

Implementing flipped learning in mathematics higher education: an action research project

Lucia Sagredo-Sanchez¹

¹Oxford Brookes University, United Kingdom; lucia.sagredo@brookes.ac.uk

Keywords: Flipped learning, flipped classroom, mathematics education, higher education, action research.

Context

'Flipped learning' (FL) seeks to reduce direct instruction by asking students to read or watch some content independently (low-order thinking) as preparatory work before a lesson, and then utilises classroom time to practice key concepts and engage in higher-order thinking tasks (Bergmann & Sams, 2015). This way, the academic is not the only source of knowledge; their role is shifted to a supportive figure, who guides students in more cognitive-demanding tasks after they have processed an exposition of contents, which they are now responsible to access. The current emphasis on digital education confers a heightened relevance to FL. There is a need for studies which consider elements of the FL experience in detail, as opposed to investigating the method as a whole (Hall & DuFrene, 2016). Additionally, FL is mostly used for small groups in secondary education, and only 13% of FL research is for scientific fields (Birgili et al., 2021).

This poster will cover the details and preliminary findings of my doctoral research project: an action research study on the course 'Engineering Mathematics and Modelling II', which is taken by a large cohort of second-year undergraduates (89), and it therefore intends to contribute to this under-researched area. My aim is to implement and develop a 'flipped learning' approach that is best adapted for teaching university mathematics courses to large cohorts, and so one of my contributions will be a framework for developing these kinds of lessons. My study does not intend to generalise, but to produce understanding which can be shared, related and interrogated (McAteer, 2013), so that this framework may provide a platform for other lecturers and researchers.

Methodology

Action Research (AR) is the preferred methodology for researching FL (Birgili et al., 2021); it strengthens the connection between research and practice in education and is a necessary, powerful methodology to improve instructional practice based on real learning contexts and experiences (Norton, 2009). I will make use of triangulation through different methods (questionnaires, interviews and audio-recordings of in-class student discussions) to provide alternative perspectives from where more information can be gathered and better claims can be made. Finally, the social learning theory of communities of practice (CoP) is especially relevant in the analysis stage, as I see FL from the four key concepts of CoP: practice, community, identity and meaning (Wenger, 1998). In the poster I will provide a table with the stages of my data collection in chronological order and with associated objectives, as well as a diagram representing the AR cycles.

After each lesson, the students and I completed evaluative questionnaires. I analysed the responses and identified what key variables were perceived as the most influential to the FL experience, and which aspects appeared to be the priority for modifications for the next AR cycle (both for the

preparatory tasks and for the in-class part). After the AR cycles, two Nominal Focus Groups (NFG) were conducted – a novel method in FL research – to highlight any aspects I may have not anticipated and reduce the risk of interpretative bias.

Preliminary conclusions

Several tensions exist in the implementation of FL. The data suggest that the active learning aspect of FL was the most problematic part for many students during the in-class activities in the first iteration of the AR cycle. It is apparent that a lack of adherence to the out-of-class portion of FL (the preparation tasks) hampers progress in the in-class portion. Despite these challenges, there is evidence that students appreciate the opportunity to work in groups during the in-class phase of FL, especially when they are able to choose the group members, and that they see more value in the FL approach once they have established a routine and realized the importance of proper preparation. In further AR cycles, a more dynamic and interactive learning environment was observed, and students perceived that this benefited them, including those who might be reluctant to speak up in a large lecture hall during a traditional lecture. More students undertook the preparatory tasks, and perhaps to a higher standard, which contributed to the more dynamic environment. In fact, one of the changes introduced was a thorough check of preliminary learning at the start of the class. Additionally, students getting accustomed to working in groups and to being active in lectures contributed to the more interactive environment. Participants also valued the guidance from the lecturer in class, and a few expressed a wish for more members of staff. This is a complication that large groups poses, and so the in-class tasks were modified to foster peer discussions so students supported one another, and to provide scaffolds and prompts for those who needed them. In terms of preparatory work, videos recorded by the lecturer with worked out examples followed by a quiz to check understanding was highly rated.

References¹

- Bergmann, J., & Sams, A. (2015). *Flipped Learning for Math Instruction*. International Society for Technology in Education.
- Birgili, B., Seggie, F. N., & Oğuz, E. (2021). The trends and outcomes of flipped learning research between 2012 and 2018: A descriptive content analysis. *Journal of Computers in Education*, 8(3), 365–394. doi.org/10.1007/s40692-021-00183-y
- Hall, A. A., & DuFrene, D. D. (2016). Best Practices for Launching a Flipped Classroom. *Business and Professional Communication Quarterly*, 79(2), 234–242. doi.org/10.1177/2329490615606733
- McAteer, M. (2013). *Action Research in Education*. SAGE. doi.org/10.4135/9781473913967
- Norton, L. (2009). *Action research in teaching and learning: A practical guide to conducting pedagogical research in universities*. Routledge. [doi.org/https://doi.org/10.4324/9781315147581](https://doi.org/10.4324/9781315147581)
- Wenger, E. (1998). *Communities of practice: learning, meaning, and identity*. Cambridge University Press. doi.org/10.1017/CBO9780511803932

¹ Access the poster here: <http://flippedlearning.luciasagredo.com>