Chapter 11

CONCEPT MAPS AS KNOWLEDGE-BUILDING AND ARGUMENT-SYSTEMATIZING TOOLS
Experimenting with undergraduate students

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ABSTRACT

In the second semester of 2012, a first experiment with concept maps (CMs) as pre-writing and collaborative work technology with 130 undergraduate students in Curitiba (Brazil) proved to be a powerful team-spirit and argumentative competence-building resource. Constructed over the principles of meaningful learning (Ausubel, 1978), andragogy (Knowles, Holton, & Swanson, 2005), concept mapping (Cañas et al., 2004, 2005; Novak, 2003; Novak & Cañas, 2004, 2007; Torres & Marriott, 2009) and the efficacy of using CMs in collaborative working scenarios (Torres & Kucharski, 2012; Kucharski, 2013; Torres, Kucharski, & Marriott, 2014), the experiment showed noticeable quality gain in works presented by the study population in three different undergraduate courses, showing an average of 15% higher grades. The research design, application and a first discussion of its results are hereby presented.

Keywords: concept maps, collaborative work, educational technologies, meaningful learning, argumentative competence.

1. INTRODUCTION

Even not focusing on rhetorical discussions about what *knowledge* effectively is (assuming each research group decides upon a concept over which all its argumentations are built), we still find ourselves before a different challenge: in how many ways can knowledge be represented effectively? The most common ways are granted: orally, in written and in rather simple graphic forms. However, new software have made it possible to combine different, ever more complex representation forms into innovative, more clarifying and attention-grasping products.

Educators in all educational levels have often complained about a perceived difficulty of their students to cohesively, coherently and contributively organize and articulate their newly-built pieces of knowledge, and such difficulty was even bigger when it came to systematize and represent the process through which such knowledge was attained.

Yet, it is necessary to make our choice of a concept for knowledge clear, one that will guide our understanding and our proposals towards ways of representing it – and/or the process of its acquisition. In this case, it is Ausubel, Novak, and Hanesian's (1978) proposition of a meaningful knowledge. Torres, Kucharski, and Marriott (2014, p. 496) describe it as follows:

> Broadly speaking, in this type of knowledge, new knowledge is incorporated via the assimilation of new concepts and, fundamentally, of new meaningful conceptual relations established with our previous knowledge repertoire. This incorporation – meaningful knowledge as such – happens by the mediation of language, provided three basic conditions are met:
> (1) The material to be learned must be conceptually clear and presented with language and example relatable to the learner's prior knowledge. (2) The learner must possess relevant prior knowledge. (3) The *learner must choose* to learn meaningfully (Moreira, 2007, p. 2; Novak & Cañas, 2007, p. 30, italics from original).

Using concept mapping as an interpretive resource to facilitate the comprehension of inner interdependencies that render a given text coherent (or not!) is far from new to Education. Much has been published and discussed about it, even very recently, from original perspectives on what concept maps – CMs – should be (Cañas et al., 2004, 2005; Novak & Cañas, 2007; etc.) to extensive reviews of their successful applicability (Torres & Marriott, 2009; Torres & Kucharski, 2012; Kucharski, 2013; Torres et al., 2014; etc.).

Nevertheless, most of what has been researched and published on the construction and use of Concept Maps (CMs) rarely differs from *a posteriori* uses to understand structures and intertextual implications of texts – all from an analyst's standpoint. Our intention, in the hereby described research, was to establish first impressions on the usability of CMs in pre-writing stages of original papers. The main objective was to identify positive qualitative changes in a variety of genres of undergraduate students' papers in cases where CMs of their structures were produced and collectively discussed *a priori* as opposed to texts written without this kind of planning strategy. As secondary goals, we intended to understand more about the influence of such strategy in collaborative team-spirit and argument-building competencies.

The initial work and research were conducted with 130 undergraduate students from the Communications, Graphic Design and Law Schools of a distinguished college in Curitiba, a large city in Southern Brazil, renowned for the quality of its higher educational institutions. The study was designed by the author, further developed and implemented with the help of three other professors in the partner college.

2. THE RESEARCH

Once the institution for the research had been chosen, contacted and formally joined our efforts, professors whose work results depended on students' strong writing and argumentative competencies were contacted to participate in the study by applying the designed work methodology with their groups and work with a review committee of volunteer researchers that would analyze the results with the head researcher.

2.1. The methodology
Three volunteer professors were given workshops on the research's main objectives, methodology and theoretical basis, which included principles of meaningful and critical learning (Ausubel et al., 1978; Moreira, 2007), andragogy (Knowles et al., 2005), textuality and relevance (Silveira & Feltes, 2002), technological mediation applied to teaching and learning (Novak, 2003; Moran, Masetto, & Behrens, 2006) and the nature and applicability of CMs in constructivist pedagogical activities (Novak, 2003; Novak & Cañas, 2004, 2007). They were also taught to use Cmap Tools, a CM building free software developed by the Institute of Human and Machine Cognition of the University of Florida, with which

students should be familiarized in order to construct their pre-writing maps – which, in their turn, would be the main source of research data to be analyzed later.

These professors would, then, show and explain CMs to their classes, later taking the students to computing labs to teach them how to correctly download, install and use Cmap Tools as a collaborative instrument to plan and discuss a text yet to be written.

Next, each professor would ask students in their classes to team up in groups of three or four which would be challenged to produce a text in a common genre in their field of work and study, collectively planning it with the use of the software. The challenge was not the same for each class, because the multiple possibilities of CMs to plan a number of different text genres was an important part of the research. Nonetheless, the underlying conditions for producing an acceptable text would always be the same. Torres et al. (2014, p.591) elaborate:

> When planning the writing of a text by concept mapping, the student/author can visualise and enrich both sequence and text coherence in such a way as to produce a much more elaborate piece of text as regards the criteria applied to scientific text production. Based on Beaugrande and Dressler, Koch (2001) discusses textual criteria, listing the following ones: informativity (what does the text complement to the reader's own knowledge?), situationality (is the chosen genre and text type the best for the communicative situation?) intertextuality (which connections does the text make with other similar pieces of text, in terms of theme/subject, and what does this demand from the reader's knowledge repertoire?), intentionality (is the informative/ argumentative intention clear in the text? Does it respect its objectives without committing unwanted ambiguities?), acceptability (is the text written in a way as to facilitate understanding by the reader?).

> Koch and Travaglia (1999) add other four categories that, although they may seem partially redundant as regards the previous ones, they bring some new perspectives: contextualization (does the text reveal its content without treating knowledge as a collection of isolated data?), focalization (does the text present its content in such a way as to create a common ground for dialogue with the reader?), consistency (is textual construction consistent, with a clear meaning, when considered as a whole in its arguments and images?) and relevancy (is there a relevant central subject guiding text construction?) (pp. 76-101, own translation).

Such conditions should be depicted in the proposed CMs, in the form of visibly predictable interrelations that should help the development of the final texts.

Undergraduate students in the Graphic Design School were asked to plan and construct a presentation of a department store signalization solution to a potential client. Their specific challenge rested on the fact that the proposed solution would be more expensive than the client had anticipated in the briefing moments, and they would need to be ready to reason in favor of their plan. The groups would be asked to build pre-writing CMs to study their strategies to restraint any predictable opposing positions the client might have by pointing the advantages of their new proposal, after which they would construct their supporting visual materials and text.

In Law School, classes were divided differently. First, they would be split in groups (A and B), and each half would form their teams of three of four people (teams I, II, III, IV, and so on). Then, they would be presented a fictional situation: a client was very likely to be considered guilty of a certain crime that would send him to jail for at least fifteen years. Teams in group A believed the client should accept the sentence, given all evidences

against him, but ask the court for clemency based on the fact that he had acted under stressing circumstances. Teams in group B had a different opinion; they should advise their client to try and use a breach in the law that could set him free because it might give cause to a mistrial plea. However, should he succeed, there was a strong chance that another procedure be started against him later on and, then, that he would not escape the maximum penalty. The groups would, at that point, be given time to work on their pre-writing CMs and final papers.

In the Communications School, Advertising students were asked to devise a central line of reasoning for a campaign aimed at making a local soda brand gain enough "weight" to be perceived as an appropriate competitor to the leading, national brand that dominated 85% of the market. Their challenge was to center their arguments on the "native" aspect of the client's product, trying to make it sound like a desirable choice not only because of its flavor, but also because it created jobs and riches in that specific state. Then the groups would have enough time to work on their pre-writing CMs and advertising pieces.
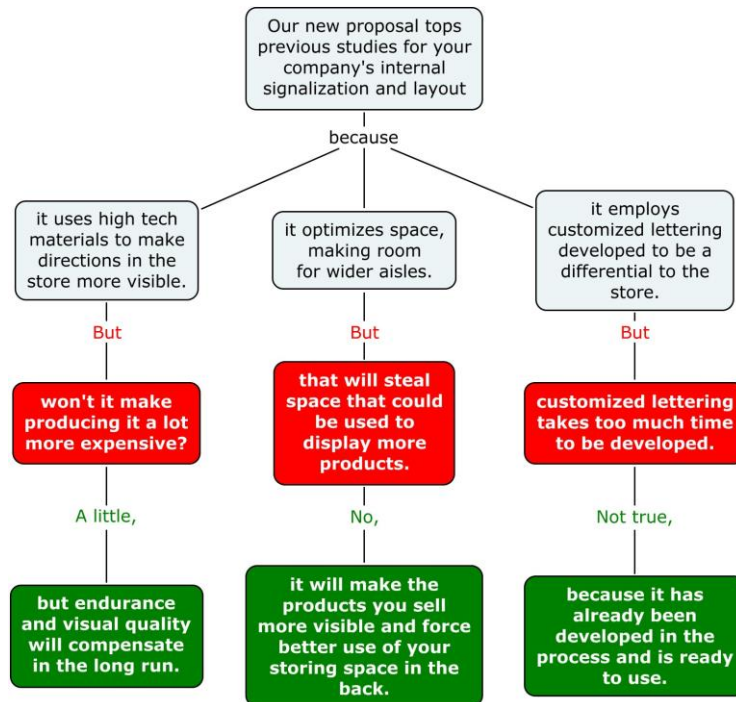
All groups were requested to use a similar protocol to work on their pre-writing CMs. The maps should begin with a short statement that illustrated the main point they would work to prove/sell to their client. Supporting arguments to that objective would be linked to the main idea by logical connectors that showed how each supporting idea coherently completed the group's intentions. Then, one or two members of the group would be asked to analyze the connections established in the first CM and supply whatever counterarguments they considered strong enough to deserve being prepared for, indicating it on the CM by a red-colored nod. The counterarguments would then be analyzed by the whole group, which would choose the best way to reply to each of them, indicating it by a green-colored nod on the map. The final versions of each group's CMs would be used to build the texts/presentations that would be offered to their clients. (Examples of the three stages of the pre-writing CMs are given in figure 1)

After three weeks of preparatory work had passed, the groups presented their results before panels of two professors who would play the role of their potential clients. Groups would hand in copies of their pre-writing CMs together with copies of the finished work, which would be the essential elements to assess the quality of the production based not only on the finished products, but strongly on the preparation process visually accessible by the CMs.

Each participant course did it their own way: Graphic Design students presented their layouts to professors who would impersonate clients, in a role-play activity. Communications students' groups were paired to present their proposals to professors who would decide which one was more adequately developed. Law students' groups were paired considering each pair was formed by teams from different groups who would present their cases before professors who would be playing the roles of the nearly-convicted clients to decide what to do according to what they considered their best chance.

The final assessment (and grade) to be attributed to the groups was not to be calculated on the basis of who won or lost, but by judging the quality and coherence of the preparation work done by each of them and the perceived quality of the cases/arguments/proposals presented. Such assessment would become notes to be submitted to the researchers, together with the final texts of each participant group.

Figure 1. Stages one (pale blue – first proposals), two (red – possible counterarguments) and three (green – strategies to fight counterarguments) of the pre-writing CMs (Graphic Design group).

Later on, professors from the three courses involved sent the researchers the final argumentative papers produced by their students, together with their (the professors') notes on the strengths and weaknesses perceived in those texts. These were the fundamental data for an evaluation process based on (and done in this sequence):

1. Content Analysis (Bardin, 1995), in which phase the superficial structure of the students' texts – their cohesive arrangement − was evaluated in terms of their intrinsic characteristics and the teachers' general opinion about each one of them, and a first step toward coherence assessment was taken, as researchers, while assessing such texts for the first time, also produced their personal notes that reflected their initial reflections on the readings.

2. Discourse Analysis (Lozano, Peña-Marín, & Abril, 2002), through which coherence in the students' texts was weighed in terms of (a) their [the texts'] effectiveness toward their main objective, (b) their argumentative strength in both argument selection and textual construction and (c) the possibility to recognize in them the quality markers implied (or openly expressed) in the professors' written assessments. It is also important to say that argumentative effectiveness was also observed, in this phase, from a textual-pragmatic point of view (Silveira & Feltes, 2002), given that all selected arguments reflect the writers' best options considering their objectives and, thus, embody what the writers' consider the most adequate form of expressing what they mean. Such view was also applied to the comparative analysis of students' texts and their teachers' notes on their grading.

3. Three focus-group meetings (one for the involved professors of each participating course) in which the researchers' notes on strengths and perceived inconsistencies in the submitted students' and professors' texts and notes were presented and discussed, as well as the professors' perceptions of the gains (or limitations) from the inclusion of CMs in those relevant activities.

4. Research leader and volunteer researchers met three more times to discuss and compare notes on the results of the focus-group meetings and the accuracy of what had been perceived and discussed so far, leading up to the corpus of documents that made this and its previous paper possible (Kucharski, 2013).

All these steps were carefully followed to ensure trustworthy conclusions that would hopefully cause further interest in the use of CMs for harboring textual and argumentative competence development opportunities in many other academic activities.

2.2. The results

What was clearly visible, as a result of all efforts, was a perception of an increment on the quality of the work done by the participating students from the three involved courses. Such gains were pointed out by the professors and confirmed in the content and discursive analysis of the texts produced by the students and of the professors' notes. It definitely pleased the research team by confirming its initial propositions and beliefs that CMs would be ultimately relevant for increasing argumentative and textual competences, far beyond their much known proficiency at summarizing and showing internal relations of pre-written texts.

Collaborative work was strongly present as a valuable strategy to devise and develop products, presentations or arguments in polyphonic, constructivist scenarios (as also discussed by Novak, 2003; Novak & Cañas, 2004; Torres & Kucharski, 2012; Kucharski, 2013; and Torres et al., 2014). Teamwork made it necessary that negotiation competencies rise and become a driving force toward the desired quality of the work. Certain disagreements were inevitable, but solving them democratically was fundamental to reach any satisfactory result.

Professors were unanimous to mention a perceptible gain in quality of the works. Reasoning lines, argumentative competence and the confidence to present and defend ideas against opposing viewpoints were more intensely present, and substituted, most of the time, the more traditional resource to common sense knowledge or improvised answers. Average grades, in comparison to previous activities in which CMs were not used, were around 1.5 point higher (in a 0 to 10 points scale), which means 15% more productivity perceived – comparison was made possible because teachers had kept their notes on the results of assessing argumentative texts from their students in the previous semester.

Learning through real challenges, in a situation where negotiating meanings and using logical arguments to reinforce or dispute a point of view are very typical characteristics of the kind of learning activities appealing to adults (Knowles et al., 2005), and facilitates meaningful learning (Ausubel, 1978). All of it was considered by participating professors and students to be true about the experiment.

As for the students, they all had positive reviews of the experiment. It is very interesting to note that such positive impressions were no different in nature than those listed as results of a slightly different experiment related in Torres et al. (2014).

In terms of using CMs and its generating software, students' perceptions were all positive. They considered it an intelligent, easier and more precise way to collect, summarize and develop ideas both individually and in groups. In addition, the construction

of the final text, after CMs were used to sort and select arguments seemed to have become an easier, quicker task.

Preparing for presentations or tests also seemed more adequate with CMs, for they reflected the main ideas and arguments involved in discussing a specific case, as well as the ways in which such information would relate with each other, building safer "maps" to follow. It was also present in the form of allegations of better learning and understanding of complex concepts, ideas and their correlations.

Yet, the facilitation of groupwork was not underlooked by the student participants, who said time-use had been made more efficient by the clarity of the argument-presenting structures provided, avoiding time and effort-consuming misunderstandings so common when only individually-produced texts or notes were taken to work meetings.

3. FUTURE RESEARCH DIRECTIONS

Using CMs as pre-writing, collaboration-building, analytical-working tools in Education is clearly an option that should be considered by ever more schools of any level. Young adults, who were this research's population, need schools to present them with more opportunities to grow confident to develop their own ideas and professional objectives, as well as for improving interpersonal skills to work in groups whose goals are building consensual answers to problems posed by real-life situations. All these gains should be extended to all other age and interest groups, for they are more than an exercise of teamwork: they are an exercise of maturity and democracy.

More research in this same direction must occur, as well as the development of new ways to use this technology to enhance professional and educational experience.

This specific paper ends a research chapter for the involved group (specifically for Torres, Kucharski, and Marriott), one that aimed at confirming the group's fundamental premises of the intrinsic worthiness of CMs to organize ideas and arguments in an *a priori* moment of textual production. The researchers and the research groups they participate in and lead now have different challenges to explore CMs in more diverse scenarios, in innovative ways.

4. CONCLUSIONS

The main conclusions of the described research can be easily drawn from the presented results. The perceived gains, both from the students' and professors' points of view strongly support further and innovative researches on the educational and competence-building values of CMs in all school levels.

It was shown that CMs are valuable tools also for argumentative textual preparation and production, and looking for other ways to apply them to the teaching-learning process is what will move our future efforts.

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