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Flipping quantitative tutorials

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ABSTRACT

Flipping has become a rather fashionable term in higher education, largely in the format of lecture environments, where students are required to watch introductory material prior to a lecture, but the literature has not discussed flipping in a small class environment. In this paper, we consider statistics and econometrics classes at two UK universities which have introduced flipping to small group teaching. We show that, on the whole, student perceptions are positive towards flipping, and we demonstrate clear, qualitative, pedagogical benefits from flipping the classroom.

1. Introduction

In the age of increasing tuition fees at UK Universities students demand more and better small group teaching. The purpose of small group teaching sessions can vary significantly and most certainly is different in course units with mainly discursive content. In the context of this paper we shall concentrate on small group teaching that takes place in a quantitative course unit where a significant purpose of the sessions is to expose students to quantitative problems. The most prominent examples here are Mathematics, Statistics and Econometrics course units.

A traditional approach to small group teaching in technical subjects has been to, initially, deliver core material during lectures. Subsequently students are asked to prepare exercises, in advance of the small group session, in which the tutor will lead the student participants through solutions. In terms of Blooms revised taxonomy (Anderson and Krathwohl, 2001), the lecture allows students to develop low level understanding and knowledge of ideas, but then the act of preparing the exercises is designed to allow students to develop higher level learning, including the application of the material, analysis and synthesis. The small group teaching should then act to reinforce the higher-level skills.

While the above format can lead to excellent and useful small group sessions, when well prepared students use the opportunity to clarify any misunderstandings and issues encountered in the preparation with their class tutors, more often than not this does not happen. In the experience of these authors students that either do not turn up at all, come unprepared or are unwilling to significantly interact with their class tutors and/or peers often make tutorials designed according to the above blueprint ineffective in achieving the above aim.¹ In fact, the small group class may simply be reinforcing the low-level remembering and understanding, whilst providing little support for the development of higher level cognition.

The issue does not always and certainly not solely lie with the students. Often the class tutors are just too willing to deliver well-rehearsed problem solutions. Seeking interaction and input from students can often be difficult or uncomfortable and indeed tutors are unlikely to be trained in the necessary skills. Class tutors (often PhD students) may also be rather weary of student questions that

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E-mail addresses: Ralf.Becker@Manchester.ac.uk (R. Becker), Steven.Proud@Bristol.ac.uk (S. Proud).¹ Tiberius (1999) lists a range of reasons why it may come to this stage, categorising them as either problematic or miscommunicated learning outcomes for the small group sessions, problems of group interaction or motivational issues.<https://doi.org/10.1016/j.iree.2018.01.004>

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lead into uncharted territory and away from their script.

Often the majority of students are just too happy to accept this situation as it allows them to disappear into anonymity and delivers full written solutions to problem sets they otherwise would struggle to solve unaided. Unfortunately, many tutorials in the more quantitative sub-disciplines of economics, including those of these two authors, do follow such a dispiriting pattern. The main issue that arises in this situation is that the class contact is used as delivery mechanism for worked solutions of problems. This could be achieved in different and cheaper ways. Perhaps more importantly, tutorials fail to deepen the students' understanding of the material nor do they develop students' generic skills through active participation.

Of course there have always been exceptions, extraordinary groups of students or teachers that wouldn't settle for lecture type tutorials. In recent years a technical innovation has emerged that greatly facilitates an approach that has the potential to deliver better outcomes. This innovation is the ability of lecturers and teachers to produce online video clips that can be used to deliver material.

Such clips have been popularised by Salman Khan through his *khanacademy.org* website. In fact Salman Khan has possibly been one of the most influential proponents of what has been called the flipped or inverted classroom. Inverted classrooms have become popular in secondary school environments (and in particular for mathematics) where online clips are used to deliver new material to students (traditionally done in the classroom) while the classroom sessions are used to support students actually working on problems.

The flipped classroom session has also found a foothold in the higher education (HE) sector. In HE most students receive different types of classroom contact. Lecture (large group teaching) settings are supplemented by tutorials or exercise classes (small group teaching). Any potential applications of the flipped classroom paradigm will have to differentiate between the purpose of these different settings. Traditionally large-group teaching is used to deliver new material and small-group teaching is used to work through problem sets which are typically meant to deepen the student's understanding of the material.

In this paper, we analyse, and describe, a flipped classroom approach, adopted in small group statistics and econometrics teaching at two, Russell Group,² Universities in the United Kingdom, henceforth referred to as University A and University B. We analyse student responses to the efficacy of the new form of small-group teaching, and discuss how this flipped classroom may be used to improve the learning outcomes for students within small group classes.

The remainder of this paper is structured as follows. We proceed by describing the flipped classroom approach as applied in the context of this paper followed by a short literature review. In Section 4 we describe the experimental setup. The evaluation is presented in Section 5 followed by concluding remarks.

2. Description of flipped approach adopted

The basic idea of organising tutorials as flipped tutorials is to allow students to spend the time in class together with a tutor in a way in which the presence of the teaching staff can make a significant difference to the learning process. In order to achieve this students get the opportunity to practice problems and see their solutions before they come to the actual tutorial meeting. Hence students receive a set of problems and an online clip with solutions about a week prior to the tutorial meeting. The online clip with worked solutions is produced by the course unit's lecturer and delivers about the same information to students that a traditional tutorial would have delivered, worked solutions to the set problems. In fact one may argue that this mode of delivering this information is superior to delivering these solutions through tutors in tutorials. It is delivered by the lecturer herself and all students receive a uniform delivery of this material. The disadvantage being that the students do not have the opportunity to interrupt the delivery and query the tutor.

Importantly the actual tutorial meeting is designed to make more than up for that potential lack of interaction. The tutorial meetings start with the opportunity for students to query any remaining issues from the published problem sets. In our experience these discussions rarely take longer than 5 min. Next, students receive a new and unseen set of problems. Incidentally these problems will not be published in any other way. Students are then asked to work in small groups (3–5 students) and solve these problems. The groups are encouraged to use any available material (like lecture notes, textbooks, online clips) to support their efforts. They are told that the next hour is part of their learning process and not a test.

It should be said that in our experience the size of a tutorial group should not exceed 20 students (4 groups of 5 students). Larger groups should be serviced by more than one member of the teaching staff.

2.1. Design of the problem sets

It is useful to formulate the problem sets that are handed out in class such that certainly the first question on that problem set is in some sense a clear replication or slight extension to one of the problems that was published.

When designing the problem set the lecturer should not be too ambitious with the amount of material that ought to be covered. Progress in these tutorials tends to be slower than in traditional tutorials. It is, however, important to understand that in some sense the problems set in the tutorial are material delivered in addition to the problems and their solutions that are set online. They are meant to make the students practice their skills and there ought to be no pressure to cover material through these.

² The Russell group is a group of 24 research intensive Universities, based in the United Kingdom.

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