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CLAIRE BLACKMAN'S OPEN TEXTBOOK JOURNEY

Grantee: Claire Blackman
Position: Lecturer
Department: Mathematics and Applied Mathematics
Faculty: Science
Course: Mathematics and Applied Mathematics
Degree level: Undergraduate
Title of initiative: Mathematics Textbooks for South Africa
Title of envisioned open textbook: *Introduction to Abstract Algebra*

Introduction

Dr Claire Blackman was a lecturer in the Department of Mathematics and Applied Mathematics in the Faculty of Science at the University of Cape Town (UCT) until she took a position at another institution in 2020. She was, and remains, an open education practitioner and advocate, having started her open education journey in 2015 when she began releasing videos of her mathematics lectures via her YouTube channel[1] as open educational resources (which, at the time of writing, includes more than 80 videos).

At UCT, Claire taught students in the second-year Mathematics and Applied Mathematics course. In 2019, she received a grant from the Digital Open Textbooks for Development (DOT4D) project to create a mathematics textbook for the 'Introduction to Abstract Algebra' module of this course which was aimed not only at creating content best suited for the practice and teaching of mathematics within a local context, but also training students to develop a 'mathematical mind'. As an open education practitioner, it was also important to her that the textbook be freely available for access and reuse.

Due to the emergence of a number of competing personal and professional obligations, Claire was unable to complete the textbook development process within the allotted grant period. For DOT4D, this means that Claire's open textbook story has a particular arc to it, one that is heavily shaped by the parameters of the project lifecycle.

[1] https://www.youtube.com/c/ClaireBlackman/videos

The Digital Open Textbooks for Development (DOT4D) project in the Centre for Innovation in Learning and Teaching at the University of Cape Town (UCT) provided grant funding and implementation support to 10 open textbook projects in the period from March 2018 – March 2019, as well as implementation support to an 11th initiative. The Open Textbook Journeys series tells the stories of the people driving these initiatives, their teaching and publishing processes and what inspires them to do this work. These case studies were developed in collaboration with and reviewed by the open textbook authors profiled.

For Claire, it is the preamble for a longer open textbook development story, one that started long before her involvement with DOT4D and one that will hopefully go far beyond it.

This case study draws on:

- Claire's grant proposal to the DOT4D project.
- Interviews (x2) with the DOT4D Researcher.
- Field notes of the DOT4D Publishing and Implementation Manager.

What is the problem Claire is trying to address?

Claire planned to address certain financial and pedagogical challenges through the development of her open textbook. First, the recommended textbook for her course costs around R700 ($50). The high price meant that many students were unable to afford the book and therefore did not purchase it. This resulted in a situation where many students struggled to effectively participate in the classroom and succeed in the course. Second, the textbook reflected mathematics from a European and American perspective, and was therefore of questionable relevance for students in the South African context.

Claire is interested in addressing issues related to her students' lack of background knowledge, their struggle to write mathematics (proofs, formulas, etc.) and the language barriers they face. Within this context, she aims to make maths less abstract and address the challenges her students face in writing mathematical proofs, which she sees as indicative of the fact that they are struggling to think in a particular way. She gears her work towards teaching her students thought processes and empowering them to be able to think mathematically.

Textbook conventions in the discipline

In her interview, Claire explained that there were varied conventions around prescribed textbooks in her department. Most courses included a recommended textbook, but the department was making a concerted effort to move away from having these textbooks as a requirement. She stated: 'I think some of the first-year courses do have a required textbook, but most of those we provide through the faculty online. And if students want a hard copy they need to buy it. So, we've tried to take the financial burden off the students.'

> Currently available textbooks focus entirely on the content, giving students no guidance on how to learn to think mathematically

Claire's open textbook journey

Original plan

Claire submitted a proposal to the DOT4D grant programme in collaboration with departmental colleague Dr Jonathan Shock. Their collective project, Mathematics Textbooks for South Africa, had two main branches – both of which were aimed at addressing the accessibility of mathematics education for undergraduate students at UCT.

Claire was responsible for the second branch of the project, the aim of which was to develop a textbook for the 'Introduction to Abstract Algebra' module. A variety of textbooks had been used in this course over the years, all of which suffered from the same issues as the first-year maths textbook (which Jonathan Shock was working on). Claire stated that currently available textbooks focus entirely on the content, giving students no guidance on how to learn to think mathematically; the textbooks seldom explain the process of writing proofs and never give alternative proofs of the same theorem.

Claire's textbook project was to contribute to a growing body of research on training different 'thought processes'. While teaching the course in 2018, she worked with her students on exercises to improve mental clarity and focus. She also developed a curriculum on how to write mathematical proofs, which improved the standards of the answers provided in tests and exams. She stated that, 'students have commented that they were able to successfully apply the techniques learned in both interventions in their other courses. Including these techniques and exercises in a textbook will give me the opportunity to expand on them, and provide students with further resources, including multiple proofs of the same theorem'.

Caire believed that providing students with multiple proofs would show students that there is no single correct answer and that there are many different styles of proof. She would also be able to address the issues raised in Jonathan Shock's textbook development process, especially as relates to making the language of mathematics more accessible.

At the proposal phase of her work, Claire spoke with colleagues at various South African universities about the Abstract Algebra textbook concept and the response was uniformly positive.

She stated that the teaching of tertiary mathematics was changing worldwide, with greater emphasis being placed on helping students develop the necessary skills to be successful mathematicians. As such, the book would be useful beyond South Africa.

> The proposed textbook would make explicit many of the thought processes, techniques and uses of language that are missing in current textbooks

The proposed textbook would make explicit many of the thought processes, techniques and uses of language that are missing in current textbooks. It would be far more accessible to students and provide support for a wider range of student abilities and backgrounds. It would also contain some neuroscience to help students understand how their brains work and how this impacts their learning, which would have application beyond mathematics.

Lastly, the textbook would include content and exercises for developing mathematical thought processes and proof writing which are not included in existing textbooks.

Authorship approach

Claire envisioned that she would adopt a 'solo author with student involvement' approach to developing her textbook content, in that her textbook would be created through extensive student engagement and feedback. The textbook would be used for the 'Introduction to Abstract Algebra' module in the second semester of 2019, with student feedback elicited throughout the term. Strong undergraduate students who had completed the course in previous years would be invited to collaborate on content development.

The content development process and student involvement

Claire planned to include students in the creation of content by involving third-year students in the development of questions, exercises and solutions. In addition, she would draw on feedback from students in her second-year class as they made use of parts of the textbook which were under development. Colleagues in the maths department would provide input on content development processes and play a role in quality assurance.

Content development and publishing tools

The aim was that Claire would produce all content, including graphics and assessment components, using the PreTeXt open source XML authoring tool and publishing suite, which enables content publishing in a variety of formats, including HTML, PDF and EPUB. One of the key features of PreTeXt is its easy inclusion of runable code within HTML, which enables students reading the book online to check answers, run examples and interact with the textbook.

Quality assurance and sustainability

The quality assurance process for the textbook was to include scrutiny by at least three lecturers in the maths department. It was also envisioned that students would provide ongoing feedback which could highlight gaps in explanations or errors in the writing. Claire also envisioned that the work would be proofread by a professional proofreader when it reached an appropriate stage of maturity.

Status at grant closure

Due to competing professional pressures and despite her best efforts, Claire was unable to complete her textbook development process within the DOT4D grant period of March 2019 to February 2020 and her open textbook production process remained in incubation at the time of writing.

Challenges experienced and lessons learned

Grant timeframes do not necessarily align with work and life timelines

Claire had every ambition to complete her textbook within the timeframe of the grant period but, as noted above, other competing work and life priorities intervened; an experience all academics have at some point. In addition, the challenge of creating a new open textbook which includes student collaboration is difficult enough in the best of times. Claire's open textbook journey provides an indication of how challenging it is for academics to undertake work of this kind over and above their standard teaching and research obligations. It also demonstrates that the timeframes required for open textbook development do not necessarily align neatly with semester cycles or grant periods.

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Budget

Overview of the original budget submitted to DOT4D as part of 2018 grant application, with actual expenditure.

Budget projected at proposal phase
Student assistant salary: R10,000
Proofreading 200 pages: R10,000

DOT4D grant amount: R20 000

Project expenditure
None. Grant funding returned.