

Flipped Linear Algebra and Calculus for Pre-Service Teachers

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KEY IMPLICATIONS

The “integrated flipped learning” model is manageable and effective to cover the objectives of two mathematics courses for the Bachelor of Science (Education) programme. This model can be modified to teach other mathematics courses (to be offered at NIE, NTU, or other tertiary institutions in and outside Singapore) as an alternative to the lecture-cum-tutorial model used to teach mathematics courses.

BACKGROUND

In recent years, computer-based technology has enabled university lecturers to teach their courses using non-traditional pedagogies. One such pedagogy is the flipped learning model. As flipped learning is being used more frequently to teach undergraduate mathematics, instructors need to collect data to identify practices that work well to promote student mathematics achievement and favourable perceptions toward this new learning mode.

This project implemented six different types of pre-class tasks for a flipped Linear Algebra II course and a flipped Calculus II course at NIE/NTU, namely short videos narrated by the instructor, synopses, summary sheets, worksheets of problems and activities, and online quizzes.

FOCUS OF STUDY

This project had two principal goals. One was related to praxis and the other was related to

research. The main praxis goal was to develop a comprehensive framework to guide the design of a variety of flipped learning activities based on strong theories of both mathematics education and general education. This framework covered three phases of flipped learning: pre-class tasks, in-class interactions, and post-class consolidation. It includes the roles of traditional lectures and tutorials. A comprehensive framework is likely to be more effective than a single flipped activity, such as watching video clips before coming to class.

The main research goal was to investigate the learning experiences of the student teachers who studied academic mathematics through flipped learning. Their learning experiences include both perceptions and academic performance.

KEY FINDINGS

On average, the student teachers spent about one hour to complete the weekly pre-class tasks, but the stronger ones reported spending less time on these tasks than the other students. Almost all the students rated very highly these tasks in terms of helping them to learn and enjoyment at mid-semester and end-of-course surveys. These perceptions had weak correlations with the course grade.

SIGNIFICANCE OF FINDINGS

Our project contributes towards MOE’s effort to promote flipped learning (Heng Swee Keat,

2013) and NTU's learning hub that involves flipped learning. For the former, our project prepares future teachers to "live through" and reflect on flipped learning, and for the latter, NIE and NTU could actively promote this learning model using our project as one of many exemplary courses that NIE/NTU lecturers can build on. Hence, our project provides another source of evidence to support the policy to include this innovative teaching-learning model as mainstream pedagogy at school and tertiary levels.

PARTICIPANTS

This project was conducted in three phases for two cohorts of student teachers. The first cohort consisted of 19 students. Fifteen gave their written consent to allow their course data to be used in this project. The four students who did not consent still completed all of the flipped learning tasks, but they were not asked to submit their surveys, or to be interviewed or observed during the in-class video recording. Their data are excluded from this report. The second cohort consisted of only four students, all of whom gave their written consent.

RESEARCH DESIGN

This project was an exploratory study of flipped learning in two second-year university mathematics courses. A mixed-methods research design was used to collect quantitative and qualitative data. Evaluation of the project followed the equivalent time series design for a single group. To address the lack

of generalisability resulting from the small sample size, and to strengthen the measures of the degree of implementation, this study examined in depth the flipped learning experiences of each participating student throughout the duration of each course. The differences in such experiences, if any, were then used to suggest plausible explanations or hypotheses that could potentially contribute valuable knowledge to applications of the flipped learning model.

The FLACPT project was a case study in which "case" referred to the class taking Linear Algebra II or the calculus module. It investigated how members of this "case" responded to a new pedagogy (flipped lessons) using multiple sources of evidence. The entire project examined this "case" under two iterations (cohorts). This was intended to strengthen the validity of the findings compared to one-off case studies. Within this case study, a mixed-methods design was used, which is a methodology that advances the systematic integration of quantitative and qualitative data within a single investigation or sustained programme of inquiry.

REFERENCES

Heng, S. K. (2013). *Student-centric, Values-driven Education: A Broad and Deep Foundation for a Lifelong Journey*. Retrieved from <https://www.moe.gov.sg/news/speeches/keynote-address-by-mr-heng-swee-keat--minister-for-education--at-the-ministry-of-education-work-plan-seminar-2013--on-wednesday--25-september-2013-at-915am-at-ngee-ann-polytechnic-convention-centre>

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