Teaching Probability and Statistics with a MOOC by using a Flipped Classroom Model

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Abstract

This paper describes the steps to transform a traditional model of classroom instruction for teaching "probability and statistics" into a flipped classroom model. "Flipped classroom" is a type of blended learning which reverses the traditional educational set-up. Events which traditionally have taken place inside the classroom now take place outside the classroom and vice versa. A MOOC is used to deliver the content to the students of teacher education before class time. The in-class activity is redefined (in)to micro teaching. This is a big challenge for the students, which demands discipline and commitment. But the results are worthwhile : students are motivated because they can practice the skills they are expected to learn. Class time is dedicated to exploring topics in greater depth in a meaningful way. My role as a lecturer changed from instructor to guide in all the phases of the learning process. I used a manual to develop this new approach of active learning, because it's a real mind shift. The steps followed and the experience are subject of the paper.

1. Introduction

University Colleges Leuven-Limburg (Belgium) offers 30 professional bachelor programs and has more than 15,000 students. Our challenges to ensure maximal success for our students are: high quality higher education, research and community services in an international context.
A big challenge in the course programs for secondary school teachers is to reach the same final level with both the part time students, who combine their studies with a job, and the day program students. The programs differ by the number of contact hours: five times three hours for the part time students, and forty hours per semester for the full time student.
This formula obliges our lecturers to limit the curriculum to the essentials for the students to reach the required learning outcomes. Even with these restrictions, contact time is not sufficient to teach the minimal curriculum. Another approach is therefore needed to reach the targets.
The "flipped classroom" model provides such a solution and is instrumental in delivering the curriculum with a high level of efficiency. Events that traditionally have taken place inside the classroom will now take place outside the classroom and vice versa. The students study the matter independently before a contact class. During this session, the teacher organises all kinds of learning activities to appeal to higher levels of knowledge of the students. After the contact class, the students process the matter by means of specific assignments.

2. Concrete Realization

I used the manual "How to flip a class?" from the University of Texas in Austin [1] to realise these ideas and concepts. I will describe my approach based on the five steps of the manual, applied to a course of probability and statistics.

Step 1 Identify where the flipped classroom model makes the most sense for your course

The question is: which goals can students acquire independently, and which goals must be included in contact sessions? The course is integrated: it means that content and didactics are provided in an integrated way as much as possible. For that reason I have chosen for the most obvious but also the most challenging solution. During contact sessions, students teach their fellow students a well-defined mathematical topic. This approach is only possible with experienced students who can process the material independently.

Step 2 Spend class time engaging students in application activities with feedback

Students teach their fellow students a previously agreed topic. This method allows them to train their teaching skills in a safe context. During this micro-teaching the students receive feedback from their fellow-students and from the lecturer. This teaching activity allows to work on higher learning objectives like creation, application and evaluation. Creating the right learning environment is very important in order to reach constructively formulated feedback. This approach gives the students insight into their skills and encourages them also to arrive well prepared at the classes.

Step 3 Clarify connections between inside and outside of class learning

Preparation

The students study a number of assigned topics at home by means of an online course. If needed, they can send me questions. These questions give me a view on their level of mastery of the subject matter. I help the students by email and I decide which topics I will explain myself at the beginning of the next contact session.
Each session some of the students will have to teach a class. They have to send me their preparation beforehand. With my feedback they then improve their lesson. These students are extra challenged because they have to master the course material and use their didactic knowledge for the lesson plan.

Class time

The concept of micro teaching creates a rich learning environment. At the end of the session we define a follow-up assignment in consultation with the students. Usually a number of exercises will be selected in order to further process the subject material. The students who have taught a class will adjust their lesson plan based on the feedback.

After the contact moment

One week later I publish the solutions in order to give the students comparisons. The adjusted lesson plans are posted for all students on a learning platform.

Step 4 Adapt your materials for students to acquire course content in preparation of class

The choice of material is very crucial to the success of this methodology. The student course on probability and statistics has to meet some requirements:

- connecting to the level of the students
- useful in a flexible way
- solutions of exercises are available with feedback by wrong answers
- sufficiently motivating

The existing paper course does not satisfy all these requirements. I found a MOOC (Massive Open Online Course) that meets the key requirements. The open and free course "Probability and statistics" from the Open Learning Initiative at Carnegie Mellon University in Pittsburgh, Pennsylvania [2]. A MOOC is an online course aimed at unlimited participation and open access via the web.

The MOOC starts with a chapter of learning strategies. While a student has more flexibility than in a traditional course, the student has also more responsibility for his own learning. Therefore the online course offers material to develop skills for independent learning.

Each unit also has features to support the individual learning. This is done by pop-up windows such as "learn by doing activities", "did I get this? activities", "many students wonder sidebars" and "checkpoints".

The introduction presents the Big Picture of Statistics and links the main activities to the units.

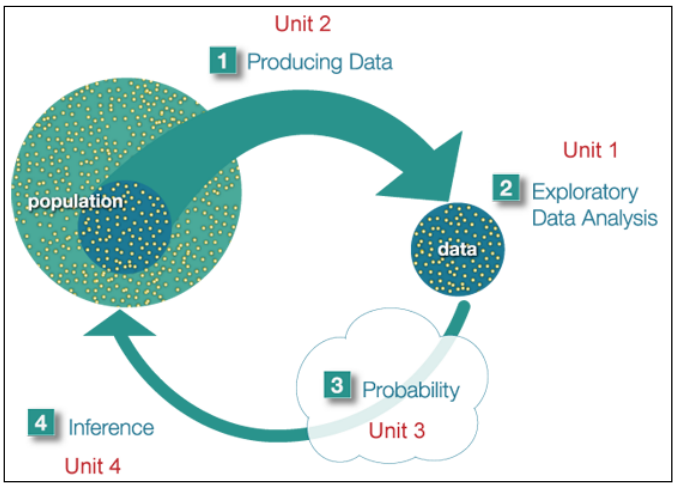

Figure 1 The structure of the course is based on the big picture of statistics [2]

At the start I evaluated the course myself based on European quality criteria - ECBCheck [3] and after the lessons I asked the students to evaluate the course. This evaluation is very important to determine the support of the lecturer.
Here is a brief evaluation of the MOOC:

- The course gives clear information about the learning objectives and the methodological approach.
- The technical requirements are clearly described. It even contains a system test.
- The learning design and methodology is well elaborated.
- The course is well structured.
- The content is of great quality.
- There is no tutor who guides and accompanies the learners throughout the learning process.
- The learning materials are relevant to professional practice and guide the learners to achieve the learning outcomes.
- The course does not support collaborative learning.
- The assignments are aligned with the learning outcomes. A monitoring system of the learners progress is not integrated in the free course.
- The virtual learning environment is technically stable and is accessible through different browsers and operating systems.
- There is no course evaluation to collect the learners' feedback.

Based on this evaluation, as a lecturer :

- I am using an introduction with a clear division of tasks, a timeframe, a list of agreements and define the goals of the inside and outside class activities.
- I act as a tutor myself.
- I use the Blackboard learning platform to support online collaborative learning.
- I evaluate the course and the application of the flipped model with the students at the end of the course.

Step 5 Extend learning beyond class through individual and collaborative practice

Based on the findings during the contact time I supply additional literature, exercises or recommendations for further processing of the matter.

3. Evaluation

When I started with this flipped classroom model I did not realize the consequences. It completely changed my way of teaching and of the students' learning processes. There are more positive effects than I could have dreamed of. The main differences with the traditional way of teaching I experienced are also described as features of the flipped-mastery model in Bergmann & Sams' paper "Flip your classroom: Reach every student in every class every day" [4].

In the traditional model my students waited for me to tell them what to learn, how to learn, when to learn it, and how to prove they had learned it. Although I have well motivated students, they tended to take on a very passive role in their learning. With the flipped model students take more responsibility for their own learning. Learning is a challenge to be unpacked and explored.

The flipped model makes learning the center of the classroom. The students must work as hard as the lecturer. The class is more of a conversation rather than simple dissemination. Especially the ones

who have to teach experience the classroom as a rich learning environment where failures are seen as learning moments.

One of the important advantages mentioned by the students is the instant feedback they get in the MOOC and during the class. Most of the exercises in the online course are multiple choice questions with feedback comments. They do not have to wait until the lecturer has corrected their work. In class the student-teacher gets immediate response from his colleagues when something is not explained clearly enough. At the end of a lesson there is an extensive discussion of the didactical approach and the mathematical curriculum.

Because of the preparations before and the active participation during class time by the students, they can explain their problems better. This gives the opportunity to personalize and differentiate the classroom easily. Moreover the amount of individual accompaniment has increased.

At the end, it's clear that the role of the lecturer changes a lot. The best way to describe the role is that of a supportive coach. Encouraging and guiding the students along the road of learning is the main task. It gives me a good feeling to encourage students and tell them what they are doing right and to clear up their misconceptions. This approach also has an important impact on the dynamics of class. Class time is learning experience for the student, and for the lecturer.

Similar advantages of the flipped system are mentioned by Kathleen Fulton in "Upside down an inside out: Flip your classroom to improve student learning" [5] and by Herreid and Schiller "Case studies and the flipped classroom" [6].

The success of this method depends heavily on students preparing outside of class. And this is the main pitfall mentioned by the students. They have a lot of time to study at home but those who cannot plan and deal with procrastination, are mostly the ones who fail and get poor results.

The most important question is of course: "Do students learn better with the flipped model and the MOOC?". Based on my two-year experience with the new approach and in comparison with the results of the day program students, it is clear that the results are the same. This isn't bad news, on the contrary, it proves that the approach for the part time students works well, knowing that they have 60% less of contact time.

4. Conclusion

Both the students and I are very satisfied with the learning content and the learning objectives that are offered in the online course. Students say they are strongly motivated by how the "flipped classroom model" is organized and completed. It requires discipline to study regularly and the students need to come in the class room prepared.
Reflecting on the given problem to have a limited contact time available and still wanting to turn out a decent graduate level, this approach is certainly effective and efficient.

References

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