

FOLLOW THE ARROWS: TRACING THE UNDERLYING STRUCTURE OF A DOCTORATE

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Abstract: This paper reports on the results of a four year longitudinal study of PhD students and their supervisors. The students were all registered in lab-based PhDs within a research-intensive university within the UK. Sequential concept map-mediated interviews were used to gain insight to the students' and supervisors' perspectives on the content and the process of gaining a doctorate. The evidence gained suggested that the students tend to focus on the PhD in terms of a product to be completed (in terms of writing a thesis and writing for peer-reviewed journals), whilst the supervisors tended to concentrate more on the process of learning and scientific development, placing the student's contribution into the wider disciplinary discourse. The structural observations from the concept maps generated within this study are that the students perceive the PhD as a linear structure, whereas the supervisors are more likely to generate a cyclic structure to illustrate the dynamic, iterative processes of research more generally. Further structural elements emerge from the analysis of the maps, indicating the need for holistic understanding of the content, structure and meanings in concept maps.

1 Literature Review

Concept maps have been widely used to interrogate the quality of understanding held by students at all levels of education (Novak, 2010; Turner, 2011). The qualitative analysis of concept maps has revealed relationships between the structures produced and the nature of the understanding displayed (Kinchin, Hay & Adams, 2000). The spokes, chains and networks described by Kinchin et al. (2000) have been augmented with cyclic maps that have been identified by Safayeni, Derbentseva and Cañas (2005), in which concepts are viewed as continuously changing and influencing each other in a loop. Such cyclic representations are seen to be more dynamic than other structures which seem to represent more static relationships (see Figure 1).

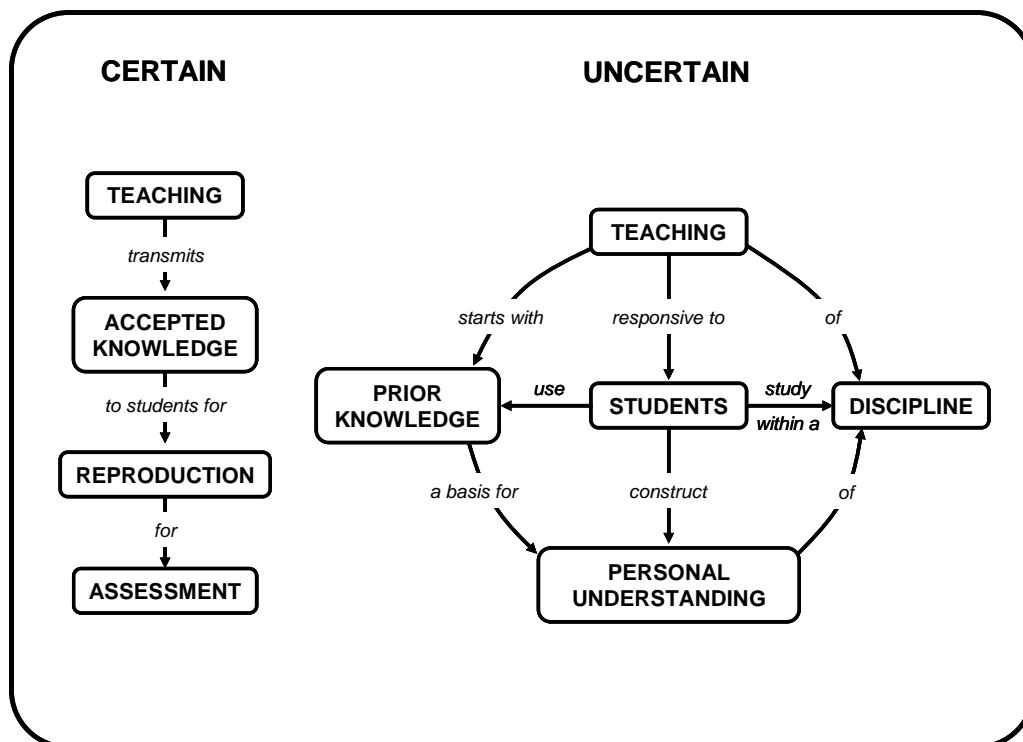


Figure 1. Linear and cyclic concept maps of teaching (after Kinchin 2011).

Doctoral education pedagogy has been a traditionally understudied area (Pearson, 1999; Pearson & Brew, 2002; Walker et al., 2008). Building on research on the visualisation of learning (Kinchin et al., 2000), the graphical depiction of the components of the underlying conceptual structure can be seen as a natural feature of the thesis. However, most theses tend to be less visual and more textual in their representations, and so the uncovering of the underlying framework may be more problematic.

This study used concept mapping to explore how students and supervisors represented their underlying conceptual frameworks in a visual manner, and how this developed and changed over time. The subsequent question that emerged was whether common features developed and if there were sufficient common attributes to describe ‘conceptual structures’ within doctoral studies. This allows for the development of a generic visualisation of conceptual structures that can be used as a tool in the supervisory relationship of doctoral studies.

2 Methodology

In this longitudinal study (Kandiko & Kinchin, 2009; 2010; 2012), the authors interviewed PhD students and their supervisors in order to gain a picture of how each viewed the content of the PhD and the nature of doctoral study more generally. The interviews were mediated by the production of a concept map (Kinchin et al., 2010) that was then the main artefact for analysis, augmented by transcripts from the interviews. The interviews were repeated with students and with supervisors throughout the life of the PhD, during which the participants were invited to develop the ideas presented in their maps (Figure 2). This process has generated a large volume of data, although space permits the representation of only three concept maps from the total of 123 unique maps, collected over 88 interviews during the four years of the study.

The goal of this approach is to provide rich descriptions of the beliefs and understanding of the participants in a particular context. This is to be expressed in participants’ own language, representing their world view rather than a researcher’s conceptualisation of participants’ personal constructs. This is not intended to contribute to the bureaucratisation of the supervisor-student relationship (Cribb & Gewirtz, 2006), but as a tool to help supervisors to engage with the conceptual framework for the thesis.

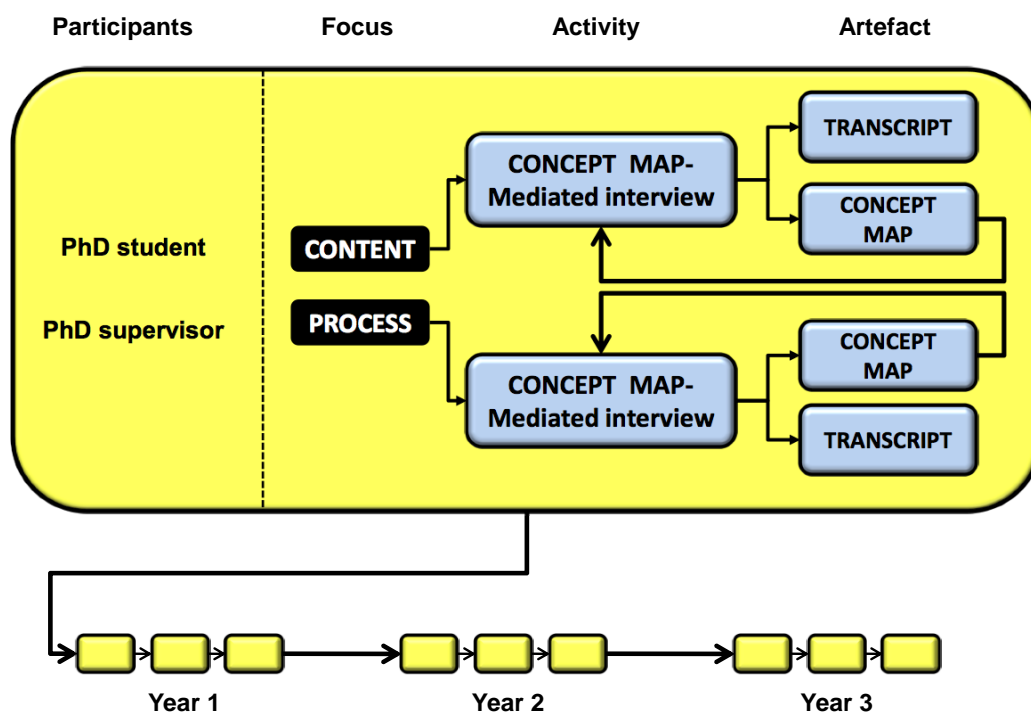


Figure 2. Graphical summary of the research process

3 Results

The concept maps revealed that the supervisors and students held different perceptions of both the content of the PhD and the process of doctoral study (Kandiko & Kinchin, 2012). The supervisors saw each student’s PhD as part of a bigger picture, both in relation to their own work and to specific area of study. The supervisors tended to view doctoral study as a process rather than as a product. The students were more focused on their own studies than on the discipline as a whole, and were very product (thesis) oriented – represented as a linear

pathway that has an observable end point. An example is seen in a student's map of the process of a PhD (see Figure 3). Although the approach is linear and leads to publishing and a degree, the content, seen in the third row in the map, all relates to learning.

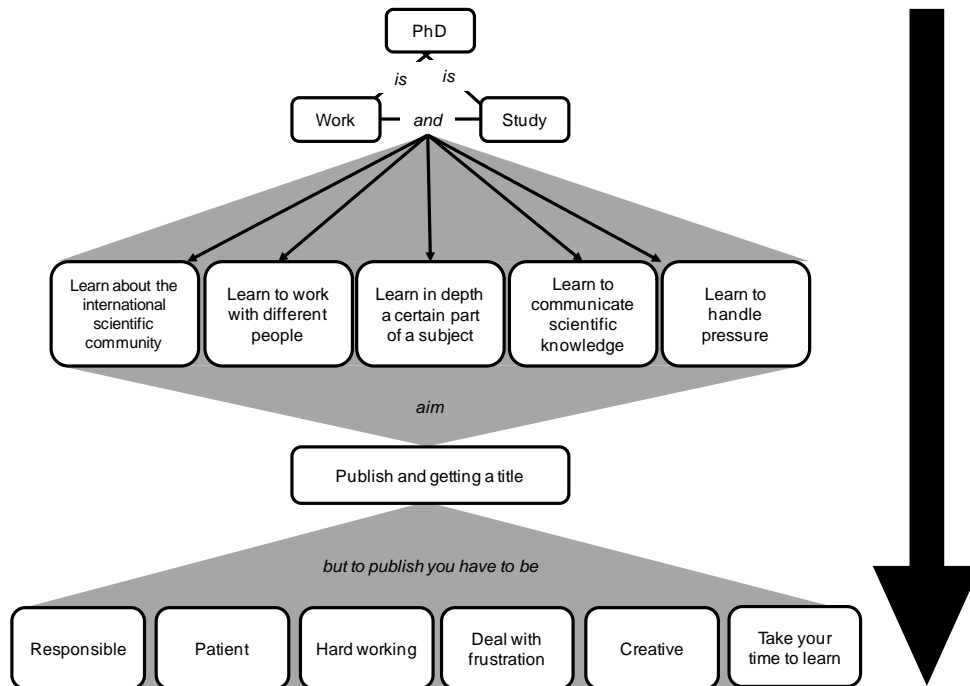


Figure 3. Student map of the process of a PhD

A contrast is seen in a different supervisor's map about the process of a PhD (see Figure 4). This map takes on a 'matrix' structure, which differs from the linear, spoke or cyclic models. The four sets of concepts that run horizontally are structured roughly as a chain, but interrelate with the other concepts. There is also a nascent cycle connecting the fourth concept back to the first one. The four concepts that run vertically are concepts that represent actions and learning the student 'should' do. The matrix design in the middle of the map is specific, meaning that not all concepts link to one another, although there is generic use of linking words ('in order to' and 'feed into'). The matrix map does not represent hierarchy. There is no sense of differing importance amongst the concepts, particularly the four that run vertically along the left of the map. Overall the matrix functions as more than a combined linear set of chains, but does not describe cycles of learning and development.

Another supervisor map on the process of a PhD (see Figure 5) is further indication that in the complex environment of doctoral education; there can be many 'sets' of conceptual frameworks or understandings. Moving from the upper left-hand side diagonally into the centre of the map is a rough chain of concepts. This leads to the 'cyclic' structure in the bottom right, which the supervisor saw the student being 'stuck in' for some time. This then led into another cycle, seen in the bottom left. This indicates a 'bottleneck' where the student feels like the experiments have reached a dead-end and that their thesis is ruined. Similar patterns of behaviour often emerged for students a few months after the mid-point of the PhD, when suddenly the final thesis deadline seems to be looming. This cycle (in grey) leads to the third cycle, seen in the upper right. These cycles represent combinations of trial and error, the development and refinement of the scientific process and progression within a complex learning environment.

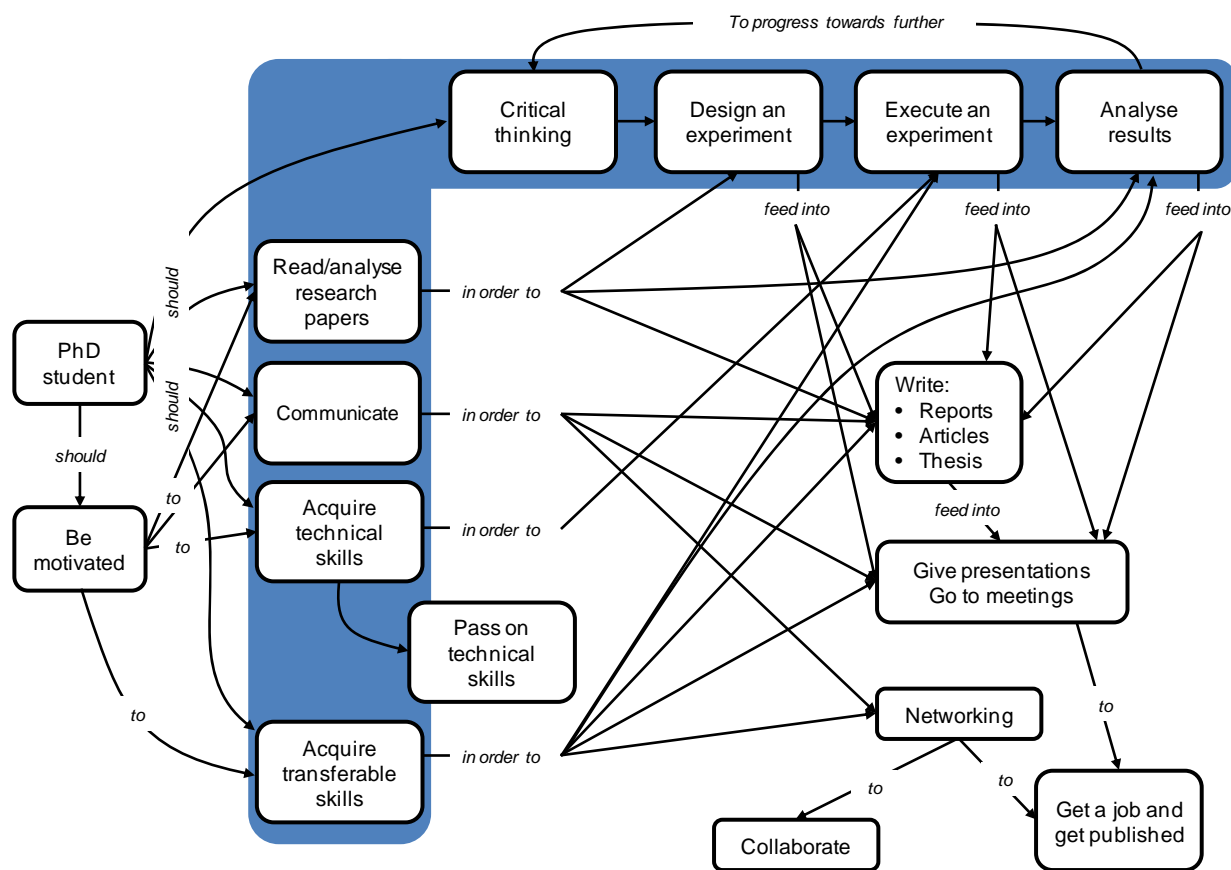


Figure 4. Supervisor map of the process of a PhD

The messiness of the map in Figure 5 may be taken as an indication that the map is acting as a ‘trading ground for ideas’ or an ‘arena for rehearsal of understanding’ rather than a record of learning that has been completed. This further reinforces the notion that supervisors focus more on the PhD as a process of learning, compared with the student concentration on the product (Kandiko & Kinchin, 2012). In the maps presented, it may be the case that students are trying to ‘make sense’ and use the maps as an organising tool, whereas the supervisors have the big picture of the research in their minds and can use the maps to ‘trace the journey’ on how to get there. The arrows for the students point to the ‘end goal’ of the completed thesis, whereas the supervisors’ arrows show the cyclical and multiple pathways that are an inherent part of the research process.

4 Discussion

The multiple conceptual structures that exist within the maps can make them difficult to understand, particularly without the wider context of the PhD. However, following the arrows within the structures presented can be seen as indications of learning pathways. The importance of the arrows can be seen within the linear and hierarchical structures; linear chains may be seen as irreversible (one-way) systems, unlike network and cyclical structures. So for example, in dentistry, the clinical procedure (linear chain) may be seen as irreversible; e.g. once a hole has been drilled in a tooth, it cannot be “undrilled”. Similarly in teaching, once a classroom activity has occurred, it cannot “un-occur”. Whereas the network of understanding has multiple routes through the concepts which can be revisited and revised in such a way that it does not have such an evident pre-conceived end point.

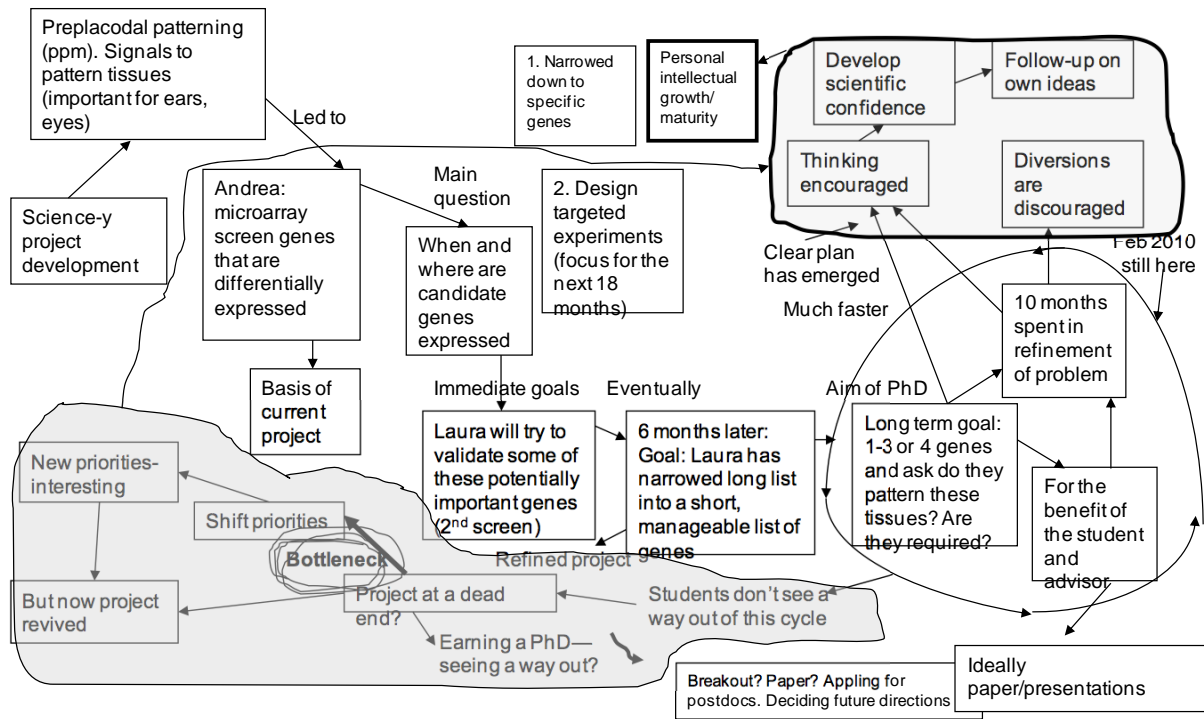


Figure 5. Supervisor map of the process of a PhD

What we can see emerging are ‘knowledge structures’, or learning activities, which make up the conception of the process of the PhD. Three of these have been developed in the work of Kinchin et al (2000), depicted in Figure 6, as spokes (A), chains (B) and networks (C). Building on the work of Safayeni et al (2005) and Kinchin (2011), we have also added the cyclic model, describing the notion that the concepts develop and influence one another. We are further adding the matrix structure (E), which is characterised by the supervisor map in Figure 4. This structure contains elements from the other four structures described, but appears to function in a different way.

A key difference between spokes and chains on one side and networks, cycles and matrices on the other is the notion of reversibility. In the former, once a step has been taken, there is no ‘revisiting’ the learning process. The student must carry on to the next step, or the supervisor must move on to the next point. In the case of the latter, cycles and repetitions develop dynamically, allowing for concepts and processes to be revisited. This is where the direction of the arrows is important, which allows one to follow a chain, enter into a network or cycle, or become enmeshed in a matrix. These can be revisited a number of times, in similar or changing pathways.

We argue that the major matrix intersections and cyclical formations are indications of thresholds, either of concepts or processes. These cycles, or interstices, represent continuous, but developing, learning processes. This follows in the tradition of the Hegelian dialectic, often depicted as an upward spiral of cycles of thesis, antithesis, synthesis and thesis again. This notion is depicted in Figure 7, which shows a conceptual structure, which through repeated cycles of rehearsal leads to greater conceptual development and sublation of previous understanding.

These developments extend the traditional notions of traditional concept mapping when using it in higher-level learning. This reiterates the need for the holistic assessment of concept maps in higher education settings (Kandiko, Hay and Weller, 2012). For advanced higher education, postgraduate education and research-based work, it is not only the development of concepts or the links between them, but also the broader knowledge structures that are formed. Although the participants in the study were briefed on concept mapping, many of the maps that developed strayed from traditional Novakian concept maps. This can be seen particularly in Figure 5. The structure and style of the maps may in fact more closely relate to the ‘messy’ and developing nature of the thesis and the process which eventually leads to the final product. Although a final map of the thesis, reflecting back from the position of the final product, may resemble traditional concepts maps, the maps represented here reflect the dynamic process of learning and development within the setting of advanced doctoral education.

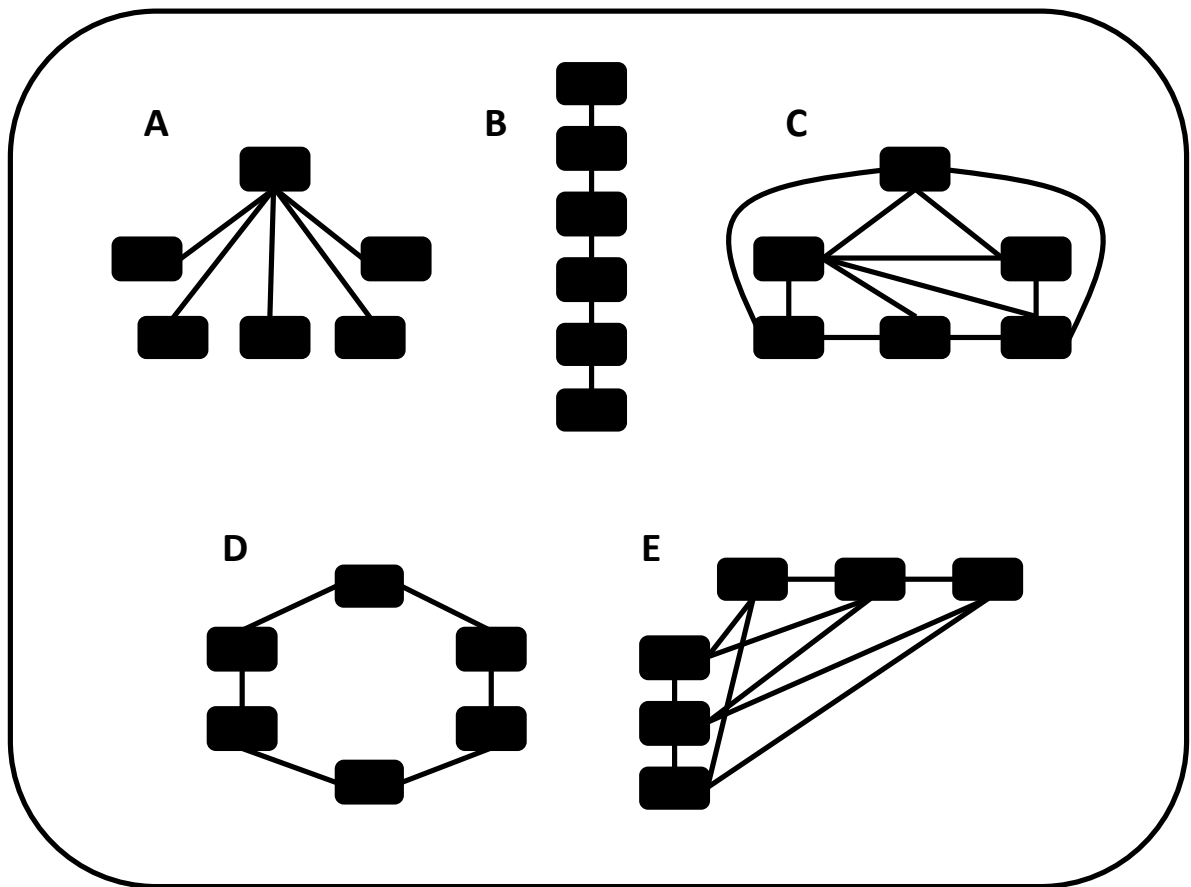


Figure 6. An expanded typology of conceptual structures, A: Spoke; B: Chain, C: Network; D: Cyclical; E: Matrix

5 Summary

In this study, concept mapping revealed more than interviews and transcripts alone. The content and the structure of the maps produced were indicative of the divide in understanding between students and supervisors, even when they appear to be talking about the same topic and using the same terms. The process of map production is seen as a useful addition to the doctoral supervision process. The cyclic processes that are illustrated by the supervisors indicate their appreciation of the changing nature of understanding and the necessity for repeated interaction with the material being studied. The cycles of learning that are described can be used as a tool within the supervisory process, which often represent the dominant method of learning, development and discovery in the discipline. In concept maps from the humanities, the cycles described are referenced to drafts, feedback, edits, and redrafts of essays and chapters.

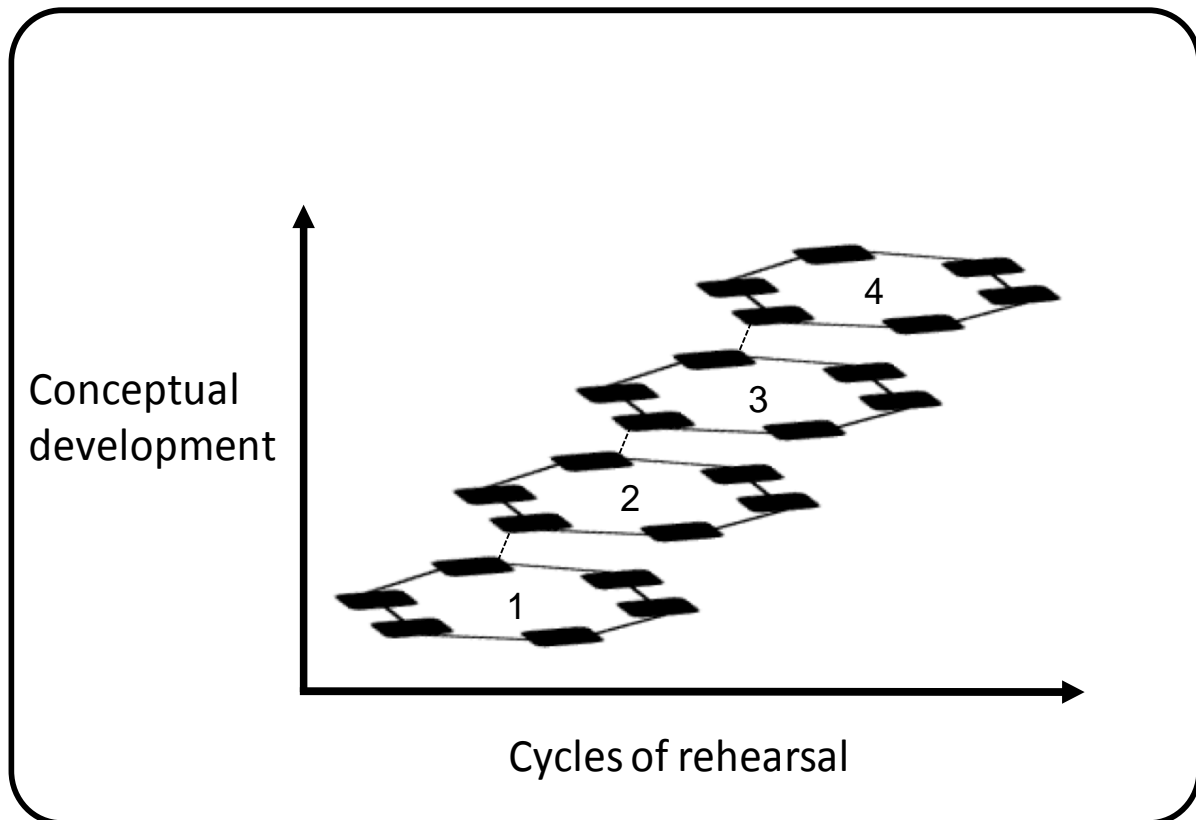


Figure 7. Repeated cycles of conceptual development

Concept maps can be used by students and supervisors as pedagogical tools, as points of departure for conversation and dialogue, and as physical representations of conceptual understandings. Such maps can also function as synopses of a student's developing thesis, which can be useful when sharing the work outside of the supervisory relationship, at a conference or with a lab-group, for example. Supervisors can investigate common 'threshold areas' and develop strategies to help students progress, particularly for when students are stuck in the 'bottlenecks' and may not see the process as one of repeated cycles of rehearsal and advancing conceptual development.

6 References

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