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EXPERT/ NOVICE PAIRS WORKING TOGETHER ON CONCEPT MAPS

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Abstract. Here we present the section on *pairwork* using concept maps, first on an individual level and then, through what we have termed "*parejas solidarias*" (expert/novice pairs). A student who has finished her/his concept map helps and teaches another who has not yet finished to complete the task. The *expert* helps by teaching, sharing, negotiating and reaching an agreement over the key words and link words to be used in the concept map, but never by doing the *novice's* map for her/him. The basic aim is to enable the *novice* with the help of the *expert* to produce accurate concept maps of her/his own. The results suggest that *pairwork* provides the *novice* with the opportunity to consider the partner's answers, and negotiate meanings so that, between them, they reach a joint solution for the *key word* or *precise link word* required to build the concept map. Students were much better able in pairs to arrange the concepts and organize them in hierarchical order, and, all except one pair accurately used the 23 concepts proposed.

1 Introduction

This study is based on a research project that received the financial support of the Caja Navarra and the Centro Asociado de UNED in Pamplona (Spain). The focus of the research, which fits into the constructivist framework, within the context of Ausubel's Meaningful Learning Theory, is Novak's concept maps. Our theoretical framework is grounded on Vygotskian and Neovygotskian research on cooperative learning, particularly the *zone of proximal development*. *Socio-cognitive conflict* as researched by the Neopiagetians and Bandura's Theory of Social Learning through the *Modelling* technique.

Team learning is grounded on three factors: personal willingness to work with a partner, dynamic and constructive social interaction, and a concept map that is the work of both partners not just that of the expert. Conflict between *partners* arising from different points of view and different stocks of knowledge, forces them to refine their modes of expression, thus leading to more interesting and complex propositions and links. Thanks to that *feed back*, obtained through the exchange of explanations, lines of argument and reasoning, and through negotiation and working out agreements with the *expert*, the *novice* is able to progress towards building up a world of shared meanings; and the expert, by taking on the *role of teacher*, is able to sharpen her/his own metacognitive processes.

2 Research plan

2.1 Objectives

The aims we hope to achieve are as follows:

- To investigate how concept mapping *in pairs* is more beneficial in results and quality of learning for *novice learners* than working alone.
- To observe how students can learn from "other" students by working in *expert/novice pairs*.
- To test whether shared learning benefits the *expert's* metcognitive development.
- To promote survival and defence mechanisms such as: self-esteem, autonomy, school success, recognition, social competence, school adaptation, and good friendship modelling.
- To promote communicative relationships with "others" by working in different pairs.

2.2 Method

The subjects for the study sample were 60 Secondary School students from a school in Navarra (Spain). In this study we present the work of 5 pairs, who worked first individually and then in pairs.

2.2.1 Procedure

The research was divided into the following stages:

Stage 1. Initial activity (for motivation): the teacher explains the technique to the whole class.

Students learn how to produce *concept maps* in a practical way by constructing and reconstructing maps using the *modelling technique* in which the teacher provides the model by talking through the process on the blackboard.

The steps are as follows:

1. We select a topic that the students that has already been taught to the students in previous years.
2. We hold a brainstorming session in which the students name concepts relating to the topic.
3. The concepts or key words are written on labels or *post-its*.
4. The *post-its* are arranged and stuck on the board in hierarchical order.
5. Arrows are drawn to link the concepts.
6. Link words are decided and then written over the arrows.

Once the students have observed and used the concept mapping technique we proceed to the second stage.

Stage 2. Activity: how to produce a concept map.
Maps of different levels of detail are then drawn: a general one relating key concepts from the area of first grade Natural Sciences, and other more specific maps for each topic.
Students are given the following instructions:

1. Read the text carefully making sure you understand it.
2. Identify and mark the concepts in the text by drawing an ellipse around them and then underline the link words connecting them.
3. Select the key concepts in the text, making sure that none of them appears more than once on the map.
4. Arrange the concepts into hierarchical order. You can do this graphically by linking then with arrows leading from the more general concepts to the more specific ones. When two concepts are interrelated, show this by using a two-pointed arrow.
5. Write the link words over the corresponding arrows.

Stage 3. Working in expert/novice pairs (supportive pairs).
A student who has finished her/his map helps and teaches one who has not yet finished to complete the task. The *novice* chooses an *expert* to work with and they produce the map between them. Alternatively, the *expert* can choose a *novice* to work with. The goal of the *pairwork* is for students to develop cognitive, personal and social resources by *modelling*. Another of the aims pursued using concept mapping as a learning tool is to help students to learn meaningfully, and to develop personal resources and skills to assist them in their personal, social and school lives.

We took MATTER as our most general concept, to be used as a starting point for the students to build up their knowledge in a progressive, organized and meaningful way. The 23 target concepts to be taught, assessed and used throughout the study period were as follows: *Living matter, inert matter, lithosphere, hydrosphere, atmosphere, biosphere, rocks, water, air, living beings, minerals, continental, oceanic, cell, kingdoms, prokaryote, eukaryote, monera, protists, fungi, plants and animals.*

3 Analysis and interpretation of the results

In their initial map, the 5 novices used between 10 and 16 concepts, that is a range of 43.47% to 69.56% of the possible total. Figure 1 shows an example of an initial concept map drawn by a novice without assistance. We can see 16 concepts; the 7 that are missing are water, air, hydrosphere, atmosphere, continental, oceanic and biosphere. Nevertheless, we are able to observe good verbal fluency in the selection of the link words, which are fairly profound, not superficial, this can be appreciated by comparing concept maps 1 and 2. The map contains no conceptual errors. We have translated the students´ concept maps from Spanish into English using the same layout.

In the final map, where the students worked in pairs, only one pair used as few as 13 concepts, that is, less than 60% of the concepts proposed. The remaining 4 pairs used 17, 17, 20 and 23 respectively, that is, between 73.91% and 100%. The average percentage of concepts used was therefore 86.95%. All the concept maps produced in pairs show an accurate hierarchy of concepts. The link words used by two of the pairs were very simple but showed a correct understanding of the topic. The maps contain no conceptual errors.

A global comparative analysis enables us to see that, in all pairs except one, the expert's instruction is followed by great progress not only in the number of new concepts used by the novices, but also in the richness of the content. This is due to the discussion and negotiation that goes on between the partners as they are drawing the map, deciding which concepts to include, selecting the most accurate link words giving reasons for their choice, all of which results in a much richer and more complex map, as can be seen in the one shown in figure 2.

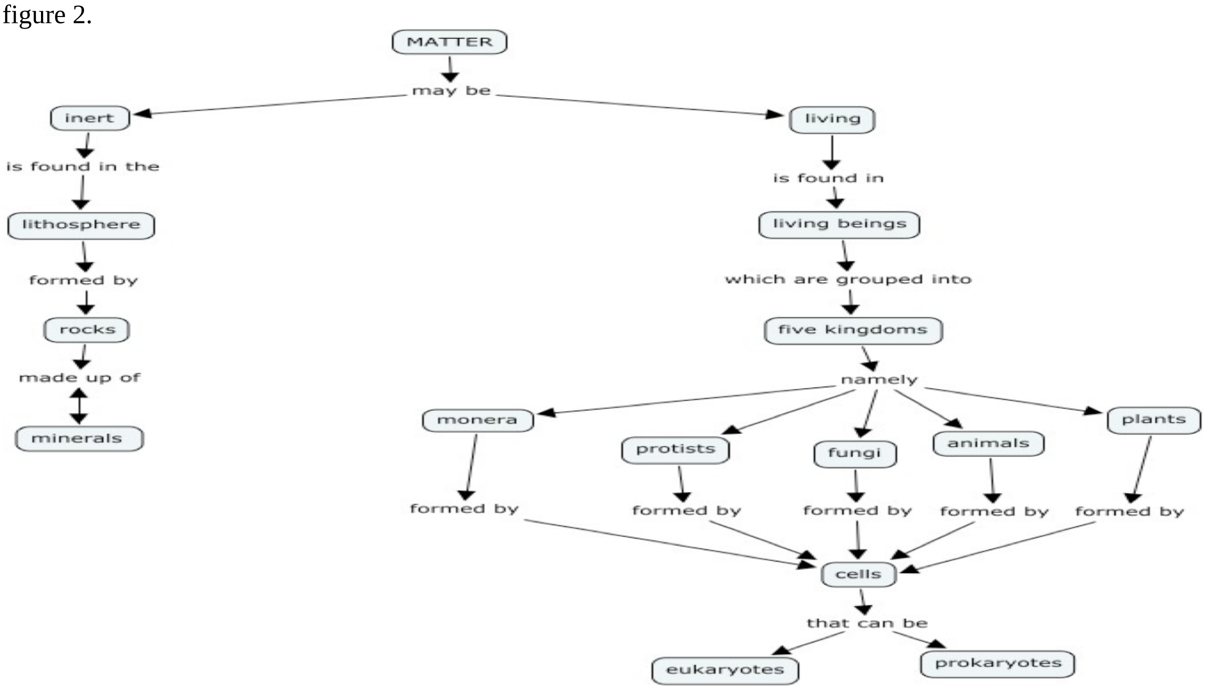

Figure 1. Concept map drawn by a novice without assistance.

All students behaved in a cooperative manner while working in pairs to produce the concept maps, helping each other, showing awareness of the activity in which they were engaged and reflecting and interchanging ideas with their partner.

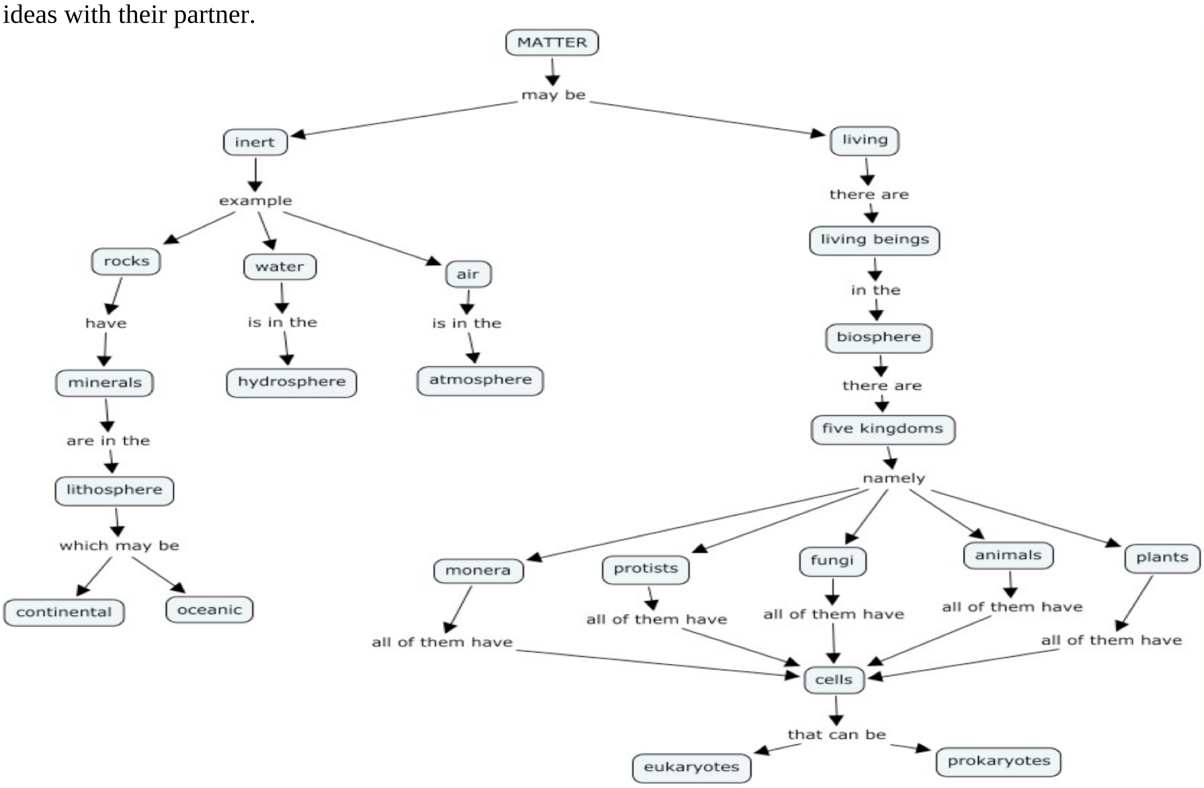

Figure 2: Concept map jointly produced by a novice and an expert (supportive pairs).

4 Conclusions

A qualitative analysis enables us to conclude that we have accomplished our proposed aims, although it is impossible in these pages for us to illustrate the conduct, helpful attitude, support, friendship, personal and social resources promoted and developed in the students through their pairwork.

In the jointly produced maps, the pairs were much better able to arrange the concepts in hierarchical order, and, in all cases but one, they correctly used all 23 of the proposed concepts.

The final maps reveal not only the incorporation of more concepts but also an improvement in the way they are used. The greatest improvement in the use of concepts in the final pairwork maps in comparison with the initial maps of the novices working alone was in the following concepts: *continental, oceanic, atmosphere, hydrosphere, biosphere, lithosphere, fungi, water, air, prokaryote, eukaryote, monera and protists.*

The exercise is mutually enriching for both partners, since, with the expert, the novice is able to include all the concepts, while the expert's observation of the way in which her partner relates the concepts helps both partners to link them more accurately.

Thus, pairwork benefits not only the *novice learners* but also the *experts*, by requiring them to verbalize what they know, cognitively structure the information they need to convey, and, in a word, play the "*role of teacher*", all of which helps to develop their metacognitive processes of awareness and reflection. Thus, working in pairs benefits both partners.

We are therefore able to conclude that working on concept maps in *expert/novice pairs* has proved methodologically very useful for developing metacognition, because it forces students to be aware of what they are doing, encourages them to think critically, reflect, and learn from their mistakes.

Finally, we are able to confirm that the incorporation of concept maps as a learning tool in the area of Natural Sciences constitutes good teaching practice.

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