ICED 2020 proceedings:

Developing a curriculum mapping framework to enhance discipline-specific academic professional development in South Africa

Ashwini Jadhav[1]

Faculty of Science, University of the Witwatersrand
1 Jan Smuts Ave
Johannesburg, 2000, South Africa

Sipho Hlabane[2]

Centre for Learning, Teaching and Development (CLTD), University of the Witwatersrand
1 Jan Smuts Ave
Johannesburg, 2000, South Africa

Abstract

Curriculum mapping is a concept that is reasonably well documented in mapping literature. However, many existing curriculum mapping processes do not address discipline-specific curriculum mapping that assists academics to develop their Pedagogical Content Knowledge (PCK) through the use of content representations (CoRe). This article, therefore, intends to address this gap and develop a mapping template that embeds PCK, through the use of a systematic review of the literature method to identify common curriculum mapping features. It is envisaged that the curriculum-mapping framework thus derived will enable academics to understand that there is a close relationship between what is taught and the choice of pedagogy in teaching a specific topic in a discipline.

1 Introduction

Curriculum mapping is increasingly being recognised as a common concept in the higher education sphere (Ervin, Carter and Robinson, 2013), not only because the academics in the higher education sphere are expected to identify and focus on curriculum learning goals to effectively teach and assess the content within their courses (Arafeh, 2016), but also for reasons such as the drive for global competitiveness (Wang, 2015), responsiveness (Moll, 2004) and quality assurance at the institutional level. However, the challenge with many curriculum mapping frameworks is the inclusion of discipline-specific curriculum mapping that will assist academics to develop their Pedagogical Content Knowledge (PCK). The purpose of this research is to develop a curriculum mapping framework that will investigate the possibilities of embedding elements of content representations (CoRe) in mapping science courses, with the end goal being the development of PCK in the academics.The research will address the following questions:

- What are the knowledge gaps inherent within the curriculum mapping processes?
- How can CoRe and PCK be embedded in the curriculum mapping process?

[1] Ashwini.Jadhav@wits.ac.za
[2] Sipho.Hlabane@wits.ac.za, +27 011 717 1485

2 Curriculum mapping and academic professional development

The concept of curriculum mapping originated in the 1980s in the work of Fenwick English (Udelhofen, 2005) who defined curriculum mapping as "a reality-based record of the content that is actually taught, how long it is being taught, and the match between what is taught and the assessment program." It was then embraced and enhanced by Jacobs (2004) by including a variety of teacher-driven curriculum maps, such as horizontal and vertical alignment. Hale (2008) later refined the definition of curriculum map as a process of indexing or diagramming a curriculum to identify and address academic gaps, redundancies and misalignments for purposes of improving the overall coherence of a course of study. However, most curriculum mapping processes do not address the issue of how the curriculum is taught and thus ignore pedagogical content knowledge (PCK) as the most important component.

Pedagogical content knowledge (PCK) was introduced by Shulman (1986), who described it as representing "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction." PCK can be enhanced through the use of content representations (CoRe). CoRe are tools which attempt to portray a holistic overview of an expert teacher's PCK in relation to the teaching of a particular science topic in a visually understandable, structured way (Nilsson and Karlsson (2019). It prompts the teacher to articulate what are called "Big Ideas" relating to queries that include what students should learn about each big idea; why it is important for students to know these ideas; students' possible difficulties with learning the ideas; and how these ideas fit in with the knowledge the teacher holds about that content. In this way, working with the CoRe as a mapping tool and/or as a reflective tool has the potential to help teachers conceptualize their professional knowledge and make explicit the different dimensions of, and links between, knowledge of content, teaching, and learning about a particular topic, thereby strengthening their PCK and enhancing their professional knowledge of practice (Nugraha, 2017).

Curriculum mapping can, therefore, serve as an academic professional development tool, as it will assist academics to think critically about the topics they teach and to question their decisions and choices about their pedagogies for a particular topic in their praxis.

3 Methodology

In developing the curriculum framework that addresses the research questions, research articles published in the years 2005 to 2019 were systematically reviewed for curriculum mapping processes to interrogate, analyse and identify central features within the curriculum maps. The key research term used while searching for scholarly/journal articles was "curriculum mapping", which was then refined to the term "higher education". The figure below outlines the process of selecting research articles from the initial search database.

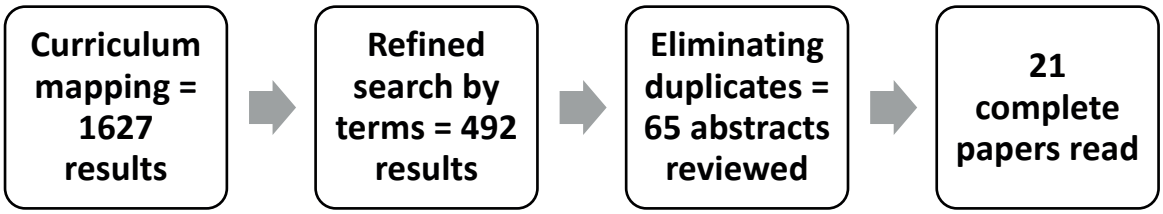

Figure 1: The process for selecting research articles

Reference lists of identified journal articles were examined to explore whether any other conventionally accessible materials such as reports, minutes, and other in-house publications existed. Abstracts of identified journal articles were then screened, which assisted in selecting relevant journal articles for further review. The selection of the articles/papers was more focused on articles that had explicitly stated and elaborated on curriculum mapping approaches which are related to constructive alignment. The content of the selected papers was then examined to determine the methods used in curriculum mapping. Twenty-one papers were selected, and similarities in their curriculum mapping approaches were identified.

4 Results and discussion

The final 21 papers that were reviewed identified the following features in their curriculum mapping:

- Learning outcomes
- Assessment
- Learner activities
- Concepts
- Declarative, procedural and schematic knowledge
- Critical graphical representation
- Materials
- Vocabulary
- Patterns

Whilst the papers reviewed addressed the typical and obvious tenets of constructive alignment and tried to locate gaps in student learning and places where instruction was being needlessly repeated, and endeavoured to embed requisite skillsets, none of them made any references to pedagogy, or specifically PCK; nor was the concept made explicit. However, one cannot conceptualise or talk about student learning without taking into account the pedagogy that the teacher would need to use for the students to learn effectively. To bridge this knowledge gap, we propose a discipline-specific curriculum mapping framework that incorporates PCK and CoRe adapted from Loughran et al. (2001) for future use while mapping science course outlines. The proposed framework is presented below.

As discussed above, the majority of curriculum maps have basic features such as learning outcomes, teaching and learning activities and assessment, a.k.a constructive alignment. However, the curriculum maps do not holistically interrogate the contents of the topic, through the inclusion of PCK. The PCK components that were not present in the curriculum mapping processes studies were core concepts, learners' prior knowledge, aspects that are difficult, use of representations and teaching strategies. These were addressed by the proposed curriculum mapping framework (Table 1). Although the generic features in curriculum mapping are no doubt important, the information provided in the typical curriculum maps does not give much information about the content of the topic and how the topic is taught. It is necessary that curriculum mapping should, therefore, delve more into the core concepts of any given topic by articulating the "Big Ideas" for that particular topic.

Criteria	Topic	Learning outcomes	Big ideas/Core concepts	Learner prior knowledge	Aspects that are difficult to learners	Use of representations	Teaching and Learning activities	Assessment	Resources
Guiding questions		-What do you intend learners to know/do in this topic?	-What would you consider as Big Ideas for this topic? - What do you intend the learners to know about this idea? - Why is it important for learners to know this big idea? - What concepts need to be taught before teaching this big idea? - What else do you know about this idea (that you do not intend learners to know yet)?	-What are the typical student misconceptions in this big idea? -How would you go about correcting them? -How would you establish what the students already know about this big idea? -How would you address the knowledge gap?	-What do you consider easy or difficult in teaching this big idea? Provide reasons.	-What representations would you use in your teaching strategies, and why? -How would you embed discipline-specific skill sets (either generic or practical or both)?	-What conceptual teaching strategies would you use in teaching this big idea? -How would you link the big idea to the practical skills/ classes?	-What kind of formal/ informal assessment (for learning) will be done, and a brief indication on how the concept(s) discussed may be assessed at another time in relation to others in the topic.	

Table 1: Proposed Curriculum Mapping Framework embedding PCK and CoRe

One of the important topic-specific components included in the mapping framework is students' prior knowledge. It is important for academics to be aware of what their students need to know before they commence the teaching and learning activities for a particular topic, as this will inform their choice of pedagogy and student learning trajectories. Knowledge about what aspects of a topic are difficult is also important, because the teacher will then know how to approach the topic in a manner that is easier for the students to learn; this also impacts the choice of assessments. The use of representations during teaching is also important, since they assist in embedding discipline-specific skills and prepare students to make the transition from "knowing" to "becoming".

5 Conclusions

The review of literature in this study highlighted the lack of clearly articulated mapping processes, particularly in the context of PCK. Further research into the processes of mapping would assist in developing a more robust system of mapping curricula with a specific focus on topic-specific PCK, which in turn would enhance the development of curricula that will respond to student needs and success issues and contribute towards preparing future-ready graduates.

Curriculum maps can also serve as an academic professional development tool that develops the PCK of academics in the higher education arena. Here the proposed curriculum mapping framework will enable academics to develop a deeper understanding of the "Big Ideas" behind disciplinary content and to articulate their implications for praxis, with the aim of producing future-ready graduates who have both the generic and discipline-specific transferable skills to function in an ever-evolving society.

References

Arafeh, S. (2016). Curriculum mapping in higher education: A case study and proposed content scope and sequence mapping tool. *Journal of Further and Higher Education, 40(5)*, 585-61.

Ervin, L., Carter, B & Robinson, P., (2013). Curriculum mapping: not as straightforward as it sounds. *Journal of Vocational Education and Training, 65(3)*, 309-318.

Hale, J. A. (2008). *A guide to curriculum mapping: Planning, implementing, and sustaining the process.* Thousand Oaks, CA: Corwin Press.

Jacobs, H.H. (2004). Getting results with curriculum mapping. Alexandria, VA: *Association for Supervision and Curriculum Development*.

Loughran, J., Milroy, P., Berry, A., Gunstone, R., & Mulhall, P. (2001). Documenting science teachers' pedagogical content knowledge through PaP-eRs. *Research in Science Education, 31*, 289-307.

Moll, I. (2004). Curriculum responsiveness: The anatomy of a concept. *In H. Griesel (Ed.). Curriculum responsiveness: Case studies in higher education* (pp. 1-19). Pretoria: South African Universities Vice-Chancellors Association.

Nilsson, P., & Vikström, A. (2015). Making PCK explicit—Capturing science teachers' pedagogical content knowledge (PCK) in the science classroom*. International Journal of Science Education, 37(17)*, 2836-2857.

Nugraha, R. A., Degeng, I. N. S., Hanurawan, F., & Chusniah, T. (2016). Process of self-regulated learning on student's strategic studies activities in learning environment. *International Conference on Education, Education in the 21thCentury*: Responding to Current Issues. 747-753.

Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher, 15 (2)*, 4-14.

Udelofen, S. (2005). *Keys to curriculum mapping: strategies and tools to make it work*. Thousand Oaks, CA: Corwin Press.

Wang, C. (2015). Mapping or tracing? Rethinking curriculum mapping in higher education, *Studies in Higher Education, 40(9)*, 1550-1559.