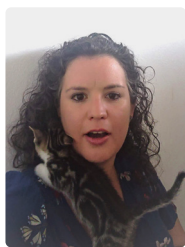# 2

CESARINA EDMONDS-SMITH AND CHRIS BARNETT'S OPEN TEXTBOOK JOURNEY

Grantees: Cesarina Edmonds-Smith and Chris Barnett

Position: Lecturers

Department: Chemistry

Faculties: Science and Centre for Higher Education Development

Course: Chemistry

Degree level: Undergraduate

Title of initiative: Ingxoxo

Title of envisioned open textbook: *Ingxoxo: Physical Chemistry Fundamentals*

Introduction

Much of students' best learning occurs outside the classroom when they are with their peers. As they chat with each other about issues that arise in a lecture, textbook or assignment, they're often able to clarify to each other – through their preferred languages and generationally relevant analogies – key insights about a given topic. In this sense, students often teach each other.

For some, peer learning is a crucial feature of their university experience, for others less so. It is however compelling to consider ways in which all students in a course can benefit from the virtues of peer learning and tap into a well of collective student wisdom. Might there be a way to formally connect lecturer-led teaching with peer-to-peer learning in order to enhance the student experience?

> It is compelling to consider ways in which all students in a course can benefit from the virtues of peer learning and tap into a well of collective student wisdom

Dr Cesarina Edmonds-Smith is a lecturer in Chemistry in the Science Academic Development Programme in the Centre for Higher Education Development at the University of Cape Town (UCT). As a former high school science teacher, she knows that 'students know more than you think, they just think differently to you'. She believes that if you ask students to explain what they understand, you can learn how they think and apply this knowledge in your teaching.

Dr Chris Barnett is a physical and computational chemist who teaches chemistry in the Science Faculty at UCT. He subscribes to the principle of 'learning by every means' and encourages students to try their best, find confidence to ask questions, and realise that getting something 'wrong' is a key part of learning.

In February 2019, Cesarina and Chris were awarded a grant from the Digital Open Textbooks for Development (DOT4D) project to develop the Ingxoxo digital platform, a forum-based approach to peer-to-peer learning and open textbook development. (Ingxoxo means 'conversation' in isiXhosa.) This case study tells the story of their open textbook journey.

This case study draws on:

- The Ingxoxo grant proposal to the DOT4D project.
- The Ingxoxo grant report to the DOT4D project.
- Fieldnotes from the DOT4D Publishing and Implementation Manager.

What is the problem Cesarina and Chris are trying to address?

Because the majority of available textbooks are written in English and from a Global North perspective, South African students typically have to engage with textbooks that communicate in a second or third language for them and emanate from a perspective that only partially aligns with their own. These linguistic and epistemological divergences can lead students to struggle with key concepts that are necessary

for understanding the lectures and succeeding in the course. To mitigate these challenges, students sometimes buy alternative textbooks that are more suited to their learning preferences, but most seek out textual and video resources on the internet to better understand chemistry concepts.

In their proposal, Cesarina and Chris stated that many students find it difficult to understand their lecturers who teach in a language (English) which is often different from their mother tongue. Their textbooks are all in English and typically written from a Global North perspective, which means that students might not fully understand certain key ideas (usually built upon unstated assumptions).

They believed that if students do not learn the foundational concepts of a discipline, they can't be expected to understand the application of these concepts to the subject at hand.

In addition, they said that the way that lecturers explain concepts and illustrate examples are not always relatable to students due to generational differences. If students are unable to relate the concept to their own life experiences, the work gets complicated, students fall behind, withdraw in class, stop attending lectures and ultimately perform badly in assessments.

Textbook conventions in the discipline

Cesarina and Chris stated that the standard practice within their discipline is to support teaching with the use of proprietary textbooks. The first-year Chemistry course textbook is identified annually by course conveners who meet with the Chemistry Department Teaching Committee to discuss their options.

South African students typically have to engage with textbooks that communicate in a second or third language for them and emanate from a perspective that only partially aligns with their own

Cesarina and Chris' open textbook journey

Original plan

In line with Cesarina's belief in the value of peer-to-peer learning and Chris's philosophy of engaging with students in ways that are meaningful to them, the Ingxoxo initiative aimed to leverage the fact that students are well-placed to explain concepts to each other. In fact, they often do so in their mother tongue rather than the language of formal instruction, using examples that are relevant and understandable to their generation.

Cesarina and Chris therefore wanted to: (a) create a digital platform for first-year students to share their ideas and understandings of chemical concepts, and (b) use the students' explanations – in combination with short video and audio explanations – to create an interactive digital textbook called *Ingxoxo: Physical Chemistry Fundamentals*.

The team believed that students were technologically savvy enough to engage with a digital resource if it was geared towards their needs. The innovative aspect of the textbook would be that it consisted of core chemistry concepts explained with references to the primary text through focused concept videos and audio. Students would be asked to come up with further analogies to explain these concepts in a way that was relevant to them. The team believed this would give the book a uniquely African feel, which was not seen in their current chemistry textbooks.

> They used a 'social' approach, in which students interacted with a user-friendly digital platform that mimicked social media principles

Authorship approach

Cesarina and Chris adopted a 'content development facilitator with student and colleague co-authors' approach, in that they saw themselves as expert intermediaries facilitating student- and peer-driven content development. They used a 'social' approach, in which students interacted with a user-friendly digital platform that mimicked social media principles, incorporating 'like' reactions, linking, bookmarking, sharing and avatar options.

Students were encouraged to get involved through modest incentives such as earning chocolates, stickers and classroom accolades for frequent posting, responding to fellow students' queries or translating content into another language.

The team's goal was to accumulate content for the open textbook over many years of engagement, while starting the forum conversations afresh each year in the hope that this would enable students to feel at home in a virtual environment dedicated to their needs. The aim was for the eventual textbook to be openly licensed for use at UCT as well as at other South African universities, though Cesarina and Chris thought some concepts would need to be added, modified or deleted based on curriculum requirements.

> The Ingxoxo content development process was founded on the principle of student involvement

The content development process and student involvement

The Ingxoxo content development process was founded on the principle of student involvement. Cesarina and Chris envisioned that either they or a postgraduate student would draw up a survey which would be distributed to first- and second-year students. They planned to establish student focus groups and run tutorial sessions in the hopes of explaining chemical concepts with them. During these sessions, tutors (postgraduate students) would ask students to explain different concepts to their peers and record (with permission) the explanations and any questions that followed. Finally, they would ask for feedback through a forum-like website where students could provide additional concepts, questions or explanations that weren't discussed during the sessions, or that they were still struggling with.

Cesarina and Chris' content development process started similarly to what they planned. The team surveyed senior students and identified key themes. However, the process of establishing the forum platform took a great deal of effort, requiring Cesarina and Chris to grapple with IT-related concerns, such as establishing the domain name, customising Ingxoxo according to the Discourse app's[1] platform options and linking UCT sign-on credentials with Ingxoxo for login purposes. In addition, through their interaction with DOT4D, Cesarina and Chris looked into how they could brand their project to raise its recognition value.

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[1]   https://www.discourse.org/

To help with this, the team placed adverts and began interviewing postgraduate students to assist with the project. However, finding the right assistants took more than a month to achieve, affecting the initial timelines set within the project.

Once the team and platform were in place, Cesarina and Chris started campaigning to the first-year students and generating content on the Ingxoxo platform. The team held several student engagements and took note of how students explained concepts to peers on the platform, in class and in revision sessions. To ensure that they themselves did not end up producing too much of the content, Cesarina and Chris held a research engagement week for students in November 2019 which generated a lot of content and interest in the project. The overall process was highly collaborative and agile.

As such, the Ingxoxo platform – which was made available to first-year chemistry students, interested second-year students and academic staff at UCT – served as a forum for student discussions around first-year physical chemistry in any South African language, providing a safe, comfortable space for students to pose questions and contribute to discussions without 'public performance' fears. Questions were answered by fellow students and course lecturers who were participating in this virtual environment.

The platform contained links to video and audio explanations, as well as other resources posted by first-year students and the Ingxoxo community, which were relatable to South African and African experiences with chemistry. The aim was that these new ideas and explanations would eventually be compiled into an online, openly licensed, mixed-media e-book, co-authored by students to allow for a fully inclusive look into first-year chemistry.

The platform provided Cesarina and Chris with an opportunity to learn from their students: seeing where the missing links were between the lecturer, the work and the student; learning how students explain concepts to their peers; and allowing students to take a greater role in the teaching process by encouraging them to use Ingxoxo to explain concepts and provide feedback on lecture content.

Publishing process

Cesarina and Chris adopted an 'initiative as self-publisher' approach in their publishing process and produced several outputs within their one-year grant period.
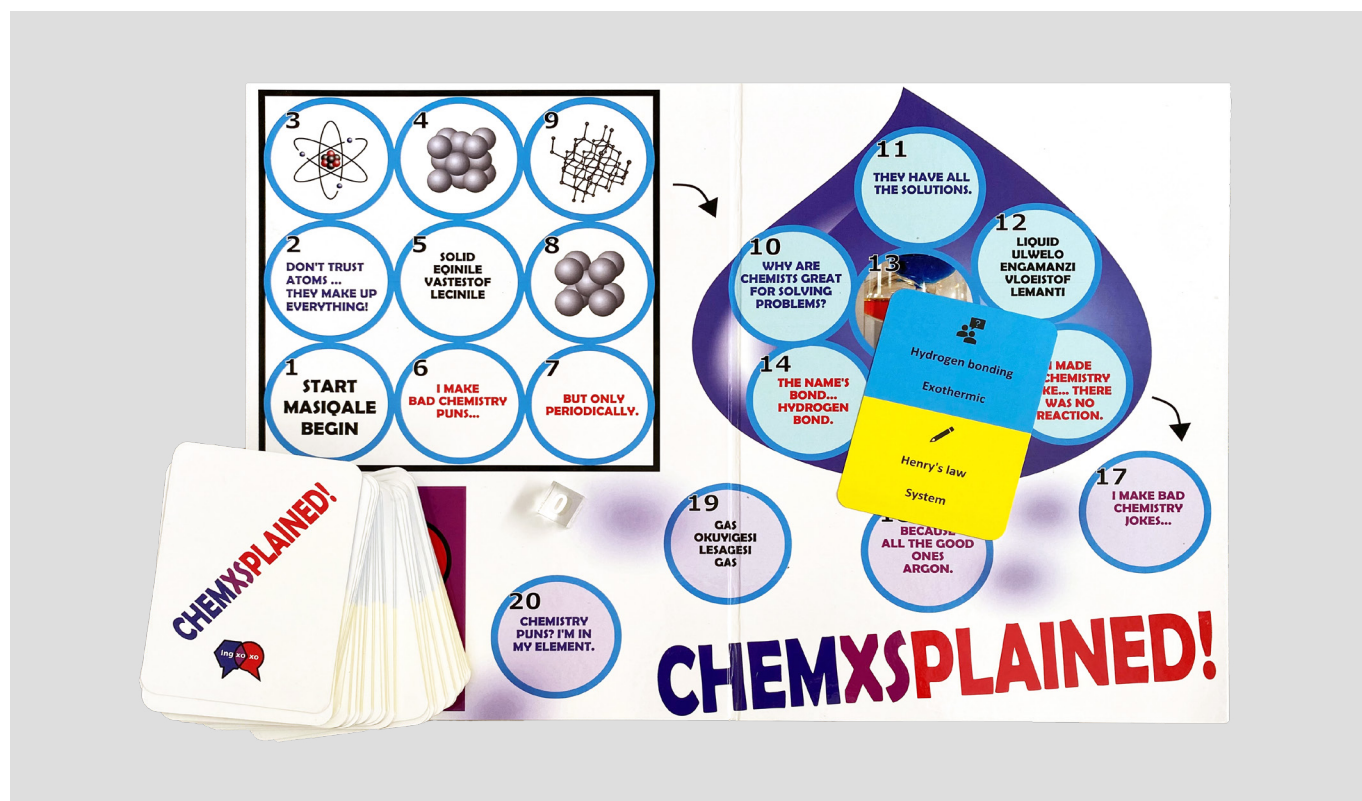
ChemXsplained cards and board images

> ## The game had a lot of potential for group learning and in some sense could be considered as 'practising the textbook'

First, though this was not part of the original plan, they developed the ChemXsplained[2] board game in collaboration with students during the student research engagement week. It is a game that aims to make basic chemistry concepts understandable in a fun and competitive way. The idea for it arose from a brainstorming session with students who put together a prototype and tested it with a postgraduate cohort. The gameboard, cards and rules were then further refined. The team believed that the game had a lot of potential for group learning and in some sense could be considered as 'practising the textbook', stating that 'the idea is not just to learn knowledge off by heart, but thinking on the spot and sharing knowledge with peers'.

Second, the team (along with their two project assistants) created the Ingxoxo platform on the Discourse app and maintained it during the second half of 2019. They had planned to distil the information and insights from this platform to create a textbook, but they realised that the platform itself represented a 'living textbook' that could be continuously updated by the first-year students. In this sense, they believed that it should continue to function as an independent entity, aside from the envisioned textbook.

Third, the team started writing up sections of textbook content in 2019. A postgraduate assistant wrote up a topic and volunteer students wrote up a section. The team's aim of writing throughout the year was, however, impossible due to time constraints. The team also realised that some of the topics they identified as important were not a priority to their students. Some topics were also overdeveloped, or needed to be taught from the ground up.

Fourth, the Ingxoxo team produced data, code and media as a result of activities such as interviews, revision sessions, surveys, notes from research week engagements and analysis of the discussion platform. They also planned to translate some of the content on Ingxoxo into isiXhosa and Afrikaans.

Finally, the team created engaging videos with custom artwork based on student review. They presented on various topics and tested props and interactive functionality. As such, they were able to use the videos to create an unscripted and dynamic debate with the students around problem-solving aspects in their work which the team felt could be engaging for student viewers. The undergraduates who assisted in the work made an informative video explaining one of the physical chemistry concepts which the team planned to use as a resource in their textbook. They stated: 'It was well thought out and done in a way that we as lecturers would not have thought of. This was the point of the project, to get the students' ideas on how content could be taught and how they understand concepts.'

> ## Some of the topics they identified as important were not a priority to their students

Content development and publishing tools

The chapters of the textbook were written on a number of different platforms – MS Word, Google Docs and Authorea – in order to determine which one would be best to use for authoring and collaboration. In the end, the team preferred Authorea, as it supports sharing, WYSIWYG, Markdown and LaTeX.

The Ingxoxo virtual forum runs on the Discourse app, a forum-based web platform for community discussions. Posts can be formatted using Markdown, LaTeX, MathJax and mhchem.

To create videos, the team used the One Button Studio (OBS), an automated video recording facility in the Centre for Innovation in Learning and Teaching at UCT. The team also used the OBS to film a few concept videos in the traditional lecturing style using PowerPoint.

The analytics platform code, game media and project overview webpage are hosted on GitHub.[3] The data generated for the various activities within the student research experience, such as videos, discussions, student feedback, student surveys and recordings are currently stored on Google Drive through UCT's GSuite subscription.

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[2]   https://github.com/ingxoxo/chemxsplained-game

[3]   https://ingxoxo.github.io/ingxoxo

Copyright and licensing

In the course of the Ingxoxo content development process, students used memes from the internet. Cesarina and Chris were unclear about how to deal with copyright in these instances. They were also concerned about using diagrams from the existing textbook in discussions with students.

In addition, privacy was also a central concern; Cesarina and Chris did as much as possible in order to ensure student anonymity.

All Ingxoxo content released via GitHub was published under a Creative Commons Attribution 4.0 International licence.

The team made use of both student and colleague review

Quality assurance and sustainability

In their quality assurance process, the team made use of both student and colleague review. Students gave feedback on content and concepts using the Ingxoxo app, while Cesarina, Chris and a Masters student moderator checked the content. In the case of the content created by student focus groups, material was reviewed by those students and the content moderator.

In terms of sustainability, Cesarina and Chris envisioned that their initial grant would fund the first round of interviews, surveys and the website for one year. This data would then be created and stored on an institutional repository. The content from the Ingxoxo site would also be used to create a PDF version of the most informative content, which would comprise the first edition of an open textbook. This too would be openly licensed and accessible via an institutional repository. The team envisioned that further updates to the text would require ongoing maintenance of the Discourse app, and perhaps further interactions with students. The continued maintenance of the virtual forum would however require resources.

Status at grant closure

As part of their continuing development and future plans, the team was able to offer the Ingxoxo discussion platform to first-year Chemistry students in 2020. They planned for the board game to be tested during first-year tutorial sessions in order to get feedback from students and tutors. They also felt that there was potential for them to generate a journal article based on their experience.

The team had a few incentives that worked well in 2019, which they felt they could offer the 2020 students to ensure that the platform continued to grow. In their final grant report, they stated that 'it was exciting to see the number of first-year students in 2020 who have already signed up to the platform without any knowledge of what the platform is about; it shows that students are hungry for any additional tools to help them in their first year'.

Challenges experienced and lessons learned

Cesarina and Chris believed that the project had numerous successes, especially related to the ability of the online platform to foster peer learning among the students. Ingxoxo created a virtual forum similar to the ones that students themselves create in small groups outside the classroom, allowing for more intimate learning opportunities. They could interact in their preferred languages, share links, video and textual content, and then point other students to the forum's saved discussions after the fact. In addition, student interaction led to the development of the board game which went far beyond initial planning and expectations. There were, however, challenges along the way and some key lessons learned around timing, planning and branding.

Students could interact in their preferred languages, share links, video and textual content

Get the students onboard immediately

Cesarina and Chris believed that they should have been more engaged and open about the project with their students from the outset. Students are very motivated in their first semester of their first year, so it helps if you can grab their attention during that time. They stated: 'In the first semester, students are still keen and have lots of energy to engage in new ideas. We were hesitant to do so as we had just created the brand and were still waiting on stickers and for the website to be available. We had to put in a lot of work to engage with students in the second semester and get them interested in the project. We should have surveyed the first-year students in the first semester and asked if this kind of platform would be useful to them. If not, we should have asked for input and ideas for creating an open textbook.'

Innovation takes time and patience

Cesarina and Chris had high expectations of the quantity and quality of output that they would produce and the amount of engagement they would have with students. In reality, the team had numerous competing commitments (teaching, supervision, research, committee meetings, etc.) and therefore limited time to promote student community engagement. A number of lessons flowed from this.

The first was they should have planned everything six months in advance and accounted for delays (finances, ordering, adverts, marketing). Secondly, they needed to be more aware of their budget. The team benefitted from academic discounts offered on some software tools and their hosting site, but realised the value in being cautious spenders as this allowed them to devote more money to the board game and student incentives. Finally, they learned to be open and adaptable to the changes in their vision, stating, 'it was through the students that the project developed. It had to grow in the way that they could relate to, not necessarily in our original ideas of the outcomes of the project'.

> In order to get students excited about the project, they had to grab their attention through an intuitive and intriguing brand identity

Branding is essential for generating interest

The team had originally planned that the project would be student-driven, but they realised early on that, in order to get students excited about the project, they had to grab their attention through an intuitive and intriguing brand identity. They had ideas about student incentives and giving out small prizes, but only after they designed the Ingxoxo logo were they able to properly market the project to students. As such, the Chemistry 2020 first-year students were already excited about joining Ingxoxo. Cesarina and Chris ascribed this to the previous marketing campaigns and word of mouth from the 2019 class.

Budget

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

Budget projected at proposal phase
Platform hosting: R15,000
Software developer: R8,280
Student assistant (Computer Science): R8,000
Student assistant (Chemistry): R8,000
Video recording: R8,000
Graphic design: R2,400
Translation: R7,000
Incentives: R8,000
Consumables: R8,000

DOT4D grant amount: R73,180

Project actual expenditure
Discourse app hosting: R14,407
Postgraduate students: R17,717
Undergraduate students: R7,500
Revision sessions: R3,019
Branding: R12,759
Content creation: R17,933

Total expenditure: R73,335