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THE CONCEPT MAP AS AN AID TO COOPERATIVE LEARNING IN PRIMARY EDUCATION. A PRACTICAL EXPERIMENT

Iraizoz Sanzol, Natividad, Colegio Público San Juan de la Cadena, Pamplona, Spain
González García, Fermín M, Department of Psychology and Pedagogy, Public University of Navarra, Spain
Email: niraizoz@pnte.cfnavarra.es, fermin@unavarra.es

What follows is the description of an experiment conducted with fifth-grade primary pupils (10 to 11-year-olds) at the San Juan de la Cadena state school in Pamplona (Spain) within the subject area of the environmental sciences. An attempt was made throughout to draw on the potential of Concept Maps (henceforth CMs) to facilitate cooperative learning, by promoting peer interaction, since we were aware that it is in these conditions that pupils are best able to learn. The results reveal the suitability of the CM as an aid to cooperative learning through its positive effect on individual performance. The value can be seen not only in the pupils' increasingly elaborate maps, but also in the skills and strategies brought into play through the dynamics of this teaching-learning process.

1 Introduction

According to research initiated by the Geneva School, all the evidence seems to suggest that peer interaction among students is more effective than students' interaction with adults for the construction of knowledge. Due to the proximity of the language, mutual explanations between peers often prove to be more effective in helping pupils to learn than explanations given by adults. According to the Close Development Zone concept, established by Vigotsky (1979), working with their peers is as useful as working with adults when it comes to helping children to make explicit knowledge that they possess but that would not have come to the surface without the mediation of, in this case, their peers.

In the standard conditions under which learning usually takes place in the classroom, a single adult, the teacher, attempts to mediate in the learning process of a number of pupils without ever fully matching his approach to any one of them. In group work, however, a more able student sitting beside a less able student will act as a mediator in helping him to learn. Small group dynamics multiply the opportunities for interaction and thereby for mediation.

In the cooperative learning situation, students work together towards a more meaningful learning outcome for all. The practice of meaningful learning, with all that it entails both for the student and the teacher will also facilitate the incorporation of new information into the student's cognitive structure, the state of which must be verified before the learning process begins. These dynamics will help individual students to realize their full potential. CmapTools software created at the Institute for Human and Machine Cognition (Cañas et al 2004) constitutes an aid to meaningful learning and social knowledge construction (Novak & Cañas, 2003). In the light of the above assumptions, the following describes an experiment in cooperative knowledge construction with primary school pupils using teamwork and CmapTools.

2 Methodology

The experience was conducted during the second term of the 2007-08 academic year with 24 5th grade of Primary School children (10 – 11 year-olds), who were divided into six groups of four. Every effort was made to make the groups as homogeneous as possible, in terms of academic performance (marks obtained in the various areas of the curriculum) and attitude towards study (completion of assignments, readiness to participate and cooperate in class, etc.). The academically-ranked groups were labelled A, B, C, D, E and F. Groups A and B contained students whose marks in the subject that concerns us were outstanding; while group C were between outstanding and very good; group D between very good and good; and E and F ranging from good to satisfactory and poor. In this way, we thought that the members of each group would possess fairly similar learning potential, which would allow them to obtain the maximum benefit from the learning situation and progress in parallel with one another. This, in turn, was expected to result in differences between groups.

At the time of the experiment, the children possessed only limited skills in the construction of CMs, since they had not worked with them in previous school years. It should be stressed, however, that they were a highly enthusiastic class who approached concept mapping with pleasure, especially when it came to working with CmapTools.

The purpose was to reinforce the learning goals of the unit and provide comprehensive reading practice using the CM as a facilitating tool.

2.1 Stage one

Following work in class on the topic of the characteristics, properties and changes in matter, a reading passage on changes in matter was selected from the encyclopaedia "Mi primera Encarta" ("My first Encarta") and the children were asked to read it to themselves and then to construct an initial CM from what they had read.

2.2 Stage two

The children were then asked to work in their groups for two sessions on the construction of a joint CM based on the contributions of all group members. At this stage they were working with pencil and paper.

2.3 Stage three

Finally, in a subsequent session, further work was carried out on the joint CM, this time using CmapTools. In stages 2 and 3, the teacher, while trying not to intervene too much, answered some queries raised by the children during the course of their work.

3 Results and discussion

Some interesting differences were observed in the children's behaviour and in the quality of the CMs they produced. They were due in part to different academic abilities of the group members, but also to their different attitudes and ways of understanding the learning process.

Groups A, B and C (Figure 1, 2 and 3,) attempted to incorporate a great deal of information in their CMs. To some extent this may be due to these children's great eagerness to learn, but may also be a result of the erroneous, albeit widespread idea that a well-constructed CM should contain a large amount of information. Groups D, E and F (Figures 4 and 5), on the other hand, included hardly any information. Group F, in particular, showed themselves to be more concerned with the design of the map (the style and colour of the links) than with the content.

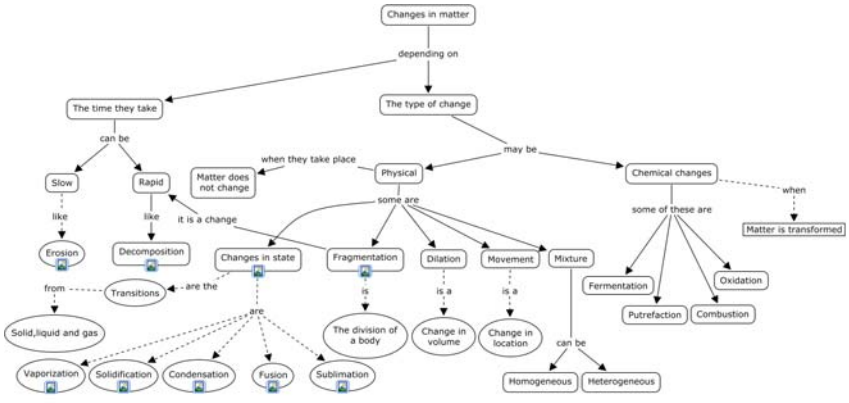

Figure 1. Concept map created by group A

Group A were, in our opinion, ingenious in the way they tackled the construction of the joint CM. Starting with what they consider to be the best, most complete individual map, they proceeded to build on it by incorporating elements from the other three individual maps. Figure 1 shows the final CM produced by this group. The concepts encircled with an oval represent the information that, after a prior agreement, had been incorporated from the other three CMs. The dotted lines represent the newly incorporated links. The concept in the rectangular box appeared on the joint CM in the second stage, but the children forgot to include it in their final map. The dynamics observed within this group can be taken as an example of the knowledge construction process carried out by the rest of the groups: discussion of the conceptual framework provided, application of the basic criteria for the construction of the maps and sharing of meanings. It is obvious in this case that the cooperative group work added value to the individual maps. The same can be said for groups B, C, D and E. Comparison of the individual maps with the final jointly-produced maps shows the latter to be richer in information (a greater number of concepts) than the individual maps. The case of group F is also worth mentioning. The members of this group were rather confused in their ideas and inaccurate in extracting

information from the text (Figure 5). Their individual maps were therefore very poor. As a result, these pupils took gained from the learning potential of group work and chose, or perhaps accepted as valid, the map that one member of the group imposed on the rest. Judging from the way they worked, they appeared to be more concerned with the style and colour of the links than with the actual content of their map, which contained conceptual errors (encircled in ovals) and inaccurate links (represented by dotted lines).

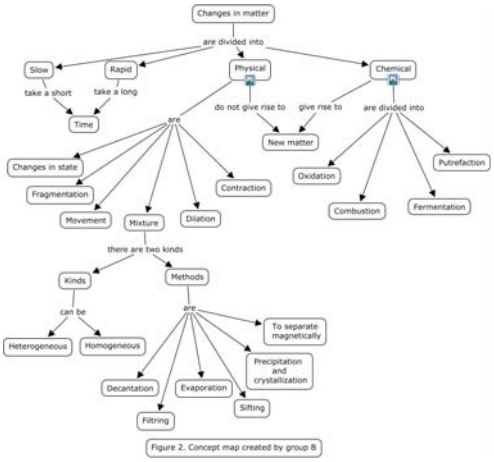

Figure 2. Concept map created by group B

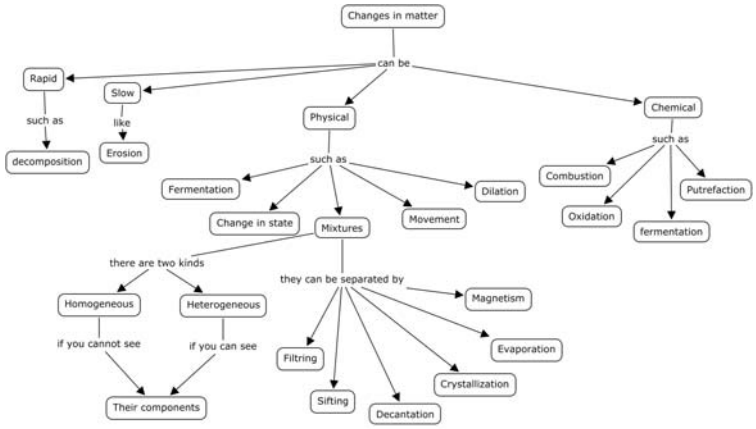

Figure 3. Concept map created by group C

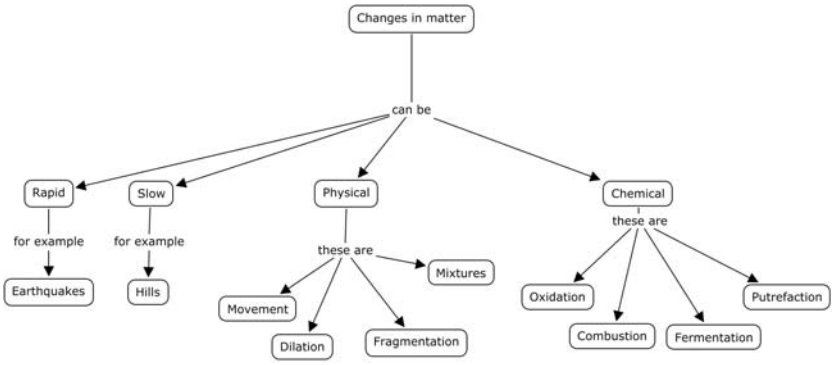

Figure 4. Concept map creado by group E

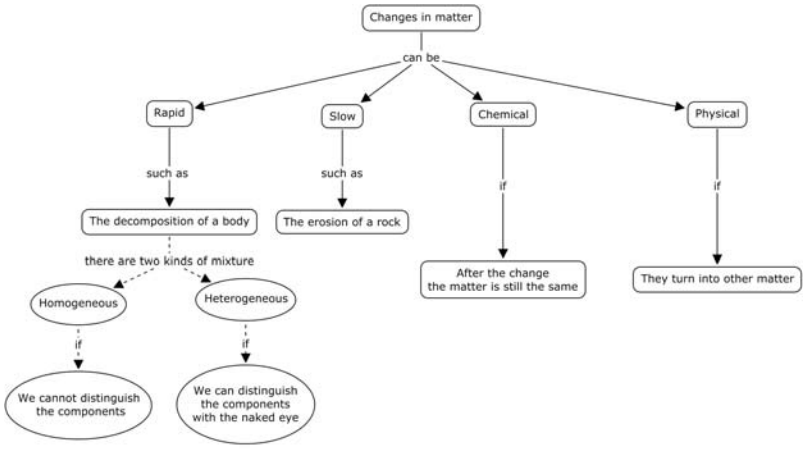

Figure 5. Concept map created by group F

4 Conclusions

In the light of these findings and with all due caution, we are able to conclude that:

- The CM is a useful tool to facilitate group work, since it stimulates discussion and the sharing of meanings.
- The CMs constructed jointly as a group are on the whole richer than those produced by the individual members on their own.
- By constructing CMs as a group, each member is able to develop the capacity to learn, share knowledge, make decisions, accept the contributions of others, and defend their own point of view, all of which promotes meaningful learning. The pupil becomes involved in the learning task.
- Major differences can be observed with respect to the amount of information included in the final maps of the various groups. Those of the academically stronger groups are more elaborate, and include not only more information but also more detailed links and the use of more expressive language.
- Significant differences were also observed in the way the different groups approached the task. The groups formed by the students with the highest learning potential organised themselves rapidly. All group members became involved and all contributed equally to the joint CM, working through the task more briskly than was possible for the groups formed by the less able students, who took longer to establish an effective working dynamic and reach agreements. The CMs of the alter were less elaborate than those of the other groups despite taking longer to complete. In addition, the discussion surrounding the learning topic was less lively among these weaker students, whose observed lack of interest meant that they tended to be more willing to accept the often less valid ideas of one member who displayed unwillingness to listen to any ideas the rest might have to offer.

In summing up, the following points are worth noting. First, it would be useful to repeat the experiment with heterogeneous groups. Second, the teacher's intervention in the learning process of children of this age group, in order to negotiate meanings with them, has been shown to be essential. It enables them to construct knowledge from information, since their own knowledge is limited with the result that they tend to attach excessive importance to the merely anecdotic, and to use excessive amounts of information, without first stopping to identify the key points. Great care is also required when selecting a text. If it is to help them process the concepts, it should neither be excessively long nor excessively linear.

2 Acknowledgements

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3 References

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