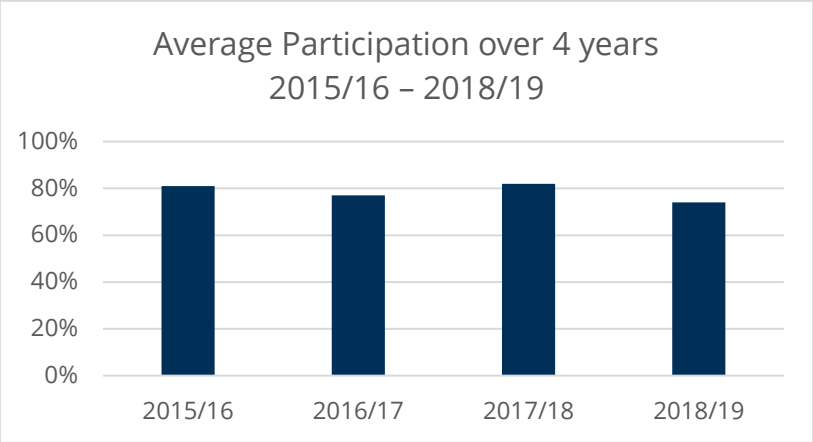
1. **The better a student did on Mastering, the better they did in their Exam**
   Strong – medium correlation Exam Semester 1: r=.80, p<.01; Exam Semester 2: r=.41, p<.01
2. **The better a student did on Mastering, the better they did in their Coursework**
   Strong, positive correlation Coursework r=.73, p<.01
3. **The more difficult a student found the assignment, 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

While detailed statistical analysis wasn't possible for the 2018/19 cohort, looking at the data over five years we find:

- **Consistent performance**: Average overall scores on Mastering remained consistent year on year, ranging between 86% and 91%.
- **Supporting attainment & progression**: In the last three years, scores have increased incrementally on Semester 2 Mastering assignments and the final Mastering Assessment compared to 2015/16, while maintaining similar average scores in Semester 1.



- **Participation:** Mastering remained a reliable, consistent way to engage students over four years, suggesting that the clear structure, support and implementation provided an effective, compelling way with which to motivate students to connect to their studies.



Semester 1 data for **2019/20** indicates that Mastering participation has increased to 80% in Semester 1, even while lower face-to-face attendance continues to challenge the teaching team.

- **Consistently positive student experience:**
  - **8.2 out of 10** for Mastering Engineering in 2015/16: in response to the survey question 'How likely are you to recommend Mastering Engineering to another student?'
  - **100%** of students thought that Mastering had **impacted 'a lot' on their learning** in 2015/16.
  - In 2018/19 module evaluations, positive student comments about Mastering Engineering were common e.g. ***"Mastering Engineering software has been extremely helpful and encourages you to do the work every week as it is graded."***

Brief recommendations for successful practice

Mastering Engineering is an integral part of the undergraduate engineering course at the University of Hull. In a changing university landscape and with changing student behaviours, it continues to:

- promote student engagement
- provide added value to students through flexible access to online learning materials
- allow lecturers to detect patterns of student understanding in different topic areas
- allow lecturers to monitor their students' achievement and ensure they are continuing to progress, especially in more difficult topics
- offer support and encouragement to any students that are not engaging early in the course
- mobilise student participation in learning activities throughout the course.

The full study indicates that when Mastering Engineering is well integrated by staff and students, it produces consistently positive results and positive student feedback over time. Key elements of this success appear to be that it is:

1. well integrated using a clear, consistent structure
2. the online resource is clearly linked to lecture content / teaching time and is timetabled effectively
3. assignments are set for credit
4. lecturers monitor student achievement, intervening to support where necessary.

"[We are] improving engagement and being able to detect people that are not engaging early. We feel that it's beneficial to the students and the staff."

– Dr Catherine Dobson, Head of Engineering, University of Hull

Learning lessons in the art of delivering effective online assessment

Learning lessons in the art of delivering effective online assessment

With five years of experience delivering the same module – and the same content – with Mastering Engineering, Dr Dobson has reflected on the key things she has learned about effective implementation of online assessment. She summarises what she would do with a blank sheet if designing a course with online assessment as a key component, based on her own experience and backed up by students' experiences.

Motivating participation with credit

As noted earlier in the study, attendance at face-to-face lectures was observed to be decreasing year on year, while the level of student participation in the Mastering homework stayed fairly consistent. Across a number of similar educator studies, we have seen that credit is one of the biggest motivators for student participation and this is borne out at this institution too.

"If it's not credit-bearing, it doesn't seem as important or as urgent, so students are less inclined to do it." – Dr Catherine Dobson

When considering how to motivate students with continuous credit and yet not being able to set additional assessments, Dr Dobson reflected on a study completed at Queen's University Belfast[4], where students were *required* to complete the practice homework before being able to access the assessment: *"That would be one way of encouraging the students to engage in the practice without assigning credit for a higher number of assessments."*

In the words of one student we interviewed, this credit is really what makes it such a compelling piece of work to engage with.

"Why would you* not *do the online work, when it has credit? You get to chip away at your grade throughout the year." – Student

Encouraging regular participation with deadlines

Over the first four years of usage, weekly deadlines ensured students worked and developed their understanding of the course content consistently throughout the module. Moving to one deadline hasn't impacted participation overall, in fact it's been higher than in previous years, however it seems as though the overall student learning experience *has* been impacted.

"With one deadline they just left it and didn't attempt it week-by-week as I wanted them to, helping them to learn cumulatively." Dr Dobson has seen that this regular study leads to better learning outcomes: students are building their knowledge and practising problems throughout the course, rather than cramming at the end to pass the exam.

Students themselves told Dr Dobson, 'We like deadlines because otherwise we just won't do it.'

"When you get work set every week it forces you to engage a bit more. …I'd say it definitely helps with getting people to engage with the work. If you don't do the work, you won't really have the practice you need to understand the next week's lecture." – Student

"Anything that's going to have weekly small assignments is always going to run better than one large assessment at the end. It makes it so much easier to keep track of your work and keep on top of it." – Student

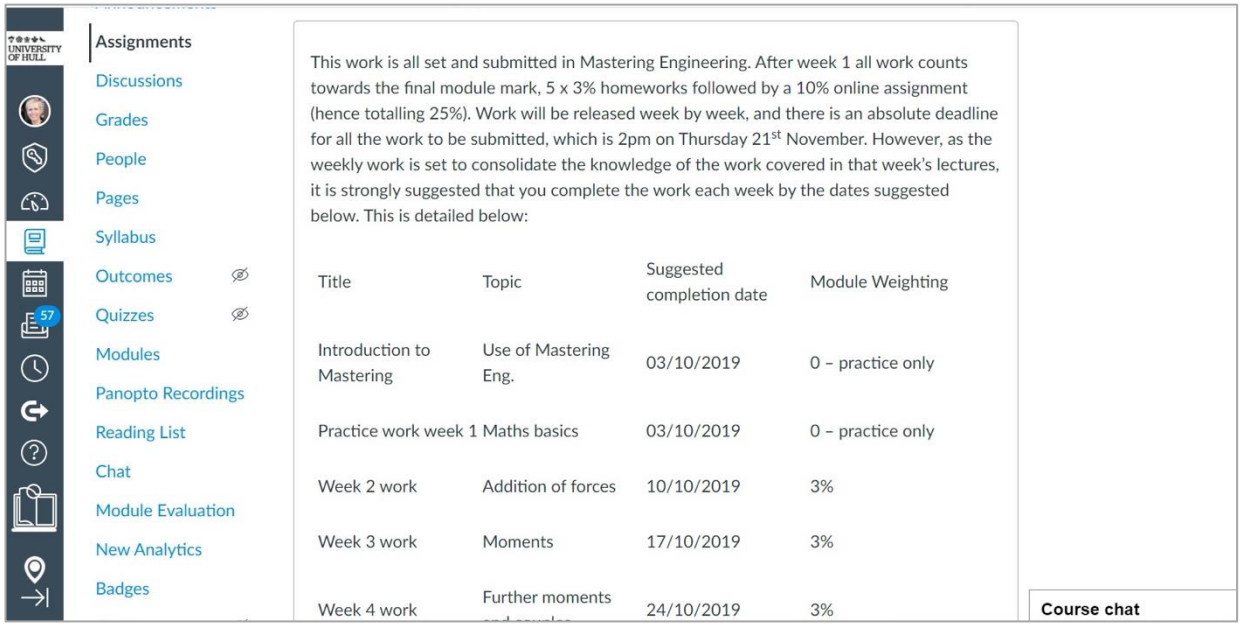
In the years prior to 2019/20 Dr Dobson found that the review classes alongside Mastering worked really well. *"There was the opportunity to go over the previous week's mastering homework and show students how to solve the problems that they struggled on. The students who attended found it really useful – that was often when I would see the penny drop – and they would go on to do better in the next homework."* That is only possible with weekly deadlines; another reason to have those regular deadlines in place.

Making Mastering an integral part of the course

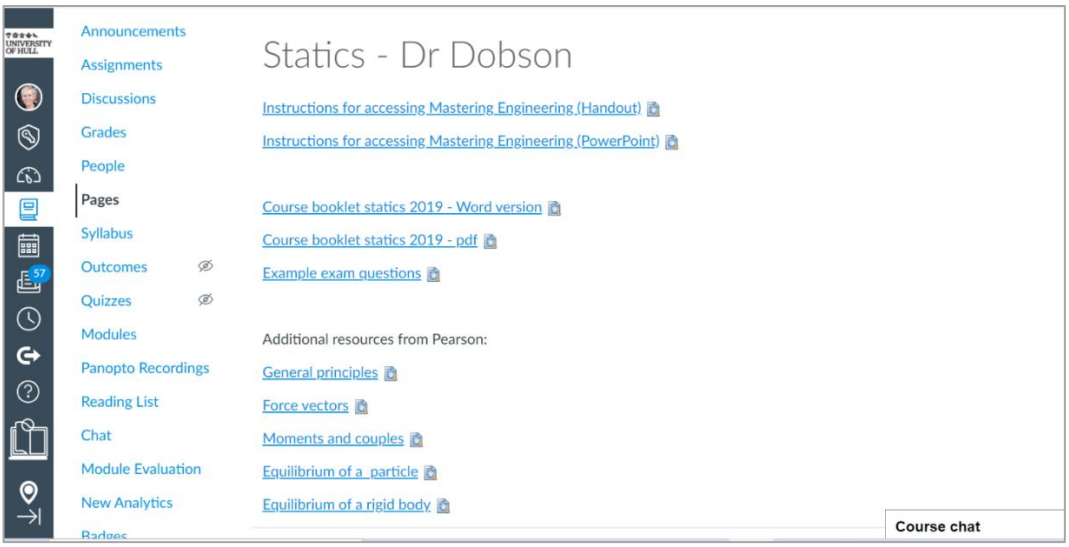
The online component of the course delivered through Mastering needs to be very clearly integrated into the course overall. Dr Dobson has a number of recommendations on how best to do this:

1) VLE structure

Set up the online assessments that students will be doing throughout the whole course *before* the start of term and ensure that this structure is visible and easily accessible on the VLE. Clarity and planning is key here.



Draw students' attention to **specific support resources** that will help them with their study in general and the online assessment in particular. Dr Dobson links directly to videos and PowerPoints from Mastering on a clearly organised course resources page on the VLE.



2) Workbooks and lectures

As part of this module students receive a printed workbook which contains all the **lecture slides**, for them to fill in and take notes alongside, and also the **problems that they will be doing on Mastering each week**. Dr Dobson finds that having them in the workbook meant that students can see clearly how the homework aligns to each lecture and how much work will be involved. Also, it *reminds* them to do the homework and provides them with a space to write down their problem workings so that everything is in one place and in the correct order to support their revision.

"Students say that they've kept the books and refer back to the workbooks years later." – Dr Catherine Dobson

This clear, blended integration is crucial to student motivation. Where Mastering is used on another module, but is not clearly connected to lecture content, students reported to Dr Dobson that they were more confused about it and less inclined to complete the work. This served to highlight the value of Dr Dobson's approach for their continuous learning.

"You can tell how meticulously she [Dr Dobson] plans. Everything that she puts on Mastering is there because we need it; you know it's always going to be related somehow." – Student

3) Problem classes

Each week after the first lecture students had a problem class, in which they were encouraged to **start that week's Mastering homework** straightaway, with the lecturer and PhD students available to support. Dr Dobson says, ***"They can get started on it, we're all on hand so we can get them going. I think they appreciated that."***

Our analysis in 2015/16 showed that students tended to do the most work on Mastering in that problem class and in the final hour before the weekly deadline, so this is another useful suggestion for fully integrating the online assessment into the pedagogical structure of the course. In 2019/20 students still had tutorial classes where PhD students were available to go through homework problems.

"The PhD students were really good, they guided you through without giving you the answers." – Student

"I went to the tutorial every week to get help on any questions I was struggling with." – Student

4) Revision resource

The clear structure of the course set out in the booklet means that Dr Dobson can advise students on the best way to revise for the final exam: ***"Read the lecture notes, do the problems that we did in class again, re-do all the Mastering problems and then look at previous exam papers. They can then revise in an organised way."*** By further integrating Mastering into the learning design of the course students are even more motivated to make good use of it.

"I found it really good for revision. I could go back through any one topic and just do a set of problems specifically based on that. [...] It gave me that confidence to say 'know I can answer that question.'" – Student

Communication

Monitoring student participation and communicating regularly with the whole class, as well as with specific students, is vital to driving engagement:

"I would check Mastering and see how many people had engaged and I would verbally remind them in class. Anyone who hadn't engaged, I would email individually." – Dr Catherine Dobson

"Sometimes there are announcements from the lecturer saying that some people aren't doing their work. She's very pro Mastering, people that want to do well are straight on Mastering. It makes it a lot clearer and everything is in one place. It's brilliant because we wouldn't be so keen on doing it if Dr Dobson didn't put it forward." – Student

Building a supportive future around online assessment

COVID-19 – the immediate impact and long-term effects

A seamless shift to online assessment

The students in this cohort were already familiar with regular online assessments and were therefore less phased by other module assessments being moved to online – they felt more prepared for it. It was also convenient for the academics who could either run additional or adjusted versions of their existing online assessment set-up.

"Without Mastering you could feel very swamped with emails going back and forward with lecturers. At least with this, lecturers have got a platform to say 'Work through it and let me know if you have any problems.' ...As long as you've got internet, you're good to go. It's really helpful." – Student

"For the [Semester 1] assessment in Mastering it was easy to do because we were prepared for it – the format was the same and I knew what to look for in the question." – Student

"In the current situation [the pandemic] it's good that we have Mastering so we can do the online learning." – Student

The future of assessment

Universities had various approaches to delivering assessment during the national lockdown, ranging from giving full or additional module credit for coursework already completed (either online homework assignments or paper-based written work) to delivering time-limited exams within a 4-hour window. A number of institutions, including Hull, decided that in this unique situation a 'no detriment' policy was the best way to support students with the sudden move to online assessment wherever they were. Dr Dobson considered that these extended deadlines actually made it too vague for students, *"the deadline kept moving so they didn't know how to plan their work – most people seem to be guided to work to a deadline, so as that keep shifting the impetus was lost."*

Following this Dr Dobson (along with institutions and academics across the UK) has reflected on assessment and what the future may look like in terms of the quantity and type of assessment provided: *"I think there will be a lot less assessment and it will a lot stricter on assessing a learning outcome once. I wonder about the future of exams: an exam is good way of assessing certain knowledge, but I don't think they will be used as widely."*

Students also discussed their thoughts on ongoing assessment versus end of module exams, including exam nervousness, the weighting of coursework and the real-life application of assessment:

"I'm a coursework person. I think the weighting [credit] we're given is fair, although I'd like it to be higher because I think basing it [our success] on just our exam isn't hugely accurate." – Student

"I was worried about the maths exam, but it was a lot easier being online, because you could do it anytime within a week and you could use your lecture notes." – Student

"I feel like I've done better not having an exam and having an assignment-based module. [...] Exams make me nervous. With an assignment I've got all the notes in front of me and I'm organised and I know where to look and how to get to my solution. [...] It's more real-life." – Student

Creating a sense of belonging

When students are together on campus, they form friendship groups within their cohort and often work on Mastering problems together – Dr Dobson believes this collaboration is crucial for engineering as a subject, where there are also formal group learning activities on a number of modules. *"We need to be using an array of online tools and to get the balance between online large-group lectures and smaller group or individual sessions. It's going to be a lot of work for academic staff and it's also important to avoid too much overuse of video conferencing software."*

Dr Dobson admits that it's really hard to replicate that face-to-face, collaborative problem-solving experience online, *"No matter how good the technology and how tech-savvy we think students are, this is a challenge. We need to look at guiding them because, so far, they're trying to figure it out themselves without really knowing how."*

"If you have a problem it's hard to explain to a tutor over the phone or over an email. I still contacted my course mates via Facebook, but it was difficult; we were sending photos and highlighting where we think we were going wrong." – Student

One student talked specifically about that need for balance and how the online learning experience can present additional problems:

"There needs to be fine balance between online and face-to-face – it's hard to engage online all the time. [...] It's hard to find the motivation. [...] I'm less anxious about being curious and asking questions in person – it's harder in the online interface. I miss the human interaction." – Student

Replicating the problem classes online

When campus was closed, and everyone was in national lockdown, students couldn't attend face-to-face problem classes, but Dr Dobson still wanted to provide the same kind of support. She scheduled an hour per week when the PhD students were available to contact via the Canvas discussion boards – this encouraged the students to only contact the PhD students when they were being paid for their time, rather than emailing them randomly throughout the week. Dr Dobson found; *"From the feedback I got, I think students made good use of this."*

Summary of lessons learned for online assessment

For anyone getting started with building online assessment, Dr Dobson's main advice is:

"You need to know what you want to achieve but you can start small setting just a few problems for the students and building up. If you have strict regulations, devise a strategy to work around but within that, so that you can assign some credit and make it the best learning experience for the students. Don't have the online platform and homework as an aside, it has to be central to the course."

To conclude, Dr Dobson outlines what 'good' looks like for online learning and assessment:

"Clear, well planned out assessment strategy. Having a schedule that the students are aware of, so they have a good overview of where the course is going. Providing credit so the students assign value to the homework and therefore benefit from the learning. Weekly deadlines to drive regular engagement."

References

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