

Paulo Correia, Camila Cicuto, Joana Aguiar
Universidade de São Paulo, Brazil

How do students see the connections among undergraduate courses? Using concept mapping to make interdisciplinarity visible (0120)

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Research Domain: Learning, Teaching and Assessment

Introduction

Real-world problems are highly complex, and addressing them in the classroom is challenging for many reasons (UNESCO, 2005). The following primary obstacles to the discussion of complex issues in higher education are the epistemological challenge of managing a substantial amount of information from diverse disciplinary fields, and the need to engage students in productive, collaborative work sessions to generate the synergistic effect of combining many informed individuals' perspectives.

The integrated understanding of different disciplines contents is a key aspect that must be considered in the undergraduate courses, in order to prepare professionals to deal with the increasing complexity of the knowledge society (Ford & Forman, 2006; Lattuca, Voigt & Fath, 2004; Moran, 2010). In this context, the interdisciplinary approach should be explored in a planned way, and the curriculum should facilitate the interrelation between subject content. Despite its importance, interdisciplinary activities in classrooms are still uncommon because the planning and implementation difficulties faced by teachers.

Complexity can easily lead to cognitive overload due to the amount and diversity of information needed to process. Collaborative work also increases extrinsic overload due to the need to communicate one's knowledge to people from diverse backgrounds. Therefore, instructional design should simultaneously address the epistemological and communicational obstacles to lower extrinsic cognitive load, making more cognitive resources available to the learning task (Sweller et al., 2011).

Novakian concept maps to guide students' through complex subjects

Graphic organisers make all resources consistently visible to the people who need to contend with a given complex problem, thereby fostering the collaborative knowledge construction process (Fischer et al., 2002). Novak's concept-mapping technique was our

preferred choice for representing conceptual and propositional knowledge (Correia, 2012; Novak, 2010). A set of hyperlinked N-Cmaps that include associated resources (digital files linked to concepts) about a particular domain can be classified as hypertext. This resultant structure is similar to a website and is user-friendly even for first-time users (Figure 1). All N-Cmaps made can be organised as follows:

- ◆ Level-1: broader view about the topic;
- ◆ Level-2: detailed view about the Level-1 concepts;
- ◆ ...
- ◆ Level-n: detailed view about the Level-(n-1) concepts.

Hyperlinks among N-Cmaps can be classified into vertical (N-Cmaps at different hypertext levels) and horizontal (N-Cmaps at the same hypertext level) links. The former expresses the overarching structure of all information; the latter relates to the complementary information about aspects of the whole topic.

This paper presents a case study involving the students' elaboration of hypertext based on N-Cmaps to check if/how they see the interdisciplinary connections among six undergraduate courses. We hypothesized that horizontal links are reliable indicators to reveal if/how students perceive interdisciplinarity.

Research Methods

Case Study

Fifty-two first-year students developed hypertext among six undergraduate courses in 2011. The Level-1 N-Cmap represents a broader view about the main topic of these six courses while the Level-2 N-Cmaps detail each course (Figure 1). These courses were devised to promote the interdisciplinary study of relevant real-world questions (main knowledge field/semester offered indicated in parentheses).

- ◆ NS: Natural Sciences (Scientific/1st)
- ◆ DTIA: Data Treatment and Information Analysis (Scientific/1st)
- ◆ SMR: Society, Multiculturalism and Rights (Humanities/1st)
- ◆ PECE: Psychology, Education and Contemporary Issues (Humanities/2nd)
- ◆ SEC: Society, Environment and Citizenship (Humanities/2nd)

- ◆ BACL: Brazilian Art, Culture and Literature (Humanities/2nd)

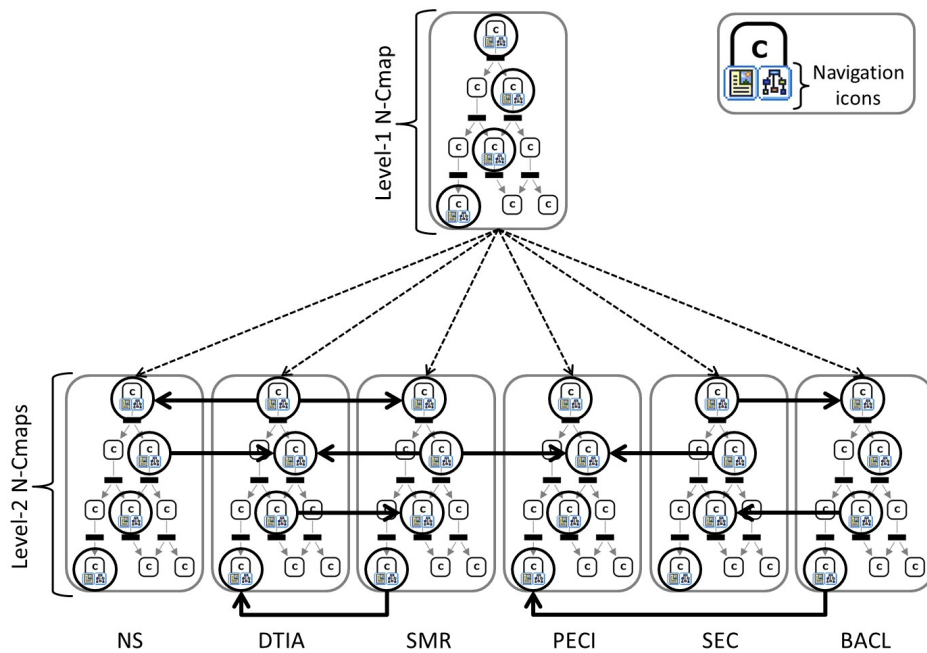


Figure 1. Hypertext organized from a set of hyperlinked N-Cmaps (hypertext), and icons for navigation between N-Cmaps and associated digital resources. Legend: vertical links (dotted lines); horizontal links (continuous lines).

General Procedure

The following instructional procedure allows students to produce their own hypertext collaboratively.

- ◆ Individual preparation of Level-1 N-Cmap (Goal: externalization).
- ◆ Collaborative peer review of Level-1 N-Cmaps (Goals: elicitation and consensus building).
- ◆ Repeat steps 1 and 2 to prepare each Level-2 N-Cmaps.
- ◆ Collaborative preparation of hypertext (Goals: consensus building):
 - Set up the hypertext structure from the revised N-Cmaps.
 - Include digital resources in each N-Cmap.
 - Create vertical links.
 - Create horizontal links.

Results and Discussion

We used students' horizontal links (n=118) to extract information about how they perceived interdisciplinary connections (Table 1). The overall distribution of horizontal links is represented in Figure 2.

Table 1. Horizontal links distribution between the Level-2 N-Cmaps.

	NS	DTIA	SMR	PECI	SEC	BACL
NS	-	-	-	-	-	-
DTIA	7.6 (%)	-	-	-	-	-
SMR	17.8 (%)	3.4 (%)	-	-	-	-
PECI	2.5 (%)	0.8 (%)	6.8 (%)	-	-	-
SEC	5.9 (%)	2.5 (%)	2.5 (%)	18.6 (%)	-	-
BACL	1.7 (%)	0.8 (%)	3.4 (%)	16.1 (%)	9.3 (%)	-
Culture Semester	Sci 1st	Sci 1st	Hum 1st	Hum 2nd	Hum 2nd	Hum 2nd

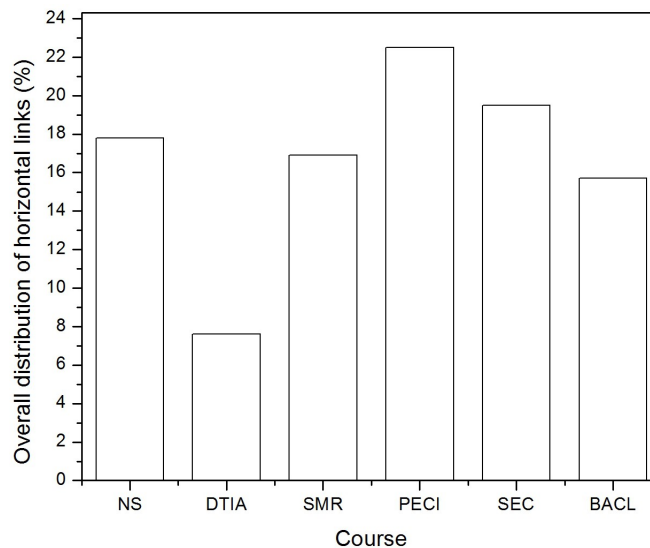


Figure 2. Overall distribution of horizontal links (%) for each course considered in our case study.

The main findings were:

- ◆ The sum of links for each course varied from 15.7-22.5%, except for DTIA (7.6%). Its content is too specific, and it hindered interdisciplinary connection with other courses.
- ◆ Concurrent courses were more connected by students because their contents are discussed simultaneously. Connections between NS/SMR (1st semester), SEC/PECI (2nd semester) and BACL/PECI (2nd semester) represented 17.8%, 18.6% and 16.1%, respectively.

- Alignment of courses' knowledge field (scientific or humanistic) increased the number of horizontal links (e.g. NS/DTIA, 7.6% and SEC/PECI, 18.6% in Table 1). An unusual situation involving NS/SMR (17.8%) might indicate an approximation of these two isolated cultures, proposed by Snow (1998).

Figure 3 presents two of the N-Cmaps developed by the students. Figure 3a shows the Level-1 N-Cmap (broad view) while Figure 3b shows one of the Level-2 N-Cmaps (specific aspect of one course).

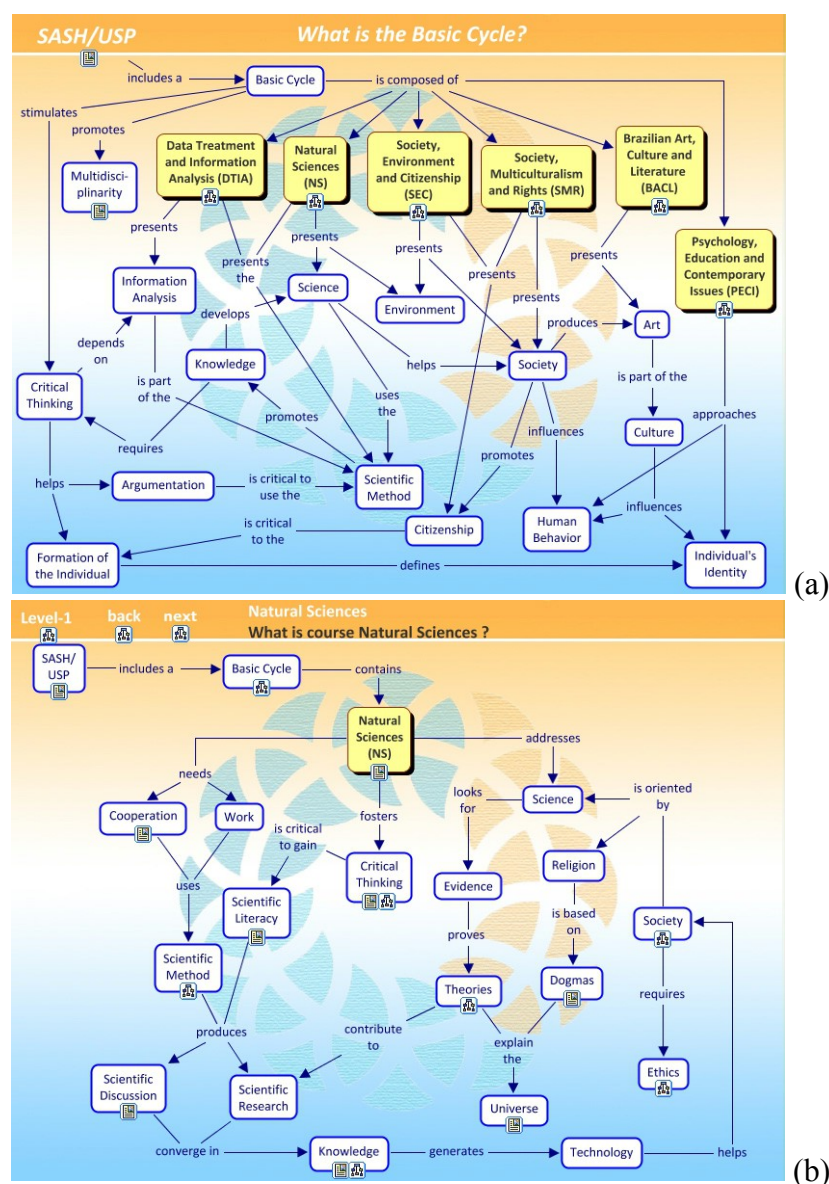


Figure 3. Illustrative N-Cmaps made by the students to represent the interdisciplinary connections between the courses (n=6) offered during the Basic Cycle.

Conclusions

Hypertext based on N-Cmaps is useful to design instructional activities addressing complex real-world problems. It manages the epistemological and communicational obstacles that can hinder such discussions. Our results confirmed N-Cmaps captured students' perceptions about the conceptual connection among the mapped courses. The comparison between students' and academics' views about these courses may inform further curricular changes to deepen interdisciplinarity, which is an example of high-complexity discussion.

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