To ‘Flip’ or not to ‘Flip’? Reflections on the redesign of an Undergraduate Operations Management course

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Abstract
Despite advances in teaching technologies the traditional classroom is still the norm. We draw on experience of ‘flipping the classroom’ for first year undergraduate students to explain how online videos, guest speakers, in-class tests, and group assessments can be used in a complimentary manner. Resonating with the literature perspectives, we observed that combining these teaching methods contributes to pedagogical excellence by addressing various learning styles. Nevertheless, the experience shows some of the challenges to achieve the shift towards flipped classroom. Based on the experience we provide ten design principles for the flipped classroom.

Keywords: Operations Management teaching, undergraduates, flipped classroom.

Introduction
‘Flipping’ the classroom has become a topic of increased interest to educators (Bishop and Verleger, 2013). This approach places students at the center of the learning experience and means that they will not be just passively receiving information. A flipped classroom can take various forms such as interactive engagement, just-in-time teaching and peer instruction (Berrett, 2015). A range of media can be used – including videos, articles, podcasts and blogs – that students engage with prior to class. The classroom is then used as a ‘live’ environment where the focus of work moves from transmitting knowledge to striving for comprehension, application, analysis and synthesis (cf. Bloom, 1956). In this paper we reflect on running a flipped classroom for a first year Operations Management core course for an Undergraduate class of 300 students. In particular, we provide an overview of the curriculum and share resources and the students’ assessments of the learning experience.

Context – The original design of the course
The course we teach is a core course for first year Business and Management Undergraduates at a top 10 UK University and regularly has over 300 students. In the past, the course was taught in a standard way. Over nine weeks, students would have a two hour lecture and one hour seminar every week. Assessment was conducted by an end-of-term examination (80% of the final mark) and group-work (20% of the final mark). The textbook for the course was Slack et al. (2013). The former curriculum for the course is shown in Table 1.
Table 1 – Original Curriculum of the Spring 2014 for first year Operations Management

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Seminar</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Introduction to Operations Management</td>
<td>Concept Design Services Case Study</td>
</tr>
<tr>
<td>3</td>
<td>Process Choice and Process Design</td>
<td>Process Design Case (Lettuces)</td>
</tr>
<tr>
<td>4</td>
<td>Design of Products and Service</td>
<td>Examples of product and service design</td>
</tr>
<tr>
<td>5</td>
<td>Supply Network Design</td>
<td>Disneyland Paris Case Study</td>
</tr>
<tr>
<td>6</td>
<td>Layout, Flow and Job Design</td>
<td>North West Bank Case Study</td>
</tr>
<tr>
<td>7</td>
<td>Planning and Control; Capacity Management</td>
<td>Using Big Data (Journal Article)</td>
</tr>
<tr>
<td>8</td>
<td>Quality Management</td>
<td>Preparation for Group assessment</td>
</tr>
<tr>
<td>9</td>
<td>Lean and Process Improvement</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Revision Session</td>
<td>Exam preparation</td>
</tr>
</tbody>
</table>

The original design of the course used a range of pedagogic mechanisms; from standard lectures, to case studies, to group assessment. We first taught the course in the spring term of 2014. During this period, we identified a range of issues which clearly showed the shortcomings of the ‘traditional’ teaching methods. Above all we realized the vast majority of students started their first revision before the last week’s session. Although attendance and engagement during the classes were satisfactory, a large majority of students showed a poor understanding of even the basic subject matters and we often found ourselves repeating the introductory concepts numerous times. Given the large size of the class (300 students), students had the overall perception that they were not an essential part of the lecture/seminars, thus passive engagement was legitimate. Hence, for many students, 9 weeks of classes only included reading related chapters, case studies and answering a few questions in the classroom. Whilst the post-course student feedback was satisfactory, we felt that we needed to drive greater student engagement with the subject and to redesign the course. This was underpinned by the need to move away from a class environment which drives engagement only before the exam towards an environment which fosters a more personal and meaningful engagement with the subject (Lewis and Maylor, 2007). The redesign needed to take into account that first year Undergraduates have – in our experience – very limited contextual and theoretical experience, are invariably time limited and overly focused on how to do well in the exam.

The new design – incorporating blended learning and expert knowledge

In the Autumn term of 2014 we redesigned the course in order to create extra engagement and a richer learning experience. The design of the course is shown in Figure 1 and Table 2 below. This section presents the overview and rationale behind each of these elements.

Figure 1 – The Redesigned Operations Management course.
On-line videos

The core curriculum was broken up into 5-12 minute segments and recorded as videos in the aim of creating an interactive self-learning experience for students (Arenas-Marquez, et al., 2012). This was done as the type of teaching previously conducted in the course was about creating awareness through knowledge (cf. Bloom, 1956). The curriculum was designed as four blocks and students were asked to watch all videos in the block before the first in-class assessment (week 3). Figure 2 shows the blocks and content. The videos were hosted in a Virtual Learning Environment (VLE) and released in blocks to coincide with the timing of the course. Figure 3 shows the landing page for the course in the VLE.
The landing page was designed to be easily navigated and to include all key notices. Each of the videos were created using TechSmith Camtasia and a tablet was used to create illustrations, write notes and underline important information on Microsoft PowerPoint during the recording. The use of the tablet enabled the presenters to focus the attention of the viewer by highlighting important areas or drawing charts and figures. Examples of these are shown below in Figure 4.

An overview to the course was videoed by the two lecturers in a studio and each block introduced in a short video. These videos allowed the students to identify the
lecturers prior to the course beginning. Only the introduction videos to each block had the image of the lecturers and others only had the slides as the main visual.

Overall the students were very complementary about the creation of videos. For instance, some noted:

“The videos were a really nice way of learning, you can go over bits which you didn't find clear very easily.”

“The online videos allowed me to learn at my pace.”

“Combination of online videos, very interactive seminars and guest lectures, this approach saved time and put emphasis on engagement with the material”

“The block videos are much more useful than a recorded lecture.”

“Having the core theory delivered through videos online allowed you to learn at your own pace and are useful for revision”.

However, we also observed that videos had unforeseen consequences on lecture attendance. As some students had the perception that videos are a replacement to the lectures. Overall this issue was addressed after Week 3 when students were clearly reminded the importance of lecture/seminar attendance. One student pointed out:

“I liked the fact that videos were posted online to help us with content, but in a way I felt less motivated to attend lectures even though the case studies and guest speakers were important.”

Operations in Practice lectures
Operations Management is, by definition, a practical subject. In order to create greater connection with practice, we invited guest speakers from industry. The purpose of these lectures was to provide an overview of ‘Operations in Practice’ and to add contextual richness to the module. In addition, these lectures aided inexperienced undergraduate students to conceptualize operations management, its tools and methods in real-life business environment. As such, four senior practitioners gave approximately hour-long guest lectures on the topics covered for each of the blocks followed by questions from the students. These lectures occurred on Weeks 2, 4, 6 and 8. Prior to every practice lecture, we uploaded a brief note to the VLE, detailing the name, title and organization of the guest speaker and also briefly describing the content of their lecture.

Three speakers were able to come to the classroom but where the speaker was in another country (i.e. the first speaker from the fashion industry) they were broadcast live into the classroom and recorded to upload to the VLE at a later date. Table 2 shows the details of the each guest speaker for the ‘Operations in Practice’ lectures.
We observed that students were able to engage with practitioners and asked relevant and pertinent questions. We observed that students had a very positive perception of practice lectures. As such, the formal student feedback included a lot of positive comments including:

“Having outside people talking and explaining their work during the lectures was great.”

“I enjoyed understanding how operations work in the real world.”

“The guest lectures provided practitioner insight.”

When students were asked to provide suggestions for improvement, only a few (3 out of 300) noted that some guest lecturers were not as ‘interesting’ and also one student pointed out that more information on the content of the guest lectures could be provided in advance. In terms of future improvements, we have identified three areas for improvement regarding the guest lectures:

1) Always contact practitioners well in advance to book these dates in their diaries and have a backup plan in case they cannot make it to the classroom.
2) Students should be informed about the content of the guest lecture through a note on the portal and where possible guest lecture slides can be uploaded.
3) Timing can be an issue as practitioner talks can be long or the question session can take longer than expected.

In-line with the design principle of ensuring that information could be absorbed at the pace of the learner, all guest lectures were recorded using Echo360.

In-class assessment
We conducted four formal in-class tests. Each of these was based on the related online video block (i.e. the first test was based on video block 1 etc.). These tests took place every other week - starting on week 3 - during the first 30 minutes of the lecture. These were created as multiple-choice tests using Questionmark Perception software, uploaded to the VLE and opened at an allotted time. Students were asked to complete the test online via their laptops, tablets or mobile phones. In order to overcome potential collusion, four different versions were created for each question. Therefore 10 questions with 4 alternatives were created for each of the four blocks. The software then randomized these questions so each student would see a unique test. As a whole we created 40 test questions with 4 variations for each question per test. The rest of the session was then based on the feedback of the online test results. Discussions
occurred in student groups for each of the question which was facilitated by the lecturer. Figure 5 is a snapshot of a test page.

![Figure 5 - Snapshot of assessment test page](image)

In terms of student feedback, we experienced resistance from the students early on for the first two tests as they were reluctant to revise so early on in the term. Later in the term, the students started understanding the benefits of the tests and by the end of the term, student feedback was very positive:

- “The regular class tests ensured you kept up to date with the work and allowed you to check your understanding throughout the module.”
- “Having tests throughout the term was very motivational”
- “I liked regular tests to keep up to date with module content.”
- “The weekly tests, which encourage students to keep up with the course.”

In terms of improvement, there were two main comments from the students. The first was to improve the software so that they can see where they made mistakes as soon as they submitted the answers. Although the correct answers were provided the students did not want to make a note of their answers as the test was on VLE, they had the expectation to see their mistakes instantly. The second comment was related to the multiple choice nature of the questions. Some argued that multiple correct answers could have been interpreted in few occasions. Whilst this was not entirely true, we acknowledged the need to make multiple-choice questions much clearer as the interpretation of 300 students can be different.

**Group assessment**

In addition to the testing throughout the course and the exam at the end, we created group assessments to create group-oriented learning (cf. Arbaugh and Benbunan-Fich, 2006). The students were asked to use concepts, frameworks and techniques from the curriculum to undertake an analysis of an operation of their choice. The operation should be one that they have significant experience of and could be from either the manufacturing or service sector. It allowed the students to take some of the learning from class and apply them to real life operation/s in an entertaining and engaging way.
within groups. Its aim was to assess the ability of students to synthesize theory with practice.

**Seminars**
The course involved weekly seminars with approximately 40-50 students in each. The seminar sessions covered the core course content with the main idea being to provide a platform for active participation and critical appraisal of course content by the students. The students were asked to carry out the required preparation in advance, such as reading the case studies provided. In weeks 2-7 the seminar discussions were tutor-led to actively encourage students to work on the case-based problems presented and to guide the discussion towards the desired learning points. In weeks 8, 9 and 10 this changed, as the sessions were designed to enable team-based learning through addressing wider questions on the course content in students groups (see Table 4 below for seminar content). The group-based approach was facilitated by dividing the students to smaller groups, each with 6-8 students.

<table>
<thead>
<tr>
<th>Week</th>
<th>Seminar Topic</th>
<th>Central material used</th>
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<tbody>
<tr>
<td>2</td>
<td>Introduction &amp; Process Design Basics</td>
<td>Concept Design Services Case Study</td>
</tr>
<tr>
<td>3</td>
<td>Process Design &amp; Layout</td>
<td>Process Design Case (Lettuce Operations)</td>
</tr>
<tr>
<td>4</td>
<td>Group assignment brief &amp; Process Analysis</td>
<td>Short videos of product and service design</td>
</tr>
<tr>
<td>5</td>
<td>Process Analysis (advanced)</td>
<td>North West Bank Case Study</td>
</tr>
<tr>
<td>6</td>
<td>Lean Operations</td>
<td>Paper Airplanes (a hands-on exercise)</td>
</tr>
<tr>
<td>7</td>
<td>Location Decision &amp; Service Design</td>
<td>Disneyland Paris Case Study</td>
</tr>
<tr>
<td>8</td>
<td>Revision: Process Analysis &amp; Capacity Mgmt</td>
<td>Previous years’ exam questions</td>
</tr>
<tr>
<td>9</td>
<td>Revision: Lean, Processses, Supply Network</td>
<td>Previous exam questions &amp; answers</td>
</tr>
<tr>
<td>10</td>
<td>Revision: Process Redesign &amp; Improvement</td>
<td>Previous exam questions &amp; marking scheme</td>
</tr>
</tbody>
</table>

Students’ active participation was encouraged throughout the course. As one mean for this, we asked in first week suggestions for preferred ways of delivery. The course delivery was designed to allow some flexibility to accommodate tailoring it to different needs of the student cohort. Based on the requests, we decided to slightly increases the amount of revision in the course and also accommodate one seminar session where the students had an opportunity to try out themselves operations management in practice. The latter was executed through the Paper Airplanes exercise in week 6, where the students’ task was to establish and run a production line for paper plain production. Based on the hands-on exercise they were able to compare craft production, mass production and lean operations.

The seminar sessions were designed to benefit from the interactive online platform for all communication on the course. This enabled sharing information on the required readings and other preparation tasks well in advance before each seminar session. In addition, this was an easy access solution for sharing seminar materials such as presentation slides after each session, to enable recap of the key learning points. The main idea of seminars to provide an opportunity to apply theoretical knowledge from lectures to practical content was resonated in the student feedback, as well as the interactive nature encouraging participation:

“*Retain the concept that the lecturers deliver the seminars. Retain the engaging games (such as the paper plane production) in the seminars. Overall the delivery of the subject was very good and engaging.*”

“*The commitment of the professors - The subject proposed were very interesting - the fact that the seminar tutors pushed us to participate.*”
“Best [course] this term [...] great delivery - combination of online videos, very interactive seminars and guest lectures, this approach saved time and put emphasis on engagement with the material [...] good mixture of summer exam, online tests and group work.”

**Improved Pedagogical Results**

Compared to the previous years, we observed that ‘flipping the classroom’ helped to improve student learning, their ability to answer questions and improved critical discussion within the classroom. In addition to our observations, the student feedback together with the results of the classroom tests (Table 5) were further proof to increased pedagogical impact. According to 75 students who provided feedback, 59 agreed that this was a very good course whilst only 3 disagreed and the other 13 had no firm opinion. It is important to point out that since in-class tests were initiated this year we do not have any comparative data for those. The final exam for the course will take place during June 2015 exam week, therefore the comparisons will be made following the announcement of the results.

**Table 5 - In class assessment overall results for the class**

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Average of 3 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>80.3%</td>
<td>85.7%</td>
<td>57.6%</td>
<td>84.6%</td>
<td>83.1%</td>
</tr>
</tbody>
</table>

*What will we change for next time?*

There are a number of learning points that we took away from the interaction and feedback from students. First year undergraduates unfortunately believe the world to be objective and we had a number of points about perceived ambiguity of questions. We also received a number of queries about seminar content despite this being part of the module handbook. The handbook was a traditional written document and students did not take the time to read it. So, an example of an old technology not working with a new technology and generation!

**Towards design principles for a flipped class**

From our experience with this module, we propose a number of design principles for a flipped class.

**DP1:** Transfer information that is transmitted (i.e. the classic lecture) into a Virtual Environment and use videos.

**DP2:** The videos need to be an adjunct to other pedagogical mechanisms.

**DP3:** Make the videos short so that they can be absorbed quickly.

**DP4:** The videos need to have an element of dynamism to maintain the learners attention.

**DP5:** Use the classroom for debate and discussion.

**DP6:** Create connection to practice. We used guest lecturers, but videos could also be used.

**DP7:** Provide specific feedback on in-class assessments as rapidly as possible.

**DP8:** Create individual and group-oriented assessment to drive collective learning.

**DP9:** Seminars should be critical and focus on a constructivist view of knowledge creation.

**DP10:** Ensure that all information is clear and signposted well in advance.

**References**


