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Trialling A Flipped Classroom in Computational Human Geography

Nick Malleson[1]*

Abstract

This case study outlines the process of trialling a new approach to traditional lectures: the Flipped Classroom. The purpose of 'flipping' a classroom is to foster deep-level learning (e.g. Marton and Säljö, 1976; Ramsden, 2003) by supporting experiential learning (Kolb, 1983) and by appealing to a broad range of learning styles (Lage et al., 2000). In short, a 'flipped' classroom reverses the more traditional style of teaching, whereby students digest teaching resources during classroom time and then complete homework afterwards. In a flipped classroom, students are provided with resources to study *before* the class. Then, the face-to-face teaching session can be spent discussing and interacting, rather than simply delivering information. This flipped classroom trial will take place in a level-three BA Human Geography lecture.

[1] *School of Geography, University of Leeds, Leeds UK*

Contents

1. Context

The flipped classroom approach is being driven by three related movements: *technological*, *ideological*, and *economic* (Crouch and Mazur, 2001; Bishop and Verleger, 2013). From a technological perspective, developments in information technology (such as web 2.0, streaming video/audio and the emergence of social media) can offer teachers a variety of valuable tools to support learning. At the same time, an ideological movement is drawing teaching resources into the public domain, allowing learners to benefit from resources that have historically been restricted to fee-paying students. These two movements are also being driven, to an extent, by economics. Student-teacher time is expensive, so teaching methods that place large numbers of students with a small number of teachers (e.g. the lecture) are financially attractive. The MOOC (massive open online course), for example, optimises the marriage of these developments through the use of cutting-edge online technology to deliver courses to very large numbers of students. The flipped classroom has grown out of these movements by taking advantage of new digital technology to deliver material that would have previously been offered face-to-face, allowing personal contact time in lectures to be spent on activities that support deep rather than surface learning.

This section provides the background to the case study. It begins with a discussion about the relevant literature (1.1) before outlining the module (1.2) and students (1.3). It concludes with discussion about how the enhancement has been designed and how it will benefit the students on the module.

1.1 Literature Review

The theoretical foundations of the flipped classroom originate from the literature on student-centred learning (Bransford et al., 2000; Bishop and Verleger, 2013) and an awareness that the traditional lecture is a poor mechanism to support deep learning (Mazur, 2009). The aim of the approach is to shift the focus of lecture time from pure content delivery to tasks such as "discussions, peer interactions, and time to assimilate and think" (Mazur, 2009). These can also be lead by students; giving them the opportunity to direct lectures to the aspects of the material that they found the most interesting

or challenging. The approach also aims to support experiential learning (Kolb, 1983) – e.g. by following-up the lesson with practical work (Lage et al., 2000) – and to appeal to a wider range of learning styles than a traditional lecture will do. In effect, the approach aims to teach by "questioning rather than by telling"[1]

The approach attempts to make better use of face-to-face lecture time by removing the burden of *content delivery* from the lecture (and the lecturer). Instead, content delivery can be delegated to tasks such as watching videos, reading, doing online activities, etc., that the students perform in their own time *before* the lecture. This frees up face-to-face time to be spend really engaging students, rather than simply delivering information. As a colleague in Leeds commented:

> *"If my lectures can be shown as videos, then they damn well should be!"*

The point being; if there is no added value to a lecturer standing in front of a class, then why not record the lecture, let the students watch it at their leisure, and then spend face-to-face time discussing it? Furthermore, the material does not need to be limited to videos of lectures. There is a wealth of blended learning technologies available that teachers can draw on, including web-based assignments/quizzes, YouTube videos, Ted lectures, television programmes, games, etc.

Flipped classroom teaching has certainly gained substantial attention, both in academic literature and public media (e.g. Fitzpatrick, 2012; Welham, 2014). This interest is supported by mounting evidence of the benefits offered by educational approaches that focus on interactive learning (Mazur, 2009; Fagen et al., 2002; Lasry et al., 2008), and nearly all flipped classroom studies have reported positive results, both in terms of student engagement and with overall performance (Crouch and Mazur, 2001; Bishop and Verleger, 2013). However, in a wide review of available research, Bishop and Verleger (2013) note that only one study (Day and Foley, 2006) examined students throughout a full semester and conclude that more research is needed to better understand the influence of flipped classroom instruction. It is worth nothing, however, that there are some startling omissions from that review including Crouch and Mazur (2001) and Fagen et al. (2002). All research read by this author has advertised positive outcomes, although this does not by any means constitute a systematic review.

1.2 The Module

The module on which the flipped classroom approach will be trialled is **GEOG3150: GIS, Geocomputation and Geoplanning**. It is part of the BA Human Geography degree at Level 3. The module accounts for 20 credits over two semesters. The author leads semester 2, but had relatively little input into the first semester. For this case study, one semester 2 lecture near the end of the course will be replaced by a flipped classroom session.

As Section 1.3 will elaborate on, this module is a departure for many students from their typical Human Geography work. It teaches the students how to use computer programming to develop virtual models of human systems and to use ideas from the field of *complex adaptive systems*, which they will not have come across before. As these skills and ideas are very different to others that the students will have become accustomed to, it was decided that a student-centred approach to their learning would be beneficial, particularly because the lecturers themselves had limited experience of how the group of students would learn in the context of this new material.

The objectives, learning outcomes and methods of assessment for the module are available in Appendix A. These had already been confirmed before the author joined the module team, so could not be adapted for this study. Therefore the flipped classroom session will be designed to support an existing outcome, as discussed in Section 2.1.

1.3 The Students

The first method used to gather knowledge about the students was to collect information from the University Portal. Table 1 outlines the degree types of the students. All students are Level 3 BA Human Geography students, but some are joint honours and a many have taken a year in industry ('Ind') or studied abroad ('Int'). These are important pieces of information because 'fourth-year' students (13 / 30) traditionally show a mature attitude to their studies and are likely to engage with both activities outside class as well as discussions in class. This helped with the choice of enhancement as it was predicted that most students would engage with the pre-class material. This might not be the case for a less mature group of learners, although there is evidence that the flipped classroom can be effective with children as well as adults (Fitzpatrick, 2012) so perhaps this was an unnecessary concern.

Table 1. The degree courses that GEOG3150 students were registered on.

Degree	No. Students
Geography with Transport Planing (Ind)	2
Geography	17
Geography (Ind)	8
Geography (Int)	1
Geography and Management (Int)	1
Geography and Sociology (Int)	1
TOTAL	**30**

In terms of the socioeconomic and cultural diversity of the students, the group is largely representative of the wider Human Geography cohort in exhibiting relatively little cultural and, to a lesser extent, socioeconomic diversity. Regardless, the enhancement would have been appropriate for a wide vari-

[1] Eric Mazur quoted on the following video about the flipped classroom: http://www.fas.harvard.edu/~bok_cen/vids/prev2/mazur.mov

ety of student backgrounds given the student-centred nature of the activities. The exception to this might be with some mature foreign students as there is anecdotal evidence from other courses that some people see a greater value in learning through traditional lectures, rather than having to learn through debate etc. with other students. The evaluation of the enhancement will attempt to identify these types of views.

With respect to the students' academic background, all students have followed a quantitative path through their degree programme. This is particularly important for the design of the flipped classroom session as it determined what the pre-class reading assignment (available in Appendix C) should focus on. Furthermore, all students admitted to owning a smart phone[2] which had a big impact on the assessment of student readiness for the enhancement and in the choice of tools available to support in-class interaction (more details in Section 2).

An important consideration for the enhancement is disability, particularly as the students will be asked to use electronic equipment during the lectures as a means of engaging with the lecturer by voting or asking questions. One student on the module had a registered disability, although this did not require any adaptation to the course material or delivery methods. Students might, of course, have undisclosed disabilities that prohibit their use of mobile devices. To mitigate any potential problems, two adaptations were introduced. Firstly, a system of electronic interaction was chosen that works with a range of different devices (laptops, mobile phones, tablets, etc.) so that students with personalised hardware should be able to participate. Secondly, the results of electronic interactions were used by the lecturer as a means of gauging the understanding of the group, not the individuals. So if some students chose not to interact it would have no impact on their personal progression.

2. Planning and Implementation

2.1 Learning Outcomes

The design of effective learning outcomes is an essential aspect to module preparation (Allan, 1996). However, a strict adherence to learning outcomes can limit the flexibility of a course and the lecturer's ability to foster deep learning in the course elements that most interest individual students (Hussey and Smith, 2003). This is the somewhat the case with GEOG3150, where learning outcomes must be confirmed more than 6 months before teaching even begins. Hence the flipped classroom session was designed specifically to support one particular learning outcome:

- An understanding of the virtues and limitations of describing geographical systems using geocomputation and GIS techniques.

This outcome requires that students fully understand the geocomputation techniques presented in the course before being able to critique their virtues and limitations. Hence the flipped classroom session will be able to probe their understanding and build on areas of weakness without knowing *a priori* where these weaknesses are.

2.2 Session Overview

There are numerous definitions of the 'flipped classroom'. After conducting a large review into flipped classroom approaches, Bishop and Verleger (2013) develop the following definition:

> *an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom* – Bishop and Verleger (2013)

This definition was married to a practical approach advocated by Crouch and Mazur (2001) and Mazur (2009)[3] with additional input from valuable teaching blogs[4] (Schell, 2012a,c) as follows (Figure 1 illustrates the organisation of the session graphically).

Pre-class study

Students were provided with a journal article that they were asked to read before the lecture. There was an accompanying online reading guide (available in Appendix C) that highlighted important sections and asked probing questions. In future, pre-class work will include activities beyond pure reading and engagement will be assessed directly (discussed below).

During the lecture

The lecture time (2 hours) was structured as follows:

1. The lecturer briefly summarised the material and indicated its fit with the wider module content and learning outcomes. Lecture slides for the entire session are available online[5].
2. The lecturer asked a question about the material.
3. Students were allowed two minutes to think in silence.

[2] In the future, a more reliable survey will be conducted as there are a number of factors such as shyness, peer pressure, etc., that might prohibit someone from being honest about smartphone ownership.

[3] See Eric Mazur's blog for more information about his approach to the flipped classroom.

[4] The blogs on Peer Instruction Net were extremely useful for this case study. In particular:

- http://blog.peerinstruction.net/2012/07/03/choreography-of-a-flipped-classroom/
- http://blog.peerinstruction.net/2012/03/15/peer-instruction-101-what-is-peer-instruction/

[5] Lecture slides and poll questions: http://www.geog.leeds.ac.uk/courses/level3/geog3150/lectures/lecture9/lecture9.html

4. An anonymous poll was conducted, using electronic devices[6] and PollEverywhere software[7], asking students what they thought the correct answer was.
5. Students viewed the poll results and were allowed to discuss this in groups for 5 minutes. The lecturer and teaching support (in this case the author's SDDU mentor) walked around the room and interacted with students were appropriate.
6. Following group discussions the students were polled again. The aim is that students find the correct answers together through their discussions.
7. Finally, the 'correct' answer (if one existed) was revealed and discussed. If all students had answered the poll correctly then the group moved on to the next question, otherwise some time was spent presenting the ideas and the process was repeated.

2.3 Pre-Class Reading

One concern expressed by teachers is that students will not prepare adequately for a class (Schell, 2012b). Indeed, even Crouch and Mazur (2001), who have considerable experience with the approach, found that some mechanisms – having students summarise a reading in this case – were ineffective. An approach that is becoming popular is the use of *reading incentives* (Crouch and Mazur, 2001). Schell (2012b), for example, encouraged students to prepare for class by offering incentives through assessment. Each week, students were given a reading assignment and asked to answer a few short questions. Grades were then awarded according to the *effort* that the students put in, as follows:

- **0** – An answer was provided, which could be correct, but there was no accompanying explanation for the student's reasoning.
- **1** – An explanation, but no evidence that they really tried to comprehend the material.
- **2** – Evidence that the student read the material and *tried* to understand it.

At the end of the course, a grade was calculated for the reading assignments and this was weighted at 15% of the module total. If the reading assignments improved the students grade then they were taken into account. If not, then the other assessment methods (exam, coursework, etc.) counted for 100%. This approach has the advantage that students know, from the outset, that if they *try* to do the reading then they can already achieve a good grade in a proportion of the module. Similarly, those that do not engage are not directly disadvantaged.

In future this procedure will be implemented in GEOG3150, although timing prohibited its use here. Instead, the students were encouraged to do the reading by repeated reminding. It appeared that most students *did* do the reading; certainly their answers during the lecture suggested this. But it is likely that part of that success was a result of the novelty of the session (the students knew it was an unusual session and part of the author's teaching development) and in future a more formal method of encouraging engagement will be desirable.

2.4 Designing Good Questions

A particularly challenging aspect in the design of the session was how to construct effective questions. These needed to be complex enough to evoke thought on the part of the students, but also have answers that are concise enough to be captured in a poll. They also needed to further the learning outcome. The final questions were confirmed following consultation with colleagues and with the author's mentor. These questions, along with an example of a poll, are provided in Appendices D and E respectively. Not all have a single 'correct' answer; these questions were found to be valuable at promoting discussion. To identify whether or not students understood the question itself, let-alone the answer, an alternative response was included ('WTF?'). After discussions within groups, the number of students using this response dropped considerably.

3. University Strategy and Professional Standards

As Section 1.1 (Literature Review) discussed, interest in the flipped classroom has emerged at a time of both technological (e.g. e-learning tools) and ideological (e.g. free courses and MOOCs) change. The University of Leeds has not been ignorant of this climate and has developed a strategy accordingly. This case study engages with this strategy and the UK Professional Standards Framework in three respects: free educational resources, blended learning, and a distinctive experience.

Free Educational Resources

Alongside its new MOOCs, the University encourages lecturers to make their resources publicly available through the University YouTube channel[8], iTunesU, and other academic digital repositories such as SlideShare[9]. To this end, most of the GEOG3150 module resources have been made available through the public website[10] (a screenshot of which is available in Appendix B). An associated VLE presence has also been created in order to cater for the Leeds students who are familiar with that system.

[6] Additional devices were sourced for students who did not have access to personal ones and consideration was given to students who might choose not to vote or those whose disability prevented them from voting (as discussed in Section 1.3)

[7] Polling software used: http://www.polleverywhere.com/

[8] https://www.youtube.com/user/universityofleedsuk

[9] http://www.slideshare.net/

[10] http://www.geog.leeds.ac.uk/courses/level3/geog3150/

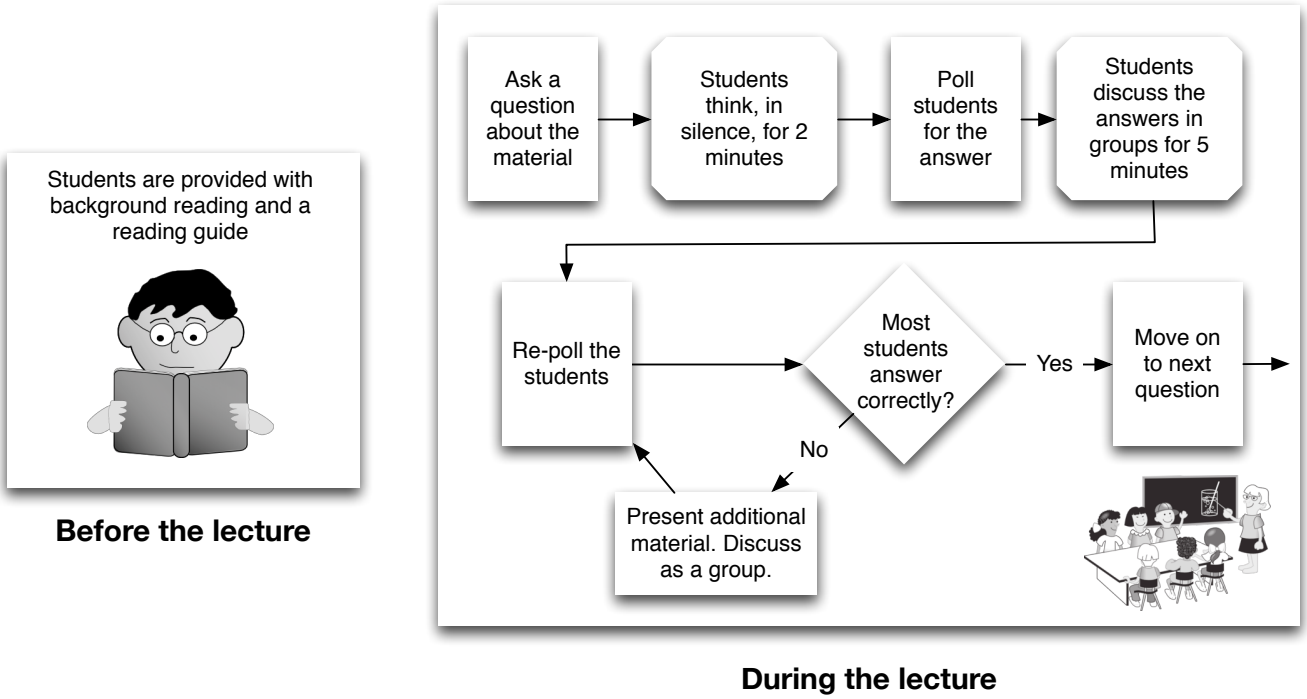


Figure 1. An overview of the structure of the flipped session.

Blended Learning

Another strategic development is the implementation of the University Digital Strategy for Taught Student Education and the associated move towards blended learning. In particular, one of the eight core principles that are recommended for use in blended learning gives support to activities such as the flipped classroom:

> "Use of learning spaces: Innovative and effective use should be made of existing physical spaces to enhance learning." (BLC/13-01/07)

In addition, the lecture capture systems that are being introduced throughout the University as part of the Blended Learning Strategy will have a dramatic impact on future lecture styles. From 2014/15 all GEOG3150 lectures will be automatically recorded and made available to students. It is envisaged that for the 2015/16 session, these lectures can be viewed by students beforehand as pre-class preparation, allowing many more lectures to be taught as flipped classrooms.

A Distinctive Experience

Finally, the enhancement has attempted to align with University strategy by "contributing to the delivery of a distinctive, inspirational and exceptional student experience". This also engages with the UK Professional Standards Framework (The Higher Education Academy, 2011) though area of activity A4: "develop effective learning environments and approaches to student support and guidance". The lecture was certainly distinctive, there are very few modules that follow such a design. In respect to "inspirational" and "exceptional", the students have been widely appreciative of the lecture as evidenced in their critique of semester 2 in their feedback.

4. Student Responses

A two-fold approach to the evaluation of the enhancement was adopted: mentor discussions (outlined in Section 5); and surveying the opinions of students. To this end a questionnaire was designed to collate quantitative data and a focus group was also planned to elicit qualitative data. Both the questionnaire and focus group were planned to take place in the same 1 hour time slot – the students were to complete the questionnaire first, the results of which were to stimulate discussion in the focus group. The students who chose to attended the feedback session were provided with an information sheet[11], consent form, and questionnaire (available in Appendix F). The questions were divided into three sections:

- Section 1 – Preparation – attempted to gauge the level of engagement with the pre-class reading and compare this to the amount of work students would do for a 'normal' lecture.
- Section 2 – Teaching Effectiveness – attempted to elucidate the effectiveness of the specific methods employed during the session (e.g. reading in silence, discussing in a group, etc.).

[11] The information sheet was adapted from the SDDU template: `http://www.sddu.leeds.ac.uk/sddu-ulta2-ethics.html`

- Section 3 – Overall Assessment – concluded with questions regarding whether the students thought that they had learned more or less during the session when compared to other lectures.

It was the intention that students would be offered a small financial award for attending, but the School of Geography course leaders argued that students should attend the session as part of their commitment to the student-university Partnership. Unfortunately coffee and cakes (see Figure 2) were an insufficient substitute and only one student attended.

Figure 2. Food and drink remaining following the flipped classroom student evaluation session.

Although the lack of attendance precludes quantitative analysis, the discussion with the one student attendee was useful and enlightening. The most important findings were:

- The student was part of a group who all read the paper in full, but each made notes on a different section that they later shared. This type of collaboration is extremely valuable and it is encouraging that the session fostered it.
- The use of assessed reading incentives (see Section 2.3) would be unlikely to encourage the student to do the reading, but the idea might be attractive to other students.
- The reading guidance helped to identify the important material and saved a lot of time.
- Discussions were more useful than silent thinking because the student had already spent time thinking about the paper whilst reading it.

To conclude, therefore, the interview provided some useful insight into the student's perception of the session, but no results were substantial enough to break with established literature (e.g. Crouch and Mazur, 2001; Mazur, 2009; Schell, 2012a,c) and warrant significant changes to the format next time. st

5. Conclusion, Evaluation and Reflective Summary

This case study has outlined the process of designing and implementing a 'flipped classroom' session to replace a traditional lecture. The case study will conclude by reviewing the success of the enhancement based on the author's own assessment, feedback from the students, and after consultation with the author's mentor.

As with many flipped classroom evaluations, there is anecdotal evidence in support of the enhancement but limited empirical evidence. Anecdotal evidence includes:

- The students seemed interested and engaged during the session and the quality of answers suggested that most students completed the pre-class reading;
- The interview with a student was broadly supportive of the enhancement;
- The applicants mentor was broadly supportive.

Feedback from the author's mentor was illuminating. There were a number of suggestions for alternative readings that the students could explore, but the chosen one was seen as appropriate. Interestingly, the mentor suggested that, as the course is very practical, the pre-class assignments could make use of small practical projects. Examples include experimenting with a computer model, completing short programming tasks, contemplating the required data for a model, etc. These will certainly be considered for the future and will bring the lecture closer to the definition of a flipped classroom used here (Bishop and Verleger, 2013).

On balance, the author is broadly satisfied with the approach, although the result was not as dramatic as might have been expected. It is likely, however, that the actual lecture was not dramatically different to the normal style of the author; generally lectures involve interactions with students and a level of discussion and debate. Nevertheless, the flipped classroom is an approach that will see further use in the future. Immediate considerations for future sessions include: trialling the implementation of assessed pre-class activities (see Section 2.3), broadening pre-class activities to things other than reading; re-running a focus group to empirically assess the success of the session; and creating short videos of important concepts for both pre-class reading and to form part of the broader range of resources available to students.

6. References

Allan, J. (1996, January). Learning outcomes in higher education. *Studies in Higher Education 21*(1), 93–108.

Bishop, J. L. and M. A. Verleger (2013). The flipped classroom: A survey of the research. Atlanta. ASEE.

Bransford, J. D., A. L. Brown, and R. R. Cocking (2000). *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*. Washington, DC: The National Academies Press.

Crouch, C. H. and E. Mazur (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics 69*(9), 970.

Day, J. and J. Foley (2006). Evaluating a web lecture intervention in a human ndash;computer interaction course. *IEEE Transactions on Education 49*(4), 420–431.

Fagen, A. P., C. H. Crouch, and E. Mazur (2002). Peer instruction: Results from a range of classrooms. *The Physics Teacher 40*(4), 206–209.

Fitzpatrick, M. (2012, June). Classroom lectures go digital with video-on-demand. *The New York Times*.

Hussey, T. and P. Smith (2003, July). The uses of learning outcomes. *Teaching in Higher Education 8*(3), 357–368.

Kolb, D. A. (1983). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, N.J: Financial Times/ Prentice Hall.

Lage, M. J., G. J. Platt, and M. Treglia (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education 31*(1), 30–43.

Lasry, N., E. Mazur, and J. Watkins (2008). Peer instruction: From harvard to the two-year college. *American Journal of Physics 76*(11), 1066–1069.

Marton, F. and R. Säljö (1976). On qualitative differences in learning: 1 – outcome and process. *British Journal of Educational Psychology 46*(1), 4–11.

Mazur, E. (2009). Farewell, lecture? *Science 323*(5910), 50–51.

Ramsden, P. (2003). *Learning to Teach in Higher Education*. Psychology Press.

Schell, J. (2012a). Choreography of a flipped classroom. Available online: `http://blog.peerinstruction.net/` [Accessed September 2014].

Schell, J. (2012b). How one professor motivated students to read before a flipped class, and measured their effort. Available online: `http://blog.peerinstruction.net/` [Accessed September 2014].

Schell, J. (2012c). Peer instruction 101: What is peer instruction? Available online: `http://blog.peerinstruction.net/[AccessedSeptember2014].`

The Higher Education Academy (2011). *The UK Professional Standards Framework (UKPS) for teaching and supporting learning in higher education*. The Higher Education Academy.

Welham, H. (2014, March). Flipped learning: benefits, challenges and best practice – live chat. *The Guardian*.

Appendices

1. Module Catalogue Entry

GEOG3150 GIS, Geocomputation and Geoplanning

20 credits

Class Size: 100

Module manager: Dr Nick Malleson
Email: n.malleson06@leeds.ac.uk

Taught: Semesters 1 & 2 View Timetable

Year running 2013/14

Pre-requisite qualifications

GEOG2065 or an equivalent qualification as agreed with the module convenor

Pre-requisites

GEOG2065	Research Methods with Career Skills

Module replaces

GEOG3090: GIS for Urban and Regional Planning

This module is approved as an Elective

Module summary

Understanding and modelling urban and regional systems; whether planning, modelling crime or segregation, the process of gathering data, analysis, mapping and developing models is similar. This module provides an introduction to key tools used in research and consultancy.

Objectives

On completion of the module, students should be able to demonstrate:

- an understanding of key geographic and attribute information sources and knowledge of how to extract data from them (including new digital data sets e.g. crowd sourcing, online social networks);
- an understanding of the development and application of GIS skills in data entry, manipulation, thematic mapping and spatial analysis using the MapInfo desktop GIS package;
- knowledge of the application of planning support systems and geocomputation tools in practice.
- an understanding of what a model is, what a complex system is (related to urban) and the basic stages of development;
- through case studies and associated practicals; understanding of urban simulation processes and the value of modelling for understanding the present and predicting the future
- skills in designing, constructing and running models in a basic geocomputation framework (NetLogo) and linking the results to a GIS for advanced analysis.

Learning outcomes

- Broad understanding of the different processes in urban and regional systems (particular emphasis on planning, segregation, pedestrian modelling etc)
- In depth knowledge of approaches to modelling urban and regional systems (through advanced GIS and introduction of geocomputation methods);
- Through the modelling process; (i) appreciate how approaches can join up and (ii) the idea of complex systems;
- An understanding of the virtues and limitations of describing geographical systems using geocomputation and GIS techniques.

Skills outcomes

A4 Spatial patterns and relationships in human phenomena at a variety of scales

A9 The theory and application of quantitative, visualisation and other spatial techniques across a wide range of geographical contexts
B1 Abstraction and synthesis of information from a variety of sources
B5 Solving problems and making reasoned decisions
C3 Employ a variety of technical and laboratory-based methods for the analysis and presentation of spatial and environmental information (e.g. GIS, water chemistry, etc)
D3 Apply numerical and computational skills to geographical information
D4 Use information technology effectively (including use of spreadsheet, database and word processing programmes; Internet and e-mail)

Syllabus

Semester 1:
GIS and models for planning GIS, Geocomp and geomodelling,
Geographical and attribute data GIS analysis and examples in planning,
Model-based GIS and planning support systems

Semester 2:
Introduction to Geocomputation - what is a model?
Building simple urban simulations
GIS for social modelling
Visualising and interpreting simulation results Example applications drawn from social systems

Teaching methods

Delivery type	Number	Length hours	Student hours
Lecture	20	2.00	40.00
Practical	10	1.00	10.00
Private study hours			150.00
Total Contact hours			50.00
Total hours (100hr per 10 credits)			200.00

Private study

Students will be provided with a reading list and will be expected to demonstrate evidence of reading in project work and examination. They will also be expected to critique selected articles.
Students will also be expected to have knowledge/experience of various online information systems and web sites
The project to be handed in at the end of Semester 1 and 2 will require independent study and use of MapInfo, NetLogo and other software in private study time.

Progress monitoring

The Semester 1 project will be a means of monitoring progress halfway through the module.

Methods of assessment

Coursework

Assessment type	Notes	% of formal assessment
Report	Semester 1: 1,500 word project	30.00
Report	Semester 2: 1,500 word project	30.00
Total percentage (Assessment Coursework)		60.00

Exams

Exam type	Exam duration	% of formal assessment
Unseen exam (MCQ, essays, etc.)	2 hr 00 mins	40.00
Total percentage (Assessment Exams)		40.00

Reading list

The reading list is available from the Library website

Last updated: 04/06/2014

2. Module Website

9/9/2014 GEOG3150 Home

GEOG3150 - GIS, Geocomputation and Geoplanning - Semster 2

Home Lectures Practicals Seminars Project

Welcome to GEOG3150 Semester 2

(Don't use Internet Explorer)

This website is for Semester 2 of GEOG3150 - GIS, Geocomputation and Geoplanning.

Use the links above to navigate to relevant parts of the course. Also see:

- Course Outline
- Contacts

Reading List

The reading list for the course, which will be updated as the course progresses, is available here

Twitter

GEOG3150 has a Twitter account. You can tweet to the account to ask questions about lectures etc. We'll also put useful/interesting information about the course.

You can also follow the lecturers' personal twitter accounts

http://www.geog.leeds.ac.uk/courses/level3/geog3150/home/home/index.php 1/1

3. Reading Guide and Assignment

GEOG3150 - GIS, Geocomputation and Geoplanning - Semster 2

Lecture 9 - Understanding Models through their Patterns: Statistics, Visualisation and Complexity.

Introduction

This lecture is about the patterns produced by models in their results. It brings together most of the ideas that we have covered in previous lectures, as well as introducing some new ones. We will talk about:

- methods that can be used to identify 'important' patterns in multi-dimensional space;
- what these mean in terms of causality (i.e. how they have been caused by a model);
- how patterns can be used to inform our understanding of real systems.

The format of this lecture will be different to the others. Rather than Nick talking for an hour, you will do some background reading before the lecture, and we will then use the lecture time to discuss the concepts you come across in the reading.

Lecture slides (available*after* the lecture)

The slides used in the lecture are available:here.

Please note that the leture slides work in two dimensions; sometimes you have to press the 'down' arrow to find additional slides explaining a particular topic. You can press 'escape' to zoom out and see all of the slides.

The slides with voting windows on them wont work after the lecture, as we will have finished voting!

Preparation

Before the lecture, please read the following paper:

Evans, A., A. Heppenstall and M. Birkin (2013) Understanding Simulation Results. In B. Edmonds and R. Meyer (eds) Simulating Social Complexity. Springer. [Available on the VLE: http://tinyurl.com/oq4bh64]

It is a difficult paper that covers a range of fairly complicated material, but you will be able to understand most of it with some effort and a little wider reading. The notes in the following section should also help.

The Paper

1 - Abstract and Introduction

Read all of this section

These sections introduce two important words: **equifinality** and**identifiability**. These are not difficult concepts to understand, but they are quite hard to explain. Look them up (Wikipedia is a good place to start) and try to create your own definitions.

Half way down page 2, some other important words are also introduced:**equilibrium**; **oscillation**; **catastrophe**; **bifurcation**. We will discuss these during the lecture, but it is important to understand **equilibrium**. Here, equilibrium refers to a model reaching a consistent state, or a number of states that it moves between. For example, after running the festival model for some time, you might find that the overall distribution of crime does not change. Individual crimes will still occur, and agents still move around, but if the model ran forever the overall spatial pattern will not change - it has reached *equilibrium*.

The authors then move on to discuss emergence. Consider the following:

1. What do you think the authors mean by: "The concept of emergence is essentially a sign of our ignorance of the causal pathways within a system" (pg 2) ?
2. What are the two problems that stand in the way of the researcher and perfect knowledge of a modelled system?

2 - Aggregate patterns and conventional representations of model dynamics

Read this section carefully, up to the beginning of page 5. Then skim rest up to the start of section 3.

This section looks at the different statistics that we can use to describe model outputs. Table 1 is particularly useful, as it shows the statistics that we can use to reduce the dimensionality in a model in order to make it easier to recognise patterns. For example, we can use exploratory statistics to take some spatial model output (2D) and turn it into a single number (1D) that describes the variables across space.

You will probably be familiar with some of these methods, but most will be new to you. Briefly familiarise yourself with the following:

- Nearest-Neighbour statistics
- Spatial auto-correlation
- Geographically Weighted Regression (GWR)
- Spatial clustering

3 - Individual patterns, novel approaches and visualisation

Read all of this section, but don't worry about recurrence plots (at the very end).

This section makes the point that the tools that we have developed over some time ("2500 years"!) are poorly suited to exploring the detail associate with individual-level data. The authors argue that visualisation is a powerful tool for understanding individual level data:

"*Our chief tool for individual-level understanding without aggregation is, and always has been, the human ability to recognise patterns in masses of data*" (pg 8).

Table 3 lists some visualisation techniques. Find visual examples of the following so that you can see what the visualisations actually look like:

1. Choropleth map (this should be easy for you geographers!)
2. Rank clocks
3. Rose diagrams
4. Space-time cube

4 - Explanation, understanding and causality

Read all of this section. It is quite difficult though, so don't worry if you can't understand everything. Wikipedia is quite helpful for some of the terms used.

This last section is probably the most difficult. It discusses how we can use patterns to better understand our models (and the systems that they are simulating) by "highlighting the mechanisms within the models which give rise to these patterns" (pg 13).

The key concepts to try to understand are:

- Types of relationship (correlation): linear, binomial, Poisson
- Experimentation: sensitivity testing, "what-if" scenarios
- Causality: "find the lady problem" and "drop in the ocean problem"
- Identifiability and equifinality

4. Poll Questions

Question A

In a complex system, which direction does the path of causality flow:

1. From the individual to the aggregate
2. From the aggregate to the individual
3. In both directions
4. WTF?

Question B

Which of the following methods tells you about the overall amount of clustering in your data.

1. Nearest-Neighbour statistics (e.g. Nearest Neighbour Index, G, F, K)
2. Spatial auto-correlation statistics (e.g. Moran's I and Geary's C)
3. Local Indicators of Spatial Association (e.g. GI*, Geographical Analysis Machine)
4. Space-time scan statistics

Question C

List some disadvantages associated with visualising data in order to find patterns and draw conclusions.

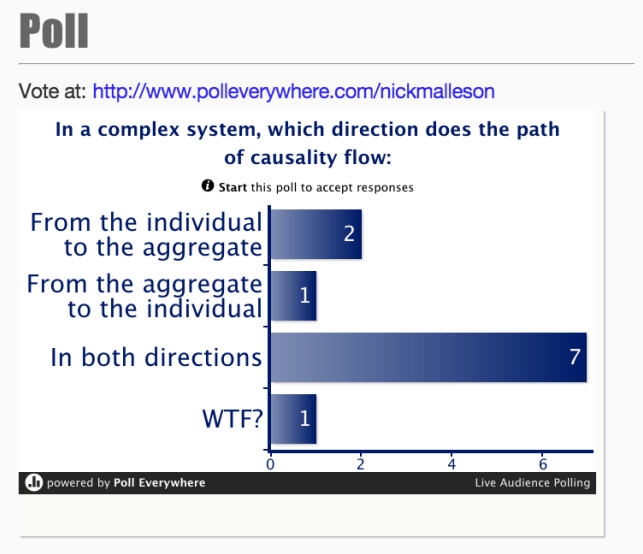
This question was open-ended; students were able to post free-text to the poll, rather than selecting from a discrete number of options

Question D

Two GEOG3150 students work independently to create models of crime in a music festival. The causal mechanisms in the models are extremely different, and yet both models lead to the same result. What best describes this phenomena?

1. The "find the lady problem"
2. Equifinality
3. The "drop in the ocean problem"
4. Identifiability

5. An Example Poll



6. Student Evaluation Documentation

This appendix contains the survey provided to students after the flipped classroom session, followed by an information sheet and consent form.

GEOG3150 Evaluation – Questionnaire

Your details

Name	
Level (i.e. 3 or 4)	

Section 1 – What you did before/during after the lecture

This section asks you about the amount of work you did before and after the lecture. Please circle the appropriate answer.

How much of the paper did you read?	0 None of it	1	2 Half of it	3	4 All of it
How much of the reading guidance did you look at?	0 None of it	1	2 Half of it	3	4 All of it
Approximately how many hours did you spend preparing for the flipped lecture?					
Approximately how many hours would you spend preparing for a normal GEOG3150 lecture?					
How many hours did you spend revising / reading after the flipped lecture?					
Approximately how many hours would you spend revising/reading after a normal GEOG3150 lecture?					

Please turn over

Section 2 – Effectiveness of the teaching methods

This section asks about how effective the different teaching methods were at helping you to understand the material. Please circle the appropriate answer.

	0 Not effective		3 Moderately effective		5 Very effective
Reading the paper itself before the lecture	0	1	2	3	4
Going through the reading guidance before the lecture	0	1	2	3	4
Thinking silently about a question in class	0	1	2	3	4
Discussing a question with peers in class	0	1	2	3	4
The lecturer presenting material in the normal way (i.e. lecturing)	0	1	2	3	4

Section 3 – Overall

Finally, this section askes you about your *overall* assessment of the module. Please circle the appropriate answer.

Did you ***think*** more about the material on the whole, compared to a normal GEOG3150 lecture?	**-2** I thought much less	**-1** I thought a bit less	**0** No difference	**1** I thought a little more	**2** I thought a lot more
Did you ***learn*** more, compared to a normal GEOG3150 lecture?	**-2** I learned a lot less	**-1** I learned a little less	**0** No difference	**1** I learned a bit more	**2** I learned a lot more
Did you enjoy the session, compared to a normal GEOG3150 lecture?	**-2** I liked it a lot less	**-1** I liked it a bit less	**0** No difference	**1** I liked it a bit more	**2** I liked it a lot more
Did you have access to a device (e.g. phone, computer) to contribute during voting?	Yes		No		

Thank you for taking the time to fill in this survey, I really appreciate it.

GEOG3150 Evaluation – Information Sheet

Title of the project: Trialling a 'flipped classroom' in a level-three computational geography module

You are being invited to take part in an evaluation of teaching practice which is a research project. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask Nick if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. If you do not wish to take part, you are welcome to first enjoy some cake before leaving.

What is the evaluation about?

As part of a training course that I am undertaking at the University, I am interested in hearing students' views on different ways of teaching university courses. The most recent GEOG3150 lecture that you all attended is an example of a 'flipped classroom' – students do some preparation *before* the lecture, and we then use the lecture time for more interaction and discussion. I want to find out students' views on how successful they thought this approach was when compared to more traditional lectures.

Do I have to take part?

Taking part is entirely voluntary and deciding not to take part will have no negative impact on your studies or progress on the course. If you decide to take part you can still withdraw at any time without giving a reason. If you do decide to take part you will be given this information sheet to keep and will be asked to sign a consent form.

What will happen if I do take part?

You will be asked to fill in a short written questionnaire and participate in this oral feedback session, discussing with Nick and some other students what you thought about the most recent GEOG3150 lecture. The session (including questionnaire) will not last more than an hour and after the session you wont be asked to do anything else.

Will I be recorded and how will the recorded media be used?

The meeting will be audio recorded, and Nick will use the recording to assist in the research project. The recording will be kept strictly confidential and no one else will be given access to it. Both the original audio recording and transcription will be deleted within two years of the date of the focus group.

Some direct quotes might be used when writing the final project reports, but these will be strictly anonymous. No names will be published and quotes will not be used if there is any risk that they can identify the participant to anyone outside of the focus group.

You are welcome to leave the session at any time. On your request, questionnaire responses can be deleted up to two weeks after the event, after which time they will be an integral part of the research and it will not be possible to delete them. It will not be able to remove your participation from the audio recording or delete the recording.

Contact for further information

If you have any question, please contact Nick on his office telephone 0113 343 5248 or email n.malleson06@leeds.ac.uk

Consent to take part in **"Trialling a 'flipped classroom' in a level-three computational geography module"**

	Add your initials next to the statements that you agree with
I confirm that I have read and understand the information sheet dated 13/05/2014 explaining the above research project and I have had the opportunity to ask questions about the project.	
I agree for the data collected from me to be used in relevant future research.	
I agree to take part in the above research project.	

Name of student	
Student's signature	
Date	
Name of academic	Nick Malleson
Signature of academic	
Date	