Concept Mapping - Connecting Educators

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A COACHING ALGORITHM FOR BUG MODIFICATION ON THE LEARNER'S CONCEPT MAP

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Abstract. It is very important both to evaluate understanding level of a learner's structural knowledge and to coach the learner to correct his or her misunderstanding. This poster presents the Concept Mapping Test method (*CMT*) as a measurement tool of structural knowledge. In the *CMT*, the learner's structural knowledge is described by a Concept Map (*CM*), which can be compared to that of the teacher. Firstly the authors will present a quantitative evaluation method for structural knowledge in individual learners. Secondly, they will present a modification algorithm for bugs in the learner's structural knowledge in order to assist individual learners. Thirdly, they will discuss a case study of the *CM* assembled for a one-dimensional slider in the Design and Drafting course of our University and show validity for its *CMT* utilization.

1 Introduction

When a learner acquires content on the learning system, what has been gained is arranged in a linear or sequential order. Each unit is presented in order. That is, they move naturally from one idea to the next without ever systematically detailing the structural relationships among these ideas. The teacher is concerned with assessing and promoting the acquisition of knowledge by individual learners. Attention has recently focused on what has become known as structural knowledge or knowledge of interrelationships among ideas in their knowledge domain. It is important to establish the internal connectedness of ideas and concepts to be learned. It is difficult to evaluate the internal relationships among ideas by using traditional poster tests, because these tests mainly measure the understanding level of individual bits of knowledge obtained by individual learners.

The authors earlier presented the Concept Mapping Test method (*CMT*) as a measurement tool of structural knowledge (Takeya, 1999). In the *CMT*, the learner's structural knowledge is described by a Concept Map (*CM*), which can be compared with a teacher's *CM*. They began with a presentation of both a new way to measure differences between a pair of maps (Takeya et al., 2004). It also shows a performance scoring method based on concept maps drawn by individual learners compared to a concept map drawn by the teacher (Takeya et al., 2006). This poster presents an evaluation method for *CMT* and the modification algorithm for bugs in the learner's structural knowledge in order to assist individual learners. Here, bugs are defined as a learner's misunderstanding of the relationships among learning objectives. Also, this poster discusses a case study on the *CM* assembled for a one-dimensional slider in the Design and Drafting course of our University and shows validity on its *CMT* utilization.

2 An evaluation method for *CMT*

Following is a discussion of a Concept Mapping Testing method by using the *CM*, instead of the traditional formative test, to do a formative evaluation from different angles (Takeya et al., 2004; Takeya et al., 2006). The logical flow is a kind of concept map, the edges of which have a single meaning of relationship, such as prerequisite relationship. The concept mapping testing involves individual learners drawing their concept map, called logical flow under restricted conditions. The *CM* can be represented by a digraph (directed graph) $G = (V, E)$, where V represents a set of concept elements (vertices) and is composed of n elements (vertices), and E represents a set of ordering relations (arrows) and is composed of m ordering relations (arrows). Here, the arrow $a \to b$ represents the ordering relation where element a is a necessary prerequisite to element b.

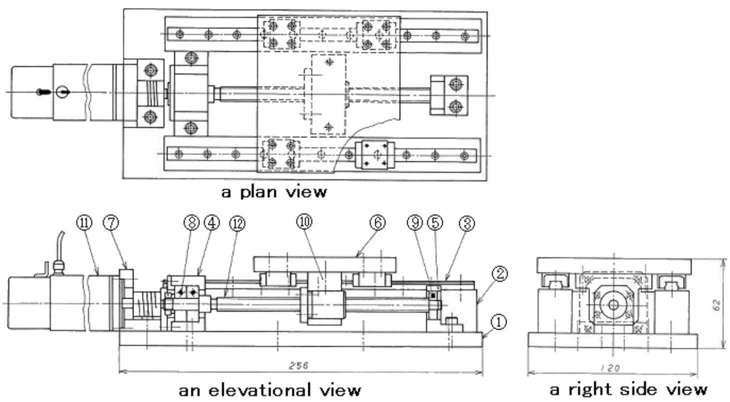
The *CM* may be used as follows:

1) The teacher may draw the *CM* $G_T = (V, E_T)$ according to the contents of the test to be presented.

2) After learning on the subject, the teacher may give the *CMT* to draw each learner's *CM* $G_S = (V, E_S)$ with elements which are equal to those of the teacher's *CM* drawn in 1). Note that the arrow → has a unique meaning, *i.e.* a prerequisite relation, cause and effect relation, influence relation, etc. By this restriction, it is possible to measure the degree of similarity between a pair of *CM*s quantitatively, in comparison with the traditional Novak's maps. The test can specify in advance that the *CM* is composed of *n* concept elements (vertices), some elements included in *n* elements are initial concept(s) and a target concept and the meaning of ordering relationship (arrow). Individual learners have to draw their *CM*s, arranging the rest concept elements and drawing adequate ordering relationships, *i.e.* arranging the rest vertices and drawing appropriate arrows.
3) The teacher can compare individual learners' maps with their own, measure the structural concept levels of the individual learners, and coach the learner according to the coaching algorithm.

Describe the assembly process of a linear slider by LFG using all the following specified parts, making reference to the assembly diagram. Here, part ⑪ DC motor and ⑫ Ball screw are initial prerequisite elements and part ① Base should be taken as the final objective item.

Part number	Name of parts	Part number	Name of parts	Part number	Name of parts
②	Guide frame	⑤	Support unit Ⅱ	⑧	Angular contact ball bearings
③	Linear guide	⑥	Table	⑨	Deep groove ball bearings
④	Support unit Ⅰ	⑦	Motor bracket	⑩	Nut folder



Answer

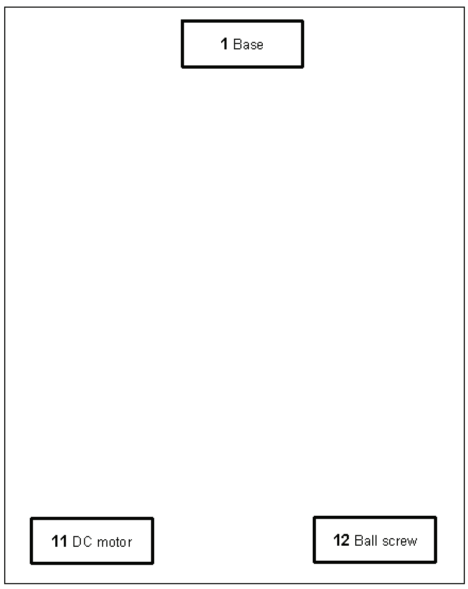


Fig.1 The *CMT* sheet on a liner slider in Design and Drafting course.

Note that individual vertices on each learner's map are the same as the ones on the teacher's map so that the teacher can evaluate how much individual interrelation of ideas was taught through the lectures. It follows that the discovery of their differences should be useful in conveying structural information to the learner. A *CM* drawn by the teacher serves as a teaching tool that allows that teacher to communicate to the learners the interrelatedness of ideas in the knowledge domain. The *CM* produced by the teacher presents learners with a graphical synopsis of the structural relationships among ideas. Comparison of *CMT*s among their maps can supply the degree of the learners' structural knowledge, an understanding that is missing in traditional tests. Discussions of *CM*s allow learners to review their own structural knowledge level. The learners are able to consider their misconceptions of relationships among ideas. The teacher is also able to extract not only misunderstandings in structuring the learners' knowledge, but also to see the deficiencies in communicating or teaching structural knowledge to learners. In order to present our measurement of similarity between two *CM*s, a similarity $S(G_S, G_T)$ between two digraphs $G_T = (V, E_T)$ and $G_S = (V, E_S)$ was defined by Takeya and *etc*.(2006).

3 A modification algorithm of learner's bugs on the *CM*

Firstly, we will present several definitions. A logical path *LP* is defined as a path on Graph Theory, with restricted conditions where a start and an end vertex belong to an initial vertex and a terminal vertex, respectively. This modification is based on edge difference focused on the most similar *LP* between teacher's and learner's *CM* in order.

Secondly, we define m *LP*s included in $G_T = (V, E_T)$ by P_T^k $(k = 1,2,\cdots,m)$. In the same manner, we define m_i *LP*s included in $G_S^i = (V, E_S^i)$ that are modified by $P_S^j(i)$ $(j = 1,2,\cdots,m_i)$ $(i = 1,2\cdots)$. Next, pay attention to both m *LP*s P_T^k $(k = 1,2,\cdots,m)$ and m_i *LP*s $P_S^j(i)$ $(j = 1,2,\cdots,m_i)$ $(i = 1,2\cdots)$. Each *LP* P_T^k and $P_S^j(i)$ can be represented by $G_T^k = (V, E_T^k)$ and $G_S^j(i) = (V, E_S^j(i))$ respectively. Here, E_T^k and $E_S^j(i)$ are included in P_T^k and $P_S^j(i)$ respectively. Now, let's define sets of *LP*s on $G_T^k = (V, E_T^k)$ and $G_S^j(i) = (V, E_S^j(i))$ by $\prod(P_T)$ and $\prod(P_S(i))$, respectively.

As a result, we can now describe the modification algorithm for individual learners' bugs.

(1) $i = 0$;

If $E_S^j(i)$ is equal to E_T^k, then go to (7).

(2) Obtain a *LP* $P_S^{j_M}(i)$ that satisfies both $S(G_T^k, G_S^j(i)) < 1$ and $Max_{\prod_T, \prod_S(i)}\ S(G_T^k, G_S^j(i))$. This is $G_S^{j_M}(i) = G(V, E_S^{j_M}(i))$.

(3) If $\overline{E_T} \cap E_S^{j_M}(i) \neq \phi$, then suggest the deletion of a set of edges $\overline{E_T} \cap E_S^{j_M}(i)$.

(4) If $E_T^k \cap \overline{E_S^{j_M}(i)} \neq \phi$, then suggest the addition of a set of edges $E_T^k \cap \overline{E_S^{j_M}(i)}$.

(5) If $E_S(i) = E_T$ and proceed to (7).

(6) $i = i + 1$; Proceed to (2)

(7) End.

4 Case study of guidance based on the coaching algorithm

To help you understand our *CMT* easily, we will examine the case study of a *CMT* following both learning and CAD lessons of the System Design Course of our University. An example of the *CMT* sheet on a liner slider in Design and Drafting course is shown in Fig.1. Here, the element (vertex) on the highest level is only the element (1). The elements (11) and (12) belong to the lowest level as shown in Fig.1. Each learner has to place a set of elements (3)-(10) between the highest and lowest levels and then draw directed edges. Fig. 2 shows (a) the *CM* drawn by the teacher and (b) the *CM* drawn by one of the learners. In Fig.2 (a), for example, as the role of (7) motor bracket is to decide the height of (11) the DC motor and to support it, an arrow is drawn from (11) to (7). In the same manner, as (7) motor bracket is fixed on (1) base, an arrow is drawn from (7) to (1). According to the modification algorithm described in 3, Fig.3 shows a modification process of a learner's *CM* to the teacher's *CM* in Fig.2. Here, a broken line and a heavy line show deletion of the arrow and addition of the arrow, respectively. For example, the Step 1 in Fig. 3 indicates that the teacher has to guide the learner to realize his or her misconnection from (7) motor bracket to (8) Angular contact ball bearings and new connection from (7) to (1). In the next step, the teacher has to make the learner notice new connection between (12) Ball screw and (8) Angular contact ball bearings. A detailed discussion has been omitted due to lack of space. Details of coaching results will be presented on our poster.

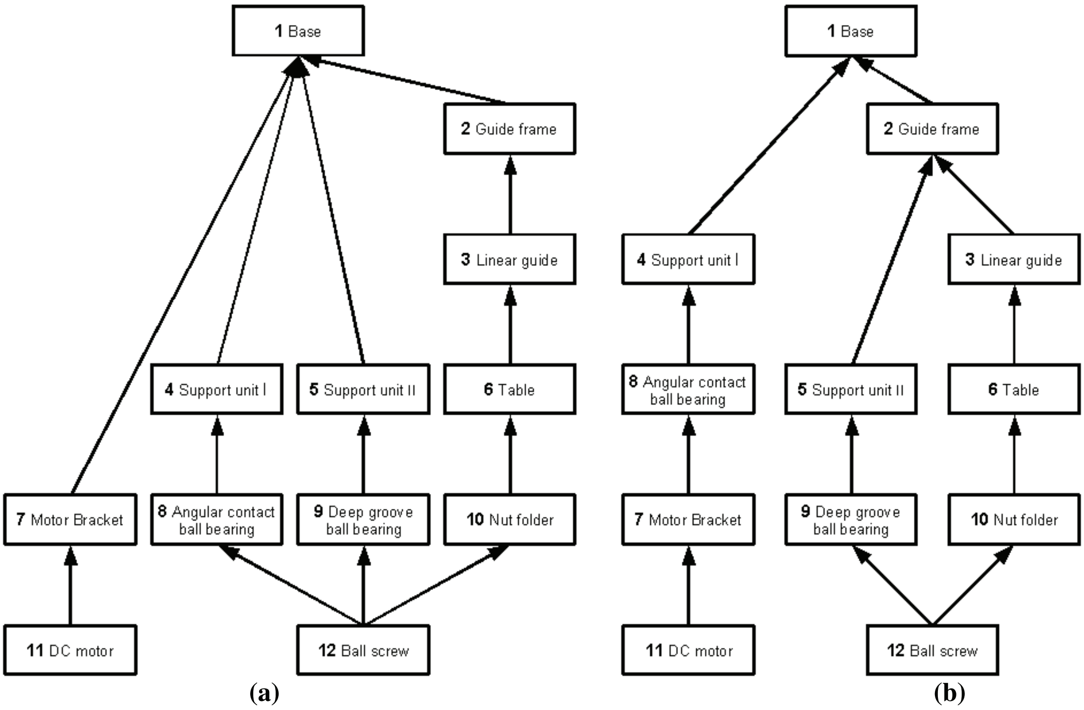


Fig.2 The *CM*s drawn by the teacher and one of the learners.

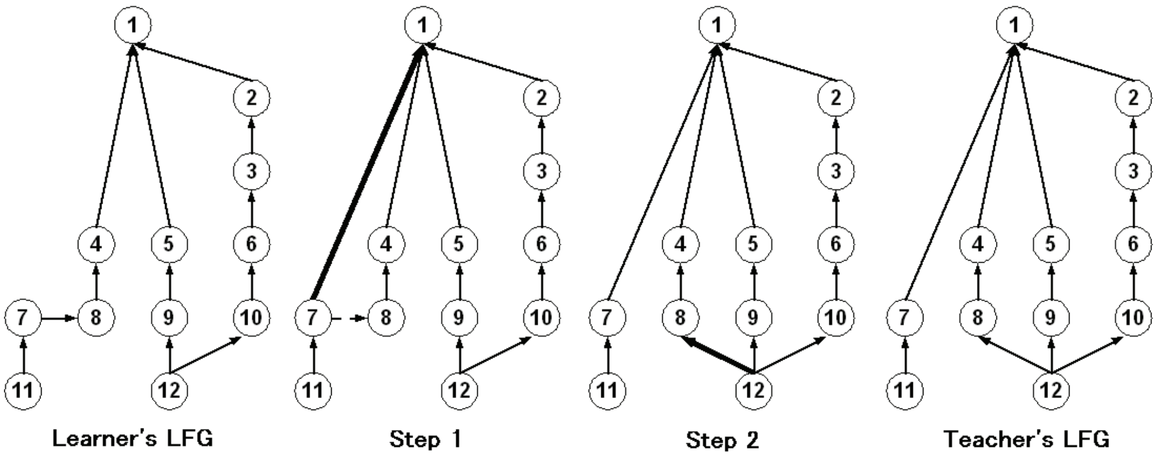


Fig.3 The modification process from the learner's *CM* to the teacher's *CM* in Fig.2.

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A COMPARISON BETWEEN CONCEPT MAPS AND A METHODOLOGY COMMONLY USED IN PANAMANIAN ELEMENTARY SCHOOLS BASED ON QUESTIONNAIRES

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Abstract. The *República de Guatemala* School in Panama joined the Conéctate al Conocimiento Project in 2006. Since then, concept maps are being used in the school to promote more meaningful learning experiences among students. Some teachers, however, have doubts as to whether this methodology is appropriate for subjects that involve a great deal of factual information, as is the case in many humanities classes. In subjects such as these, teachers generally prefer to use "questionnaires" a methodology that allows them to cover, in the limited amount of time usually allotted to these subjects, the voluminous amounts of content mandated by the Ministry of Education programs. The experience presented in this poster constitutes an effort by three teachers to compare the benefits of using concept maps versus the traditional questionnaire approach in the area of Social Sciences. Results of three tests applied to the students indicate that the groups working with concept maps obtained on average greater than or equal scores as those using the questionnaires; the variability in the concept map groups in each case was lower. Aside from the actual scores, participating teachers noticed that the responses of students using concept maps tended to be deeper or more thoughtful than those of students working with questionnaires. This study has helped to convince teachers at this school of the usefulness of concept maps.

1 Introduction

Our school the *Escuela República de Guatemala*, joined the Conéctate al Conocimiento Project in 2006. As a part of this program, teachers of 4th, 5th and 6th grade were trained to use concept maps as a way to bring about better learning experiences for our students. Concept maps were developed by Dr. Novak over 30 years ago. A concept map is a graphic resource "intended to represent meaningful relationships between concepts in the form of propositions" (Novak & Gowin, 1984, p. 15). They have their origin in David Ausubel's theories about the psychology of learning, stated during the 60's.

Instructional strategies commonly used in Panama focus on students learning facts, but seldom help students to really understand, or allow them to learn how to *learn*, much less, to develop fully, and learn how to *be*. In most educational centers in our country, students are required to pay attention and memorize; specific tasks involve listing, enunciating, enumerating, defining, describing, summarizing. We can point out that the kinds of actions reflected by these verbs belong to the lowest level in Bloom's (1956) Taxonomy. Teachers who resort to strategies that call upon only these tasks are requiring little from their student in terms of cognitive effort, and thus are hindering students' potential for constructing their own knowledge.

A frequent problem we teachers encounter is to determine the most appropriate technique or strategy to help a group of students learn a given curricular content. One teaching strategy commonly used in Panamanian elementary schools involves "questionnaires." This teaching strategy tends to be used for subject matter in which a large amount of factual material needs to be covered in the course of a school year, as is the case with most of the humanities. By "questionnaire" we mean a teaching strategy in which the teacher gives his or her students a set of questions (mostly closed questions, but sometimes open ones are included as well) for them to answer. Students may then work individually or in small groups to find the correct answers to these questions. After answers are checked by the teacher, the best ones are selected and are taken down by everyone. Students then use these questionnaires to study from, as tests are based on them.

Since 2006, when our school entered the Conéctate Project, several of teachers began to consider and to experiment using concept maps as an alternative teaching-learning technique for a number of different subjects, including areas with much detailed information such as social sciences. However this led to a controversy as to whether this technique was suitable for this subject. Some teachers believed concept maps would not serve well with the large amounts of content involved, since the time required in creating the concept maps would not compensate for any benefits that might result.

This debate led to the present study. In it we set out to compare the effectiveness of concept maps, as compared to questionnaires, as techniques for to help students learn the curricular content. Specifically, we were interested in comparing these learning tools in the context of the 5^{th} grade social science curriculum, the content of which is dictated by Panama's Ministry of Education.

2 Methodology for the study

The present study was carried out at the *Escuela República de Guatemala*, an urban elementary school located in the province of Panama, in the Republic of Panama. It has a student body of 701 students, served by 34 teachers. The study used as sample one of several 5th grade classes. The group had 30 students, and was divided into two equal sized groups, group A and group B. The homeroom teacher formed these groups by choosing alternate names from the enrollment list. Two different topics were studied: "The Organs of the Panamanian State" (topic 1), and "Pre-Hispanic period" (topic2). Both topics are considered to be rather lengthy and detailed. Topic 2, however, is somewhat longer, and probably less familiar to students.

For topic 1, group A worked in their regular classroom, with their homeroom teacher, using the questionnaire methodology; while group B worked in the innovation classroom, a special room equipped by the Conéctate Project (Tarté, 2006), using the concept map methodology implemented through the CmapTools program. The work was directed by the coordinator of the innovation classroom (CAI). One week was devoted to the subject. Once the topic had been covered, students took a test on this material (test 1).

Subsequently, a similar scheme was carried out for topic 2. The main difference was that the groups were inverted: this time group A worked with concept maps in the innovation classroom and group B worked with questionnaires in the regular classroom. A total of 2 weeks was dedicated to this topic. Afterwards a test on this material was applied to both groups (test 2).

Finally, in order to measure knowledge retention, a third test was given two and a half months later. This test covered only the material of topic 1, "The Organs of the Panamanian State." Questions were based on the content of the questionnaire as well as the concept map. Students were not warned previously that they would be taking this test (test 3).

The use of **questionnaires** in the regular classroom was as follows:

- Homeroom teacher provided questions on the topic. Questions were both closed and open.
- Students organized themselves into teams of 3 students (a total of 5 teams), to complete the questionnaire.
- Students read material indicated by the teacher.
- Answers from different teams were discussed with the guidance of the teacher.
- Best answers to the closed questions were chosen. All students copied down these answers.

The use of **concept maps** was as follows:

- The CAI directed a brainstorming session with all students.
- Students read the same material as students in the regular classroom.
- Together students formulated a focus question and identified the main (root) concept for the map.
- Students looked up additional information on the topic on the Internet.
- Guided by the CAI, a group concept map was created, based on the content of the assigned reading, the brainstorming session, and the information gathered from the Internet.

3 Results

Tables 1, 2 and 3 show the results of tests 1, 2 and 3, in that same order. The statistics in table 4 summarize the results from the other three tables; they show that in spite of the differences, the only significant difference was the first one.

Topic 1: "The Organs of the Panamanian State"					
	Group A (Questionnaire)			**Group B (Concept Map)**	
	Student grade[1]	**Number of students**	**Percentage of students**	**Number of students**	**Percentage of students**
Test 1 (50 points)	1.0 - 1.9	1	6.7%	0	0%
	2.0 - 2.9	5	33.3%	0	0%
	3.0 - 3.9	4	26.7%	2	15.4%
	4.0 - 4.9	3	20.0%	11	84.6%
	5.0	2	13.3%	0	0%

Table 1. Results of test 1.

Topic 2: "Pre-Hispanic Period"					
	Group B (Questionnaire)			**Group A (Concept Map)**	
	Student grade	**Number of students**	**Percentage of students**	**Number of students**	**Percentage of students**
Test 2 (50 points)	1.0 - 1.9	0	0.0%	0	0.0%
	2.0 - 2.9	5	33.3%	0	0.0%
	3.0 - 3.9	3	20.0%	5	33.3%
	4.0 - 4.9	4	26.7%	9	60.0%
	5.0	3	20.0%	1	6.7%

Table 2. Results of test 2.

Topic 1: "The Organs of the Panamanian State"					
	Group A (Questionnaire)			**Group B (Concept Map)**	
	Student grade	**Number of students**	**Percentage of students**	**Number of students**	**Percentage of students**
Test 3 (50 points)	1.0 - 1.9	1	6.7%	0	0.0%
	2.0 - 2.9	3	20.0%	2	13.3%
	3.0 - 3.9	4	26.7%	7	46.7%
	4.0 - 4.9	4	26.7%	5	33.3%
	5.0	3	20.0%	1	6.7%

Table 3. Results of test 3, applied two and a half months after test 2.

	TEST 1		**TEST 2**		**TEST 3**	
	Questionnaire	**Cmap**	**Questionnaire**	**Cmap**	**Questionnaire**	**Cmap**
Mean	3.5	4.3	3.8	4.2	3.8	3.8
SD	1.2	0.4	1.4	0.4	1.5	0.7
Comparison	Significant (P = 0.03)		non-significant		non-significant	

Table 4. Means, standard deviations and statistical significance of comparison for each of the three tests.

[1] In Panama, grades range from 1.0 at the low end, to 5.0 at the high end. Grades below 3.0 indicate failure.

4 Interpretation of the results

It is interesting to notice certain aspects of the grade distributions shown in the tables. For example, the percentage of failures for students using concept maps was always lower than for students using questionnaires. In fact, in the first two tests the percentage was 0%. This is important, since one as teacher is always looking for strategies that help reduce student failure. On the other hand, in the concept map group more students were concentrated in the higher grade ranges. The results we got for concept maps are similar to those obtained by Rodriguez & Coloma (2006), where they found that when using concept maps, the grades of the class became concentrated in the upper ranges, with no failures.

Perfect scores (5.0), though, were more frequent in the questionnaire group. We believe this may be a reflection of the fact that these students studied from a questionnaire, which would have been very similar to the test format. Students learning with concept maps did not have this advantage.

We noticed also that the answers of students from the concept map groups seemed deeper, more substantial. We can not be sure that this was due to the maps themselves, though, since it could also have been a reflection of their use of Internet, which provided them with additional information compared to the other group.

Finally, in table 3 we have the results from the third and final test, given two and a half months after the second test. Overall, the distribution in the questionnaire group remained similar to the previous two tests, but the concept map group shows much more variation, including some students in the failure region. Nonetheless, there is still less variability than in the questionnaire group.

One other thing strikes our attention. Why, if the concept map groups had higher average scores (and lower variation) on the first two tests did this change on the final test? Why did the two groups even out? We think this might be because the concept maps were created as an entire group. This means that not everybody worked or thought as hard. In the questionnaire group, students worked in small teams of 3.

Another thing is that even though the concept map students looked up and discussed additional information, much of it was not placed in the concept maps (the CAI made sure the content of the maps was the same as that of the students using questionnaires). Even so, after two months and a half, students using concept maps knew as much as students using questionnaires, which is what we had set out to show.

5 Conclusions

In Panama, some educators think concept maps may not be an appropriate tool to study subjects with a great deal of detailed content. They feel that the amount of time it takes to construct concept maps does not justify their possible benefits. They prefer strategies like questionnaires, which, in our opinion, are more inclined to promote learning by memory. Our study, though it had methodological limitations, shows that this is not the case. Taking the same amount of time, students using concept maps performed as well or better than students using questionnaires.

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A MULTI-DIMENSIONAL FRAMEWORK FOR ANALYSING CONCEPT MAPS

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Abstract. The hypothesis underlying this short paper is that conventional modes of assessing teachers do not provide a full picture about their learning about digital pedagogies when they are engaged in Continuing Professional Development (CPD) programmes. In this research study, therefore, teachers' were asked to draw a concept map at the beginning and end of three different kinds of computer course. These maps were analysed to discover what they revealed about the map makers' digital priorities. Numerical methods of scoring maps and analysis of content were found to be effective in studying the learning patterns of the group. However, an analysis of the maps as a holistic semiotic signs was found to be the most effective in revealing the priorities and motivations of individuals. One pair of hand drawn maps is used to illustrate how the semiotic framework devised for this study helped to identify details of the learners' position at two points in time. This paper also outlines the ways in which teachers took ownership of this mode of assessment.

1 Introduction

Continuing Professional Development (CPD) programmes for teachers about the uses of digital technologies are usually assessed by means of a multi-choice questionnaire or a linear, written essay. This kind of assessment of learning provides no opportunity for teachers to display their understanding of the multimodal digital communication possibilities in a visual way. What is missing is a multi-dimensional approach to assessment that acknowledges that digital communication has tended to decentralise the role of written language in making meaning. The term 'concept map' is being used throughout this short paper in the popular sense that associates a variety of forms and shapes for communicating ideas with a general notion of concept mapping. A multi-dimensional concept map can be defined as a multimedia, multimodal and multilayered assessment opportunity that acknowledges the role of students and their teachers as creators of web-texts. At best these texts can mix music, graphics, sound, and animation to be accessed by a wide public audience. Hyperlinks also extend the creators' opportunity to prioritise and layer ideas on the screen. Interactivity with an audience or another text creator also deepens communication awareness in new ways that traditional written tests do not exploit.

In the research project hand-drawn and digital concept maps were the focus of experimentation in innovative summative and formative assessment that included self and group assessment strategies. The aim was to offer teachers scope for expressing their understanding of computers and networks in modes that replicated some of the features of digital communication. Sixty teachers in CPD programmes about digital technologies were invited to draw 'concept maps' at the beginning and the end of the courses as an alternative to traditional testing. Three methods of semiotic analysis were piloted: the first was a scoring method adapted from the UK Impact2 Project (Mavers, Somekh et al. 2002). A connectivity score indicating cognitive activity was derived from diving the number of links into the number of nodes. This quantitative scoring method was found to be effective for tracing the patterns of learning in large groups. However, it was found to be unreliable as a single measure when the learning of individuals was under review. A simple content analysis, the second method, provided more qualitative information. However, a range of qualitative semiotic features within the drawings seemed to be conveying information that was different to the words or that stressed or undermined their meaning. As a result a third method of analysis was devised. This analytical framework (Figure one) was based on the work of several semioticians from the sociocultural school. This framework is designed draw out the qualities of concept maps as they are developed in multi-dimensions. Their different contributions to this framework are described in the next section.

2 The literature

Kress and van Leeuwen (Kress and Van Leeuwen 2007) are leaders of a school of semioticians who have widened the scope for analysing concepts by looking at multimodal examples of how the global society is using this form of communication. Kress and van Leeuwen (op cit) select, from contemporary magazines, newspapers and textbooks a variety of linear flow-charts influenced by the notion of networks. These networks offer a freer mode for the formation of ideas into associations or concepts that are not so dependent on hierarchical structures. They point out that mapping is particularly appropriate for interpreting the Internet itself where information is often freely available for those who have perfected their searching techniques. Kress and van Leeuwen (op. cit) also make an important distinction between hierarchical diagrams, which they see as classificational, and networks, which they suggest, are more analytical. These references to networks also allude to the influence of computer networks in new structures for communicating new concepts. The ideas explained

Figure one: Emerging analytical framework for semiotic investigation

MCM features	Evidence	Key theorists
information and transmission		
Concepts to include words	Grouping of ideas and themes towards a key summarizing node; symbols used for ideas and how they are juxtaposed and connected in clusters; a classificational or an analytical design with some political implications: a hierarchical shape or network style map perhaps denoting authoritarian or liberal knowledge patterns.	Kress and Van Leeuwen 2007(second edition)
Modalities	The features of the map that promote veracity from the point of view of the map-maker- shading, colour, brightness etc.,	Kress and Van Leeuwen 2007(second edition) Mavers, Somekh & Restorick 2002
Compositional elements and their interrelations	Framing. Positions on the page, sizes, foregrounding and marginalising etc.	Kress and Van Leeuwen Mavers, Somekh & Restorick2002
Materiality of Meaning	Surface textures, inscriptions and additions	Kress and Van Leeuwen 2007(second edition) Mavers 2004
Dimensionality	Multilayering and hyperlinking	Kress and Van Leeuwen 2007(second edition) Mavers 2004
Constructive Learning		
Narrative	Trajectories that tell a story	Kress and Van Leeuwen 2007
Affectual factors, ludic qualities	Indications that the learning was not only cognitive but affective.	Kress and Van Leeuwen 2007(second edition)
Dynamics	direction of links and arrows: animation of images and lettering	Mavers 2004
Social Interaction		
Representations and interactions	Indications of the relationship between the map-maker and the viewer or audience	Kress and Van Leeuwen 2007(second edition) Jewitt 2003

by the semioticians suggested that the choice of multidimensional mapping might be ideal for representing computer concepts. The recent advances in digital mapping have increased the potential similarity between mapping and thinking in multi-layers like a computer network design.

In this study a framework of modes of analysis has been adapted from the relevant items in the list of topics covered in the tentative visual grammar in Kress and van Leeuwen's, *Reading Images: the Grammar of Visual* Design (revised 2007). This framework has also been enhanced by the Impact2 social semiotic studies (Somekh, Mavers et al. 2002; Jewitt 2003). Mavers' case studies provide more detail about analytical issues because she investigates the analysis of maps specifically. Her careful and respectful examination of children's graphic representations, or signs seeks to identify the variety of ways in which meanings are made on the page and on the screen (Mavers 2004; Mavers 2007; Mavers 2008 in press). Her detailed observations about children's practices provide exciting insights into their mastery of contemporary text making. She investigates texts made at school and autonomously at home, as drawing, as writing, and as multimodal combinations of writing and image. These extend to activities such as colouring, gluing and copying which are not normally given this much attention in schools or at home. Mavers looks in great detail at what has been represented in order to see what can be learnt about young people's meaning making. In many ways what emerges is that they are not given credit for their sophistication of their text making. Her study draws attention to the complexities of representation and communication, and how children readily adapt the ways in which they make texts in response to the particular social context. Their representations are subtly different in ways that indicate creative interpretation. Jewitt's studies in multimodal literacies (Jewitt 2002; Jewitt 2003; Jewitt and Kress 2003) bring a further concentration on the affordances of multimodal resources that engage the learner in dynamic relationships and interrelationships with the topic. Whereas Jewitt and Maver's work focuses on the digital resources available to children at home and in classrooms, this study investigates how teachers make use of similar opportunities. The rationale was that concept maps seemed to offer a particularly appropriate method of investigating representations of new technologies, since the maps make extensive use of images and icons like computers, rather than conforming to tradition and privileging textual and numerical symbols.

In order to provide coherence in analysis the elements that these researchers identify as units of analysis in the framework have been divided into categories based on Pachler's identification of three cognitive theories: information transmission, constructivism and social interaction (Pachler 2005). These categories are intended to distinguish between details that denote the plain facts that have been learnt, the elements of construction and interpretation and, finally, evidence that the map maker is aware of the dynamic opportunities for interactive communication on networks. Because of the shortness of this paper, a pair of simple hand drawn-maps has been selected in the next section to show how the framework can help to illuminate the map-makers' meaning. However it is important to remember that this cannot be comprehensive as all maps are 'fascinating, cultural artefacts, full of unique detail and often aesthetically pleasing' (Mavers 2002 p. 191.)

3 A sample semiotic analysis of one pair of maps

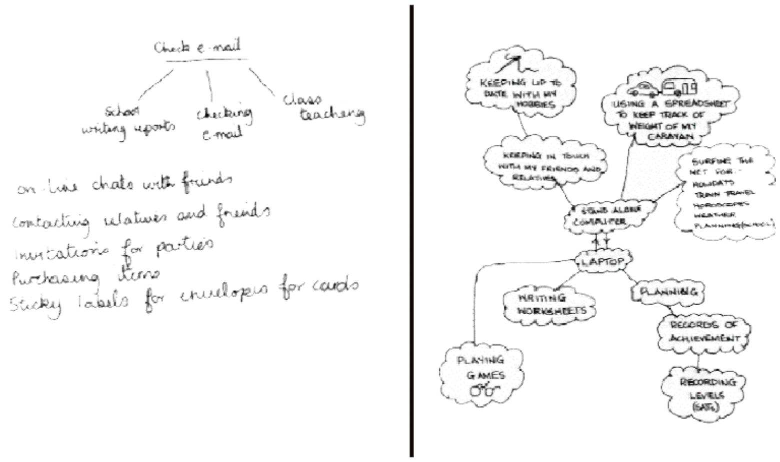

Figure Two: A pair of concept maps by Amy

In contrast to the methods advocated by Novak and Buzan, this mapping activity was not dependent on previous teaching of concepts or on prescriptive forms of mapping (Buzan 2002; Cañas and Novak 2007). Examples of Novak's concept map shapes and Buzan's radiant mind maps were shown to the teachers on three different kinds of course based on information transmission, constructivist and social interaction principles. But each cohort was advised to be as creative as possible in their mapping style. The teachers had 20 minutes to work on their map. The heading of each of these maps was the same for each cohort: the impact of computers on my personal and professional life. This topic was not intended as a means of covering the course syllabus, but to provide a vehicle by which the teachers could indicate their reactions to computers at these two points in time.

The two simple hand-drawn maps by Amy in Figure Two are used to illustrate briefly how an analyst would use the framework can be used by an analyst to supplement other information about her. In her questionnaire, for example Amy had rated her computer knowledge as 'little or none'. Amy's first map is typical of many of the first maps because it appeared that teachers who had not had much exposure to computers also seemed to find drawing a concept map challenging. Although Amy had been shown some examples of concept maps she was not able to translate this knowledge into her composition. In the second map, after a year's course in computers, her control of over composition is contrastingly confident and expansive. She has also illustrated the difference between her standalone and laptop computers by making the nodes a different size. She seems to have imbibed some key concepts as her administrative use of the laptop in school is oriented towards planning, creating resources and recording achievement. Two dynamic arrows between the laptop and the standalone indicate integrated use between them both, although it is not clear if Amy means through a network or simply by carrying a storage device. From the constructive point of view the second map begins to offer some biographical detail and some humour. Her drawing of the caravan conveys her pleasure in what she can achieve with her computer. These references to the affective elements of learning were important in developing an understanding of motivation and of reluctance to engage with computers that were helpful to the tutor/researcher.

4 Summary and discussion

The analysis of Amy's two contributions suggests that a clear progression could always be seen between the two maps, but this was not the case. The semiotic framework offered new insights into the individuality of teachers' interpretations and the value of their different approaches to communicating learning. Furthermore, when the teachers in the social interaction CPD programme were invited to analyse their pairs of maps in groups, the ideas were articulated that threw new light on how individual teachers' learning progresses. From 2003-2006 some teachers in CPD programmes that included action research became interested in the potential of multi-dimensional mapping with their classes. The introduction of digital mapping and interactive whiteboards was a combination that underpinned a new trend in complex multi-dimensional collaborative mapping. After forming a working group, some of these teachers have published practitioner and academic studies in two e-journal volumes (Preston, Cuthell et al. 2007; Howell Richardson and Preston 2007). This ownership of the framework by the learners was possibly the most important outcome of this multi-dimensional mapping assessment study.

5 Acknowledgements

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A PROPOSAL FOR THE USE OF HEURISTIC TECHNIQUES AND CONCEPT MAPS IN IC-IPN

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Abstract. The present work proposes the use of heuristic techniques developed by Novak and Gowin. This is done starting from the didactic experience in the classroom for computing engineering (IC) at Instituto Politecnico Nacional (IPN) by the implementation of concept maps and Gowin's V in the solution of design problems and algorithms design and computational analysis. This has been done trying to achieve a meaningful learning that should render a better understanding by the students. Gowin's V and concept maps where proposed by Novak and Gowin as heuristic and metacognitive tools. The main reason behind this work is the evidence of success of the use of Gowin' V and concept maps in research done at the University of Cornell, Brazil, Argentina and Spain, in physics, chemistry, and environment sciences. A second reason can be found in the difficulties that the students face in some topics of computer programming, as in algorithm design.

1 Introduction

The problem of the low grades of the college students has a worldwide realm, and it has in Latin America, and particularly Mexico, provoked a very deep concern. At IPN researchers and professors have devoted special attention to this problem, and as a consequence of these studies several decisions have been taken. Among them we may find the attempt to change the traditional teaching scheme and implant a new one based upon a constructivist teaching model. The students belonging to engineering computing do not know techniques that could help them in their learning process. This fact has been detected through polls applied at the beginning of the term. These polls have shown us that 88 percent of the students have no idea of metacognitive techniques. The present proposal intends to reduce the number of flunking students in topics of programming whose foundations is algorithm design, but also to increase the level of comprehension. The idea could also imply a meaningful improvement in which the budget is used, an additional point in favor of this model. Clearly, the reduction of flunking students entails a way to avoid the loss of human resources.

2 Theoretical framework

Any theory is founded upon postulates and assumptions, pur case is no exception. The postulates are the same behind Ausubel-Novak-Gowin constructivism theory, see, Ausubel: Educational Psychology, a Cognitive View (1968). The main idea to be underlined in the model is the idea of meaningful learning, which is to be confronted against the memoristic one. The student must relate his/her previous knowledge with the new one. I expose the application of the Gowin's V and the Concept maps in the algorithm design's teaching, to improve the Computing Engineer carrier's at ESIME-CU as a part of the Universities' modernization. This will be made, attending to the need of solving their academic low output problems, which is the main cause of a high school desertion. It is important to comment that in the algorithms' field, one of the hardest points is the fact that there is no "recipes" made to construct them.

3 Methodology

The methodology (figure 1) present research resorted to a Piaget Modified Clinical Poll (PMCP), shown in figure 2. This PMCP was a tool that allowed to know how the students feel, think, and act in relation with any educational event connected with algorithms design. Also a questionnaire was applied with the idea of finding the opinion of the students about the metacognitive method and Gowin-s V. The course began with the selection of the experimental and control groups. In the first week the learning techniques were explained, as well, as an explanation of Gowin´s V. During the semester the work in the computing laboratory, as well as the classroom were done resorting to Gowin` s V. The student improvement was also regularly monitored, and the possible failures detected and amended, see figure 3 and 4.

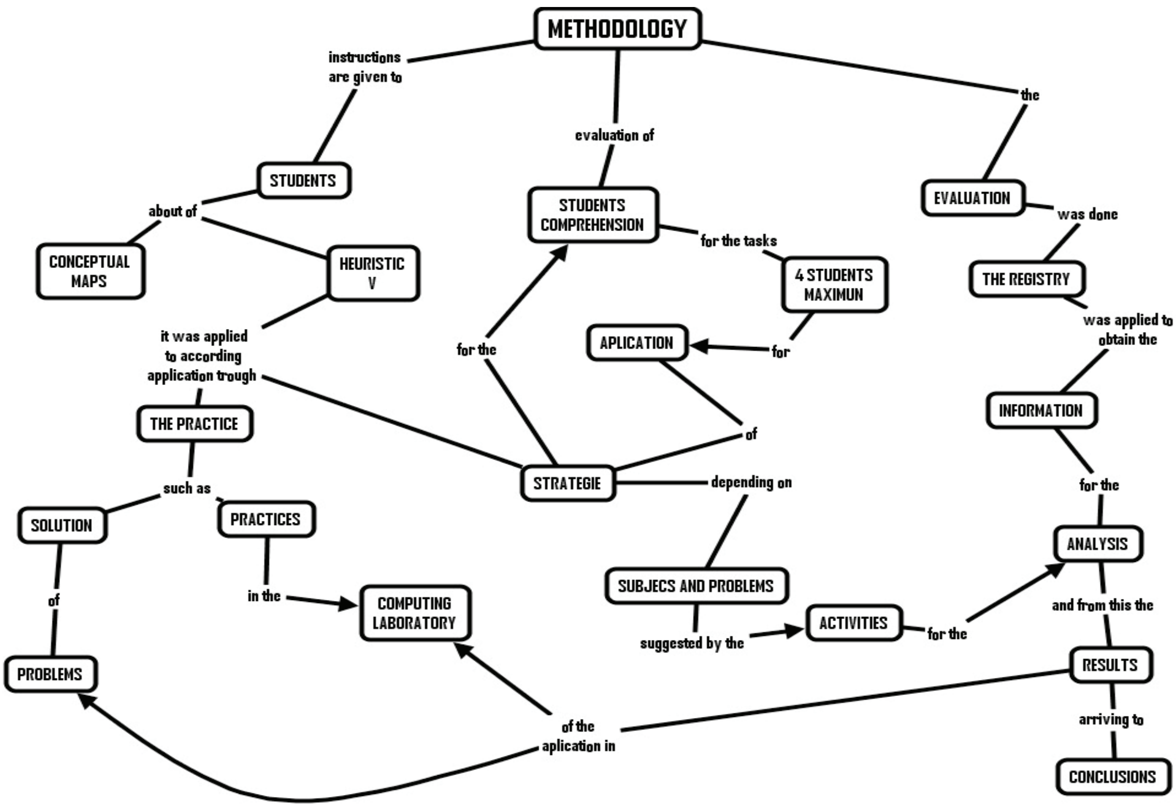

Figure 1 Methodology

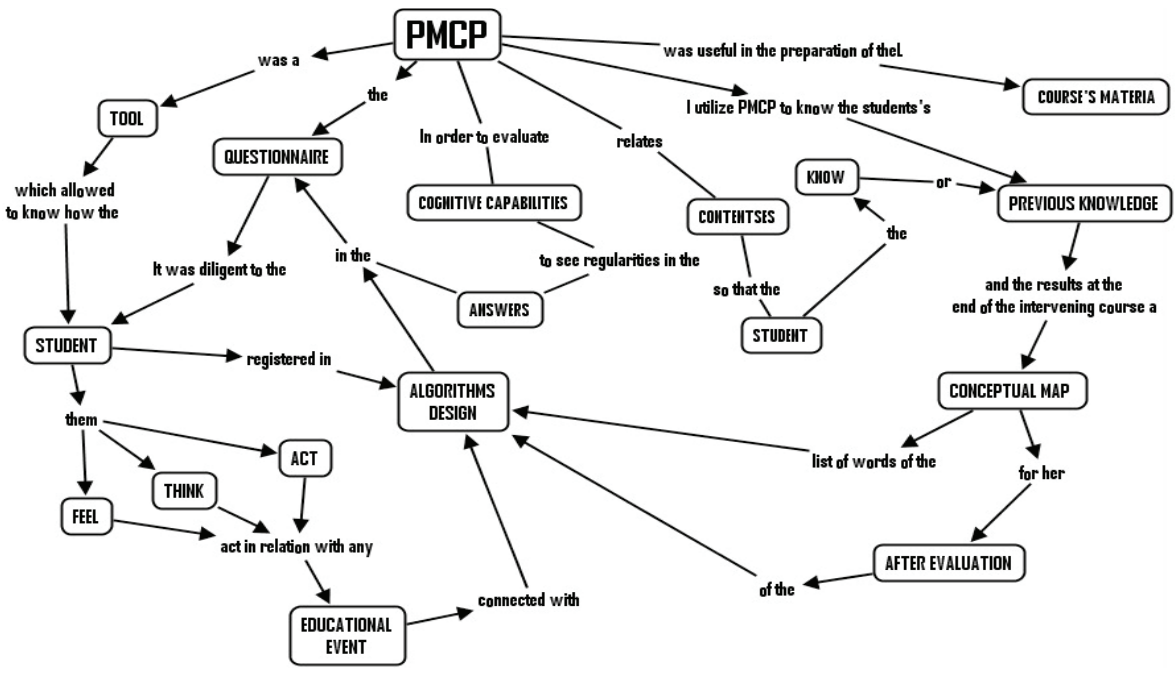

Figure 2 concept map of process of interviews

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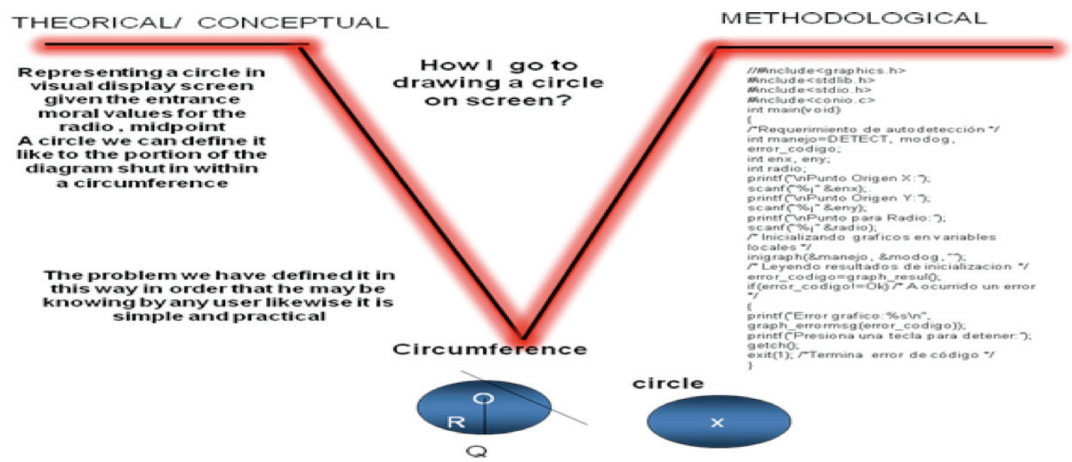

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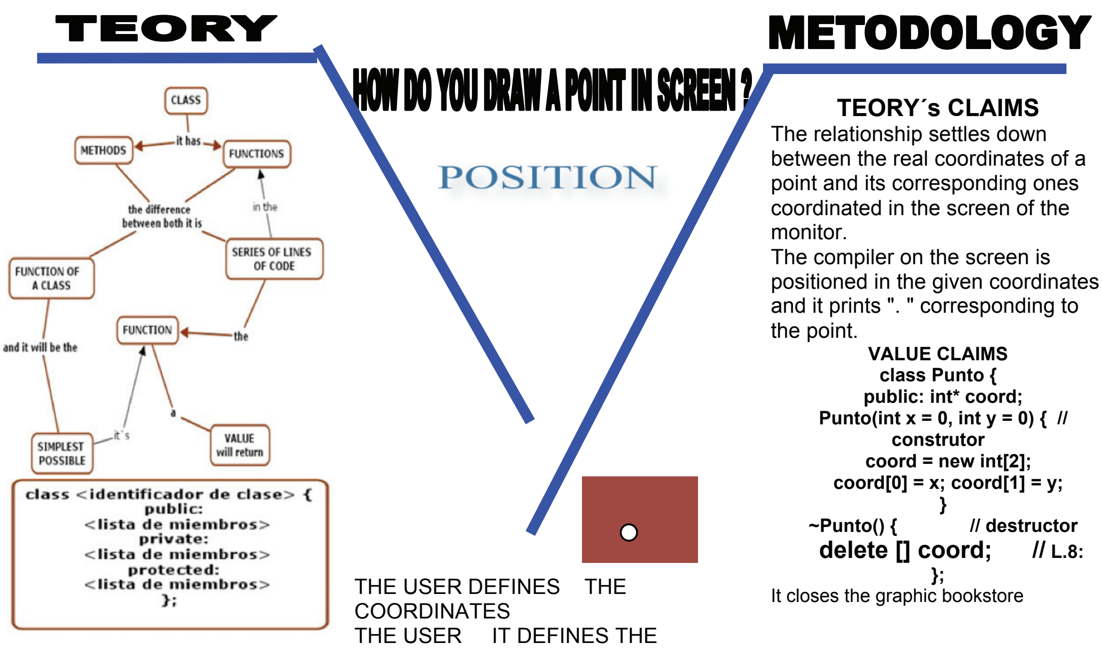
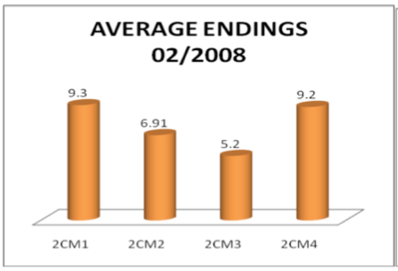
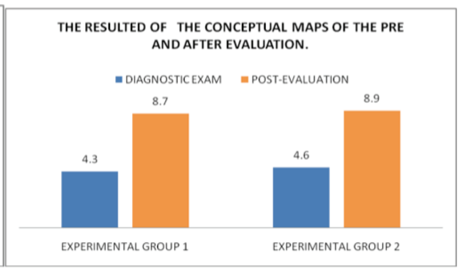
• Figure 3 Example Gowin¨s V constructed in class



4 Results

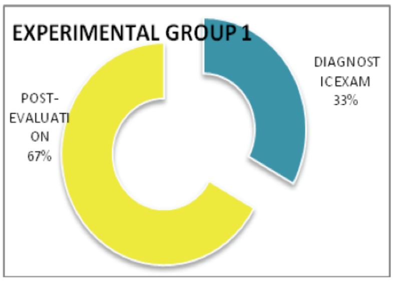
The use of strategies was an important tool in the achievement of a meaningful learning, and therefore, an important improvement in the academic results appeared as a direct consequence of the model. As a bonus the students were prepared for selflearning, see graphs 1, 2, 3 and 4.

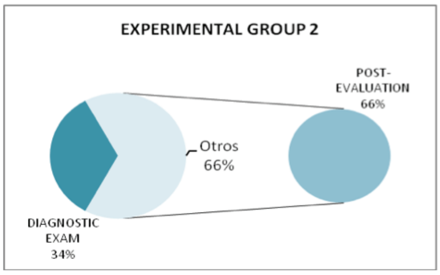




Graph 1 Averages of the the groups

Graph 2, Resulted of the ECPM





Graphic 3 The result of group 1

Graph 4 The result of experimental group 2

5 Conclusions

The same happens, for example, in resolving problems to Physics solution. The successful heuristic V application, by Moreira in Brazil, to the Physics teaching case, we supposed, because of the mentioned analogy between the Physics problem's solution and the algorithm construction, that it is possible to obtain the right result, hoping that its application is not already a failed project.

Metacognitive strategies in virtual environments are very useful since the results obtained in thos topics in which they were applied showed a remarkable advance in comparison to those cases in which these techniques were not considered. Thanks to the good results worked out, several professors were interested in applying to his groups these learning tolos, in the next semester.

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A SCHOOL CURRICULUM FOR VISUALISING THINKING

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The Victorian Essential Learning Standards (VELS) is a mandated curriculum framework for the compulsory years of schooling, developed by the Victorian Curriculum and Assessment Authority (VCAA) for schools in Victoria, Australia. It is structured around three core and interrelated learning strands, one of which is Interdisciplinary Learning, and housed within that is the Information and Communications Technology domain. A feature of this domain is standards related to visualising thinking; in essence this means the ability to apply ICT tools such as concept mapping software to support the filtering, refining, reorganising and systematic assessment of content and concepts associated with the domains from the other strands. This paper outlines the nature of the visualising thinking component of the curriculum framework, its potential contribution to enhancing student learning and provides an example of how young learners are using concept maps to support deeper understandings.

1 Victorian Essential Learning Standards

The Victorian Essential Learning Standards (VELS) is a curriculum framework for the compulsory years of schooling (typically for children aged five to 16 years) developed by the Victorian Curriculum and Assessment Authority (VCAA) for schools in Victoria, Australia. Published in 2005, schools use this framework for a whole-school approach to designing and delivering teaching and learning programs that support students to develop capacities to 'confidently manage themselves and their relationships with others, make sense of the world in which they live and effectively participate in that world' (VCAA 2005a).

1.1 VELS structure

Conceptually the VELS is structured around three core and interrelated learning strands that address the processes of physical, personal and social development and growth, the branches of learning reflected in the traditional disciplines, and the interdisciplinary capacities needed for effective functioning within and beyond school, as shown in Figure 1 (VCAA 2005b). Each strand has a number of domains which describe the essential knowledge, skills and behaviours students need to prepare for further education, work and life.

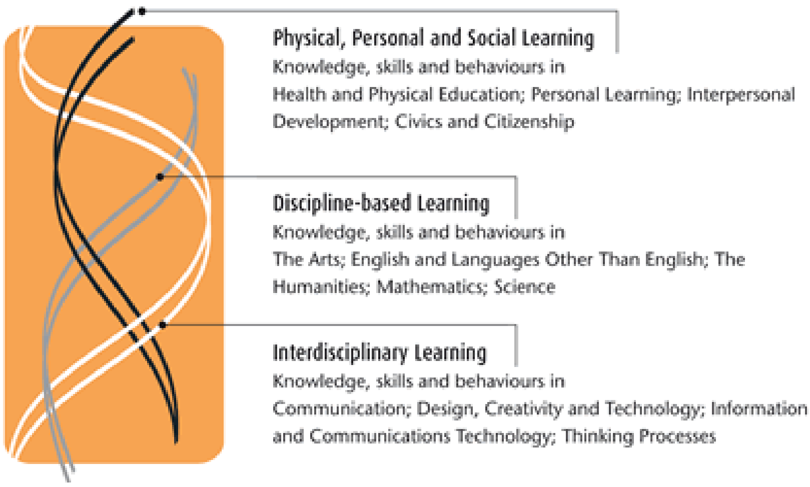

Figure 1: VELS Structure

2 Information and Communications Technology Domain

Within the VELS the Information and Communications Technology (ICT) domain focuses on providing students with the knowledge and skills to change how they learn and to enrich their learning environment. ICT acts as an active agent in supporting students to apply knowledge 'in ways appropriate to context, rather than merely exercising one's memory … and approaching new situations in flexible ways' (VCAA 2005c).

The knowledge, skills and behaviours for this domain enable students to develop new thinking and learning skills, to work productively, to create information and solutions, to express ideas in contemporary ways, to communicate to solve problems and share information, and to act responsibly and critically when using ICT. These knowledge, skills and behaviours are encapsulated in three dimensions, namely ICT for visualising thinking, ICT for creating and ICT for communicating, as shown in Figure 2.

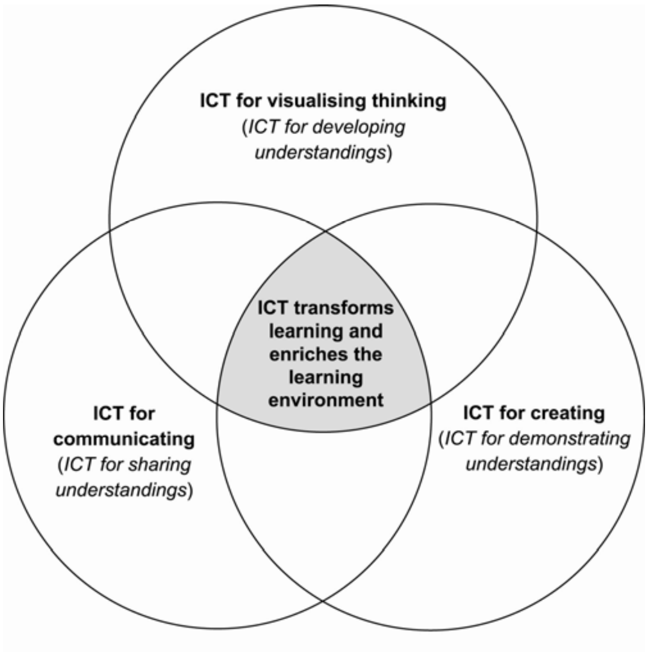

Figure 2: Dimensions of ICT Domain

While the standards are organised around these dimensions, in practice their boundaries are usually seamless with students drawing on ICT knowledge and skills relevant to the task rather than to the dimension.

Historically, the ICT curriculum in Victoria focused primarily on content similar to the ICT for creating and the ICT for communicating dimensions, however, it was silent about how ICT could be used to organise ideas and relevant information to foster effective thinking. Based on writings by authors such as David Jonassen, (Jonassen, 1998) David Whitehead (Whitehead, 2005) and Tim van Gelder, (van Gelder, 2002) the conceptual underpinnings of the visualising thinking dimension emerged – at its heart was the premise that making thinking visible (explicit) is a powerful framework for understanding content and nurturing intellectual development.

2.1 ICT for Visualising Thinking Dimension

The focus of this dimension is on students using ICT to assist their thinking strategies and to reflect on the suitability of their visualising thinking strategies for different learning situations. It is intended that this dimension act as a real lever to change how students learn.

Students use ICT tools and techniques to assist in developing their understandings of domain-specific content. These tools can complement other thinking routines such as artful thinking espoused by Project Zero (Perkins 2003).

The flexibility, speed and capacities of ICT supports the drafting, filtering, reorganising, refining and systematic assessment of ideas, content and concepts in order to structure thinking processes and construct knowledge. Text and image representations of ideas, content and concepts can be created using tools such as concept maps, graphic organisers, ICT-generated simulations and models.

In the VELS, visualising thinking is defined as ‘The process of using ICT tools and editing techniques to visually code and represent thinking (for example, classifying data by colour coding; using a graphic organiser such as a concept map to discover links between data; using simulation software to model a process). It is a process that allows students to clarify thought, and to identify patterns and form relationships between new and existing knowledge’ (VCAA 2005d).

Visualising thinking tools such as concept maps are 'frameworks that help students structure their thinking processes … and help students make connections between existing knowledge and new information, and make visible their thinking processes (VCAA 2005e). Typical concept mapping software used by students in Victoria includes *Inspiration, Kidspiration*, *Rationale*, Intel visible thinking tools, *2Simple*, Cmap.

2.1.1 Visualising Thinking Standards

Standards exist for five levels in ICT and they state what students should know and be able to do at the end of grades 2, 4, 6, 8 and 10 (students are typically 8 years at the end of grade 2 and 16 years at the end of grade 10).

In broad terms the ICT standards for visualising thinking are connected to the following key concepts and skills: using ICT tools to visualise thinking; visualising thinking strategies; modifying visualising thinking strategies and reflecting on visualising thinking strategies. Table 1 identifies the VELS standards (VCAA 2008) linked to one of these skills, *using ICT tools to visualise thinking*, for levels 3 (10 year olds) to 6.

Level 3	Level 4	Level 5	Level 6
Use ICT tools to list ideas, order them into logical sequences, and identify relationships between them.	Apply ICT tools and techniques to represent and explore processes, patterns and cause-and-effect relationships.	Select and apply ICT tools that support the filtering, classifying, representing, describing and organising of concepts, issues and ideas. Use editing functions of the ICT tools when visualising thinking.	Use a range of ICT tools and data types to visualise their thinking strategies when solving problems and developing new understandings. Use appropriate ICT tools and editing techniques efficiently and effectively for assisting in visualising thinking.

Table 1: Standards for the key skills of using ICT tools to visualise thinking

2.1.2 Example of Learning Progress

Teachers are required to make regular assessment judgments and report to parents on a semester basis. To assist in making informed assessment decisions, the VCAA provides samples of student work, published on the VELS website, that illustrate what work might typically look like at a varying levels of performance.

Figure 3 (VCAA 2006) shows evidence of a student progressing towards the Level 4 standard statement identified in Table 1. Students were asked to develop their understandings of a range of farm animals and their product derivatives in an integrated studies program focusing on life on a farm. This work was originally written in French and the students were required to add a sound wave recording (in French) to support their text.

The commentary accompanying this work sample identifies that the student has used different shapes to clearly show hierarchy, however, this would have been enhanced through the use of different colours in the bubbles (subsets). Some relationships were shown through text, arrows and lines, however, additional dialogue is needed to connect the animals and their product derivatives.

A range of other examples at varying levels in the early years of schooling are available on the VELS website (Assessment Maps).

3 Conclusion

The VCAA values the role that ICT plays in supporting student learning and has identified rigorous standards for the ICT domain. How students progress from 'being novice to more expert learners' (VCAA 2005f) is of importance and it is acknowledged that tools and techniques that support 'noticing features and meaningful patterns of information' (VCAA 2005g) contribute to this development. As yet no formal evaluation has taken place regarding the impact of the ICT domain (in particular the ICT for visualising thinking dimension) on learning. The domain is in its infancy, hence opportunities abound. On the positive side, anecdotally the news is good for those schools that have teachers who are not only experts in their field, but who are also confident and competent in using ICT as a teaching and learning tool. Victorian schools are technology rich so a solid foundation exists for the ICT domain, and in particular the visualising thinking dimension to make an important and unique contribution to student learning. Some schools and teachers are grappling with the idea that ‘polished’ work is not the only output expected from students when using ICT. A legacy of the pre-VELS curriculum is a continuing focus of students mainly using ICT for presentation purposes – for some teachers to acknowledge that ICT tools can be used as workhorses is a challenge for schools and the VCAA.

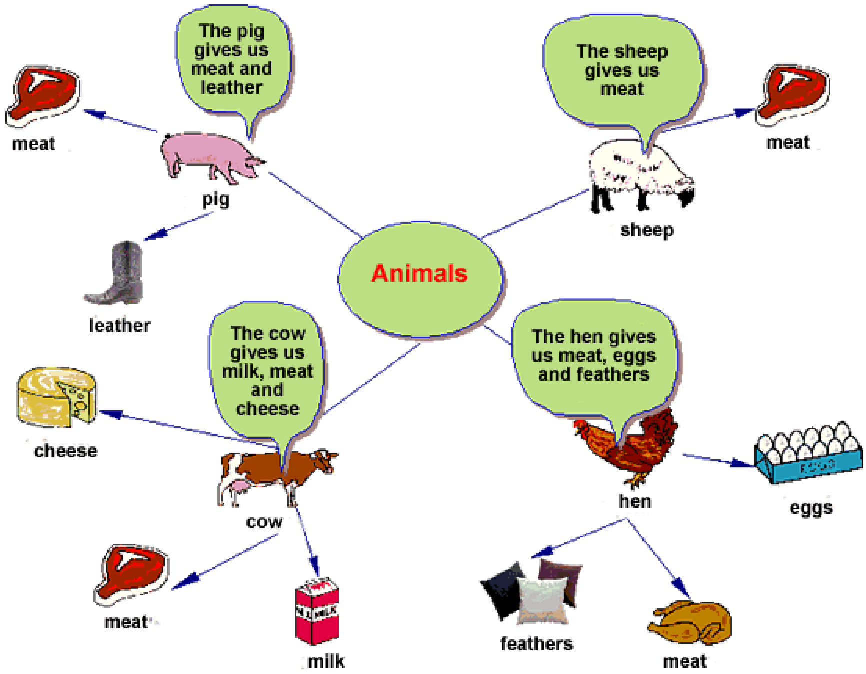

Figure 3: Using a concept mapping tool to explore the relationship between animals and product derivatives

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A STUDY ON 3D CONCEPT MAPS MODEL

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Abstract. Up to now a very rich experience on Concept Maps design and ways to use them has been accumulated. Series of 3D maps were developed, where concepts were represented with balls and connectors by the bars. The distribution of the concepts on a 3D map has a geometrical structure and keeps the hierarchy. The experiment was developed following three steps: 1) Introduction session on Concept Maps construction; 2) Exercise on 2D concept maps; 3) 3D maps following some geometrical body shape. According to the first two steps, all participants designed 2D maps following Cmap Tools, beta version and then went to try them in a 3D body. After experience an opinion quest to contrast both types of maps was applied and student's comments were registered.

1 Introduction

Up to now a very rich experience on Concept Maps design and ways to use them has been accumulated. Developing of this learning tool has shown to be a very valuable instrument to help and support basic knowledge attainment at almost any field where it has been tried on.

Though there still are some problems to solve in order to have a correct use of concept maps as it was pointed out by Cañas and Novak (2006) like the characteristics of many constructions that tend to be more descriptive than explanatory or else the fact that, to be accessible to any observer, a limited number of concepts are to be included in each map so interconnections can be clearly established and easy to read. There are proposals to consider a balanced topology in regards to the distribution of elements in a map (Brenes & Valerio, 2006).

There has been many different ways to develop 3D structures out of a plane design like for example Gaudi´s works for Güell Church which helped him to visualize the geometrical body and the whole 3D structure out of the 2D design as it can be appreciated in Fig. 1. (Giralt, 2002)

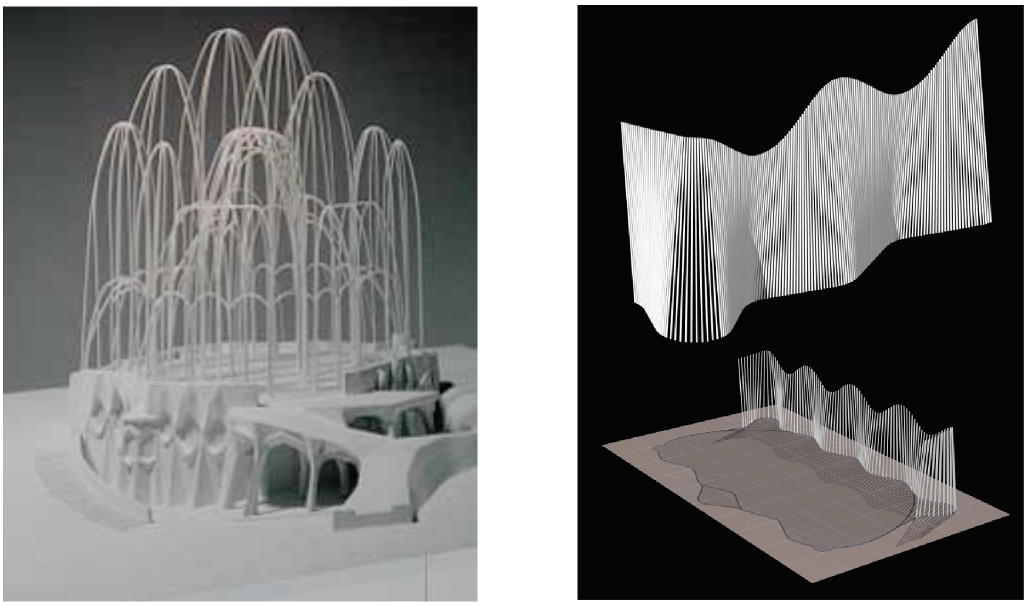

Fig. 1. a) 3D Gaudi´s project to Güell Church b) 2D plane design

So taking in consideration the mentioned facts as well as the main Novak's principles which point out that "concepts are constructed by humans as perceived regulations or patterns in events which are designated by a label, usually a word" (Cañas & Novak, 2006, p. 495) and knowing that two or more concepts can be linked to state a meaningful proposition which can be concretely represented on a map, we decided to explore three dimensional models as another possibility for concept maps usefulness.

2 Methodology

Taking in account the problems mentioned by Cañas and Novak (op. cit.) and trying to help Chemistry students basic knowledge development as well as their creativity, several experimental 3D maps were worked out to see if it is possible to overcome bidimentional planar difficulties like: inadequate connectors, many crossing lines, including too many concepts in a map. Considerations were made on the idea that perhaps 2D does not quite represent a 3D world in which we are and this study may explore other possible way to work with maps.

The exercise was made with a sample of 80 Chemistry students at the 1st level of Chemical Engineering programs offered by the School of Chemical Engineering of the National Polytechnic Institute (ESIQIE). Out of previous studies we detected some difficult concepts for them to comprehend and understand, like “solutions” and “mixtures” so they were chosen to be reviewed.

The way to introduce 3D concept maps followed these steps:

1. Introduction session on Concept Maps construction
2. Exercise on 2D concept maps design
3. 3D maps developing on geometrical bodies shape
4. Analysis and contrast of both 2D and 3D maps.

After the experience, an opinion quest was applied, so participants could comment on both types of maps and express about:

1. Advantages or disadvantages,
2. Main difficulties,
3. Recommendations and comments.

3 Results

- All participants designed 2D maps following CmapTools version beta which produced about 70 different maps.
- According to the quest answers, main difficult was: find out adequate connectors (60%) and going from 2D to 3D (45%).
- The main comment was that it is easier to follow up connections between concepts in a 3D model because there are not line crossings

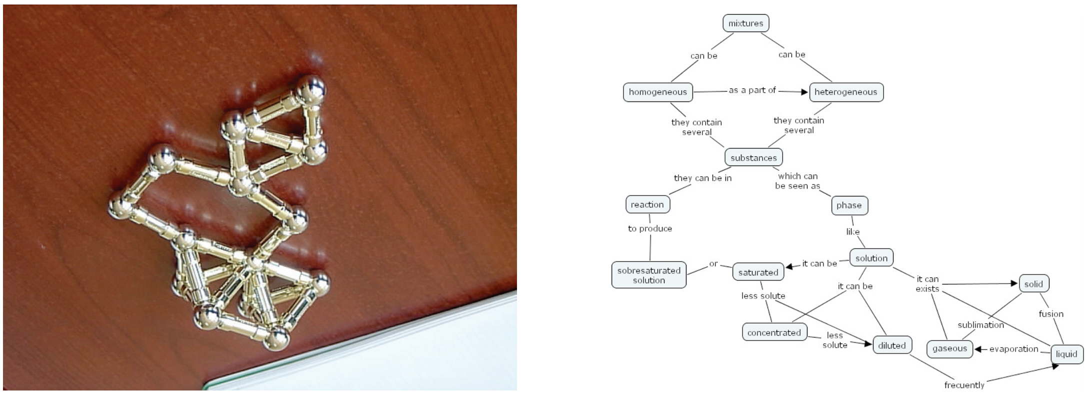

Fig. 2. a) 3D map about concepts related to “mixtures” b) 2D original map

Figure 2 shows a 3D structure build up out of a 2D one with a set of concepts related to “mixtures”. A group of 14 concepts were represented with balls and connectors by the bars. The distribution of the concepts in a 3D body has a geometrical structure and keeps the hierarchy.

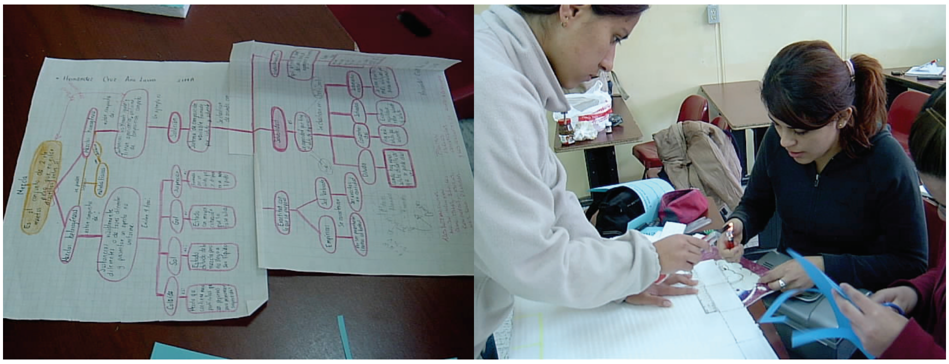

Fig. 3 a) 2D map b) Building the 3D map

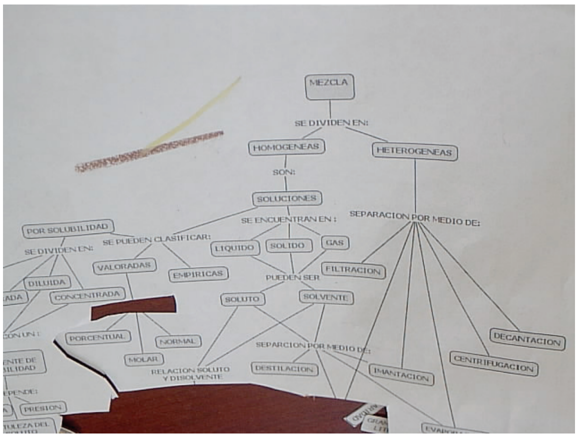

Fig. 4 Cmap of "Mixtures"

Figure 3a and 4 show 2D maps and figures 3b and 5 present 3D maps on "concentration units" and "colligative properties"

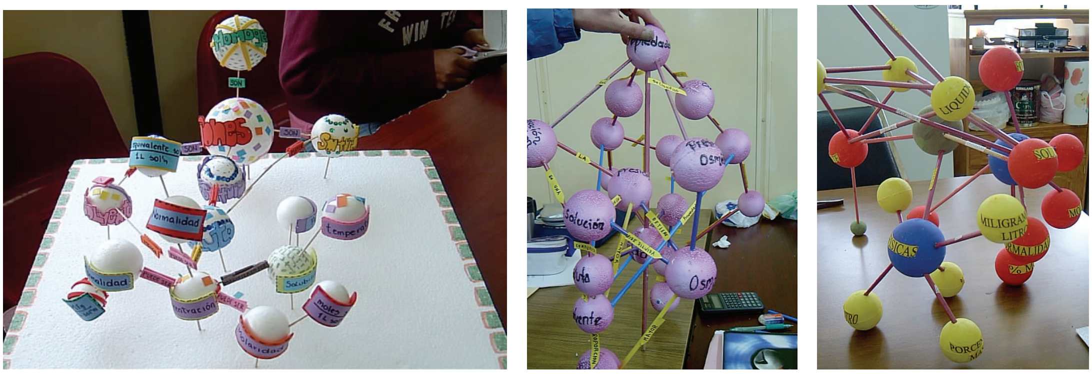

Fig. 5 some 3D maps about "Concentration units" and "Colligative properties"

- Another comment after the experience was that the geometrical body support has to be related with the number of concepts, they suggest that for a set of 5 concepts a tetrahedron could fit, as for a group of 7 concepts an square based bipyramid can be used or a cube for a group of nine and for 13 or more a cone can be suitable.

4 Comments

It seems that the main goals of the study were reached according to the student's opinion who said to like this new way to study and learn. Their creativity was promoted as they had to look for materials and representations to built up their models.

Teamwork and support were a valuable tool to convey their task and construct their basic knowledge on the chosen concepts.

This experience is a starting point that has to be worked out in a deeper way but it seems to be us help in exploring new ways to use Concept Maps.

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A STUDY ON STUDENTS' LEARNING ACHIEVEMENT WITH CONCEPT MAP IN SENIOR HIGH SCHOOL ECOLOGY COURSE IN TAIWAN

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Abstract. Finding relevant information on the Internet can be a daunting task which would be enhanced if the material were organized and could be accessed in an efficient manner. Browsers based on a concept map-based interface and on a World Wide Web page-based interface were compared for ease in finding information necessary to answer a series of search questions based on the same domain material (developmental psychology). Users differed in the amount of concept map training they received and the type of learner they tended to be (meaningful vs. rote learners). The results indicated that the concept map-based interface resulted in better search performance for all learners although this difference was most pronounced for meaningful learners. Training in concept map construction appeared to have no more effect on search performance using the concept map-based interface, than control conditions. Taken together, the results suggest that organizing information via a concept map-based interface leads to more accurate search performance than the typically used web page-based browser.

1 Introduction

This research is to study the effect of Concept Mapping in the course of Fundamental Biology for senior high schools. Based on the content of Ecology in this course for senior high school, a study was conducted in the school that the researcher teaches, adopting Concept Map teaching methods and traditional teaching methods separately. Students from different interest-oriented groups were studied to examine the difference in learning showed by these students.

Briscoe (1991) indicated that students are usually of the opinion that to memorize contents in the text book is enough and it does not make much sense creating concept mapping. Other students comment that to use concept mapping in learning is difficult. Many students even think that they do not have sufficient knowledge framework to create concept mapping and tend to give up when the slightest frustration is encountered.

It is because positive results and results of no significant difference have both been reported in the application of Concept Mapping in teaching and learning, the researcher feels interested and would like to probe into this topic to see whether different teaching strategy may influence the learning of students, and whether there will be difference among students of different interest-oriented groups.

1.1 Objectives of this study include the following:

1. To probe into effects on the learning of Fundamental Biology by different teaching strategies.
2. To probe into any difference it may have on learning achievements between students of different interest-oriented groups and between different teaching strategies.
3. To compare any difference it may have on learning achievements between students of different teaching strategies, between different interest-oriented groups, and between different capability-oriented groups (high performance group and low performance group).

2 Methods and Procedures

There are four classes participating in the study as research samples: Concept Mapping Group (or Experiment Group)- which are taught with Concept Mapping methods- including 50 students in a social-science-oriented class and 52 students in a natural-science-oriented class, Traditional Teaching Method Group (or Control Group)- which are taught with traditional methods- including 49 students in a social-science-oriented class and 53 students in a natural-science-oriented class

Data processing and analysis in this study take the mode of quantitative data analysis and employ Statistical Products and Service Solutions (SPSS) software to run the following:
1. Comparison of difference in students' diagnostic results between different Teaching Modes.
2. Comparison of difference in diagnostic results between different interest-oriented students under the same Teaching Mode.
3. Comparison of difference in diagnostic results of same interest-oriented students between different Teaching Modes.

4. Comparison of difference in diagnostic results of high (low) performance students between different interest-oriented classes but under the same Teaching Mode.
5. Comparison of difference in diagnostic results of high (low) performance students between different Teaching Modes but in the same interest-oriented class.
6. Comparison of difference in diagnostic results of high (low) performance students between different Teaching Modes.

3 Results and Discussion

Results of this study show that diagnostic scores of student samples adopting Concept Mapping are higher than those of student samples adopting Traditional Teaching Strategy (and not influenced by different interest orientation). Analysis of variance (ANOVA) with diagnostic scores as dependent variables while teaching modes and interest orientation as independent variables reveals that different teaching strategies will cause significant difference in both natural-science-oriented and social-science-oriented students.

Conclusions of this study are as follows:

1. Whether students taught with Concept Mapping Strategy have better academic achievements than students taught with Traditional Teaching Strategy.
   a. From t-test analysis of mean and deviation, it is found that students with Concept Mapping Strategy have better diagnostic results than the Traditional Teaching Group.
   b. As for the performances of different interest-oriented students, there exists significant difference in the Traditional Teaching Group, but there is no significant difference in the Concept Mapping Group, which reveals that through Concept Mapping students' performances do not differ with interest orientation.
   c. Through Concept Mapping, students have better diagnostic scores than those in the Traditional Teaching Group regardless of their interest orientation, and the difference is significant in statistics.
2. Whether the difference in interest orientation affect students' academic achievements.
   a. Through the test of mean and deviation on diagnostic scores of different interest-oriented students in both Concept Mapping Group and Traditional Teaching Group, it is discovered that interest orientation has effect upon academic achievements in the Traditional Teaching Group, while in the Concept Mapping Group, no significant difference exists in diagnostic results between students of natural-science-oriented class and of social-science-oriented class.
   b. When classes of the same interest orientation but under different Teaching Strategies are examined, it is discovered from diagnostic results that Concept Mapping Group has better performance than the Traditional Teaching Group.
3. Whether academic capability has effect on achievements.
   a. No matter of which interest orientation, students taught with Concept Mapping will have better performance in diagnostic examination than those taught with Traditional Teaching strategy, and there exist significant difference between the two. A further review of diagnostic scores of high performance group and low performance group in each class discovered that in natural-science-oriented classes there is no significant difference in high performance groups between different Teaching Methods, while significant difference exists in diagnostic scores of students in other classes. (As shown in Table 1 (3) and (5))
   b. In the Traditional Teaching Group, interest orientation has effect on students' achievements. (The natural-science-oriented class has better scores than the social-science-oriented class.) A further investigation into the difference between high performance students and low performance students in each class revealed that there exist significant difference in diagnostic scores of high performance students between different classes, while there is no significant difference in the diagnostic scores of low performance students. (As shown in Table 1 (2) and (4))
   c. In the Concept Mapping Group, there is no significant difference in diagnostic results between different interest orientation classes. A further investigation into the difference in achievements of high performance and low performance students in each class discovered that there is no significant difference in diagnostic results between high performance students and low performance students.
   d. After the application of different teaching methods in instruction, through the test on mean and deviation of diagnostic scores, it is discovered that students in Concept Mapping have better performance than students in Traditional Teaching Strategy. A further review of the difference in diagnostic results between high performance division (the leading 25% in ranking) made up of from high performance students of different interest-oriented classes and low performance division (the last

25% in ranking) made up of from low performance students of different interest-oriented classes having been taught with different teaching modes revealed that the performance of Concept Mapping Group is superior to that of the Traditional Teaching Group no matter it is in the high performance group or in the low performance group.

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ADAPTIVE CONCEPT MAPS: ISSUES ON DESIGN AND NAVIGATION

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Abstract. This paper presents some issues on design and navigation in concept maps. It shows a set of visual features based on proposals from information visualization and it describes the navigation tasks a user could perform on a concept map. As a result of this, the article provides the first step in the construction of a visual aids language for concept map exploration.

1 Introduction

Concept mapping has its origins in 1972, when Novak tried to represent the student's knowledge based on personal interviews. In the late 1990's a team mainly composed by Novak and Cañas developed the well known *CmapTools*, a software application for concept mapping. Since that date, many similar applications have been developed in order to ease the creation of concept maps. However, due to most these tools for concept mapping focus on the creation process to the detriment of the exploration process, they lack of aids for navigating the concept map.

On the other hand, a set of concept maps has been defined as a *knowledge map* (Crampes, Ranwez et al., 2006) or as a *knowledge model* (Cañas et al., 2005). Thus, knowledge map navigation is the process of exploring and/or modifying a set of concept maps. Since most of the concept mapping software tools don't deal with the dynamic appearance of nodes, links and resources, it is difficult to explore a concept map with thousands of nodes and links. The dilemma mentioned by (Waterworth, 1994) commenting Norman's book: "*How can artifacts created to serve the function of reducing mental effort be designed to encourage that very effort?*", it serves as an starting point and it poses some questions about concept mapping design and navigation: how to facilitate navigation once a knowledge map has been created and how do visualization and interaction influence in the learning process?. Collin Ware stresses the importance of navigation and the effectiveness of a particular interactive visual display (Ware C., 1994): "*the cognitive cost of navigation in visual data spaces well be critical in determining the effectiveness of a particular interactive visual display.*"

Next, we mention examples of software tools that deal with navigation aids. These systems do not explicitly take in consideration the proposals from information visualization, but somehow it presents visual artifacts that help the user in the navigation process:

- (Coffey, 2005) proposes a system called LEO, which adds some features to the exploration of a concept map. The main visual techniques presented in the system are: the use of the gray color in nodes for diminishing importance, the possibility of visualizing the content of a node by means of an expanded node and the floating window that presents a reduced view of the entire organizer map.

- (Crampes et al., 2006) defines a knowledge map as a map that may contain not only concepts and relations, but also thousands of instantiated propositions. They propose a *Domain-View-Controller* for adapting contents: the *Controller* takes charge of the user's interactions coming from the mouse and the keyboard, the *Model* is the part of the code that transforms the internal state of the data according to the events sent by the *Controller* and the *View* manages different graphical objects that present the data on the interface.

- (Brusilowsky & Peylo, 2003) proposed the *adaptive and intelligent web-based educational systems* as systems that combine resources from the web for further adapting the content and presentation to the end user, making easier the exploration of contents and thus enhancing user navigation.

2 Issues on Designing Concept Maps

In spite of many visual design guidelines, a central principle in information visualization might be summarized in the Shneiderman's Visual Information Seeking *Mantra* (Shneiderman, B., 1996): "*Overview first, zoom and filter, then details on demand*". If we wish to follow this principle in order to visualize a large combination of concept maps, we firstly need to show a clear overview of the entire structure of the concepts and arcs. We propose to show initially the knowledge map with the labeled nodes replaced by circles, getting the labeled text associated by means of clicking it or just placing the mouse over the node. In this way, the user is encouraged to use the mouse as a pointer of his/her thought.

In order to show a description of the general way in which entities and relationships can be expressed using node-link diagrams, next, in Table 1, the visual artifacts and their semantic are presented. The first three rows of the table are taken from the book (Ware C., 1994). As it is claimed there, these are conjectured to be good display mappings, although none has been proved through scientific study to be the best; the elements in the list has a perceptual, rather than conventional, basis for the way in conveys meaning. The last two rows and the last to columns show our proposal for knowledge map visualization and navigation.

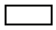
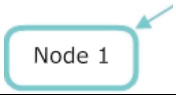
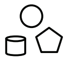
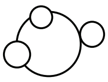
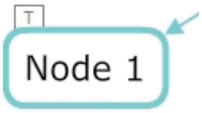
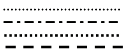
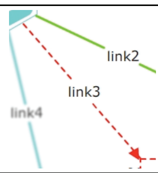
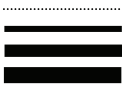
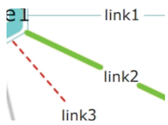
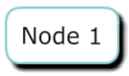
Graphical Code	Visual Instantiation	Semantics	Our Proposal	Our Semantics´ Proposal
1. Closed contour		Entity, Object, Node.		Node
2. Shape of closed region		Entity type.		Node before clicked
3. Color of enclosed region		Entity type		Number of clicks
4. Size of enclosed region.		Entity value. Larger = more.		Letter and contour size depends on the number of clicks and child nodes
6. Attached shapes		Attached entities, Part-of relations		Type of resource contained in a node: Text, Sound, Image, Video, Nested concept map
10. Linking line quality		Type of relationship between entities		Type of relationship between nodes
11. Linking line thickness		Strength of relationship between entities		Number of times the nodes connected by the link have been clicked
14. Blur				Lost of focus during a session
15. Shadow				The user accesses the node or it has been accessed
16. Transparency				Lost of global focus

Table 1. The visual artifacts and their semantic.

2.1 Concept Map Navigation

A common problem that knowledge and information visualization systems share is that the visualization on very large data sets is still difficult. The difficulty relies on the computer display and its size. Due to this limitation, it is complex to visualize a large data set in such a manner that the user can perceive all data elements and can understand the data structure. For easing this limitation, interactive visualizations play a key role in supporting navigation tasks.

In (Shneiderman, 1996), it is enumerated seven tasks that users could perform on the data. Complex tasks e.g. focus & context, can be described as a combination of tasks presented, in this case overview, relate and zoom. Next, in Table 2 we show how these tasks can be performed when users navigate over a knowledge map.

Tasks	Definition	Applied to knowledge map navigation
1. Overview	Gain an overview of the entire collection	Initially, nodes without labels displayed as circles. Zoom transition by means of mouse
2. Zoom	Enlarge items of interest	Click to enlarge node. Zoom transitions. Nested nodes visualization
3. Filter	Filter out uninteresting items	Contract node branch, blur and transparency
4. Details on demand	Select an item or group and get details when needed	Content and relations display
5. Relate	View relationships among items	Type of links (arcs)
6. History	Keep a history of actions to support undo, replay, and progressive refinement.	This tasks is performed through the adaptive feature
7. Extract	Take out sub-collections of data or history to save and communicate.	Selection of a set of nodes. Collaborative web environment

Table 2. A list of navigation task and its application on knowledge map navigation

From this point we start to build a conventional basis of a visual aids language for concept mapping, where the visual artifacts offer complementary information of the meaning of nodes and links and the interaction allows to navigate a knowledge map in a user-friendly way.

Next, in Figure 1, we show an example of a simple concept map design follow the suggestions mentioned above.

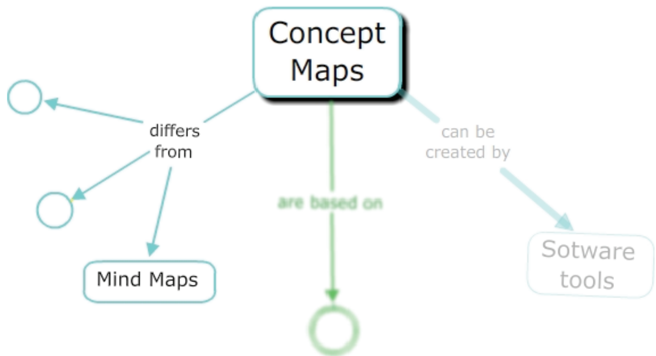


Figure 1: an example of a concept map containing nodes in its initial state, a blur node, a modified transparency node and a node with shadow.

3 Conclusions and Trends

When a user creates a concept map with a software tool like CmapTools, she/he has a set of options for the appearance of nodes and links. These visual options are basically the next: font type, font size, font color, and the properties related to the aspect of the node, as the thickness of the line, line type and line color. In this way the user chooses the design options regarding to his/her preferences. This design is static and it will be modified only by the user during the creation phase. However, once the map is finished, it might be used for personal purposes or for sharing with other people. In the latter case, the learning process of the concept map differs from the author of the map.

The above justification is the reason we propose to distinguish between an interface for the author and an interface for the end user that facilitates the exploration tasks. Moreover, it would be convenient an interface that takes into consideration the paths a user follows when she/he is exploring the knowledge map, in order to adapt the presentation and the contents with visual artifacts. These artifacts would allow to register the paths and to suggest new ones through color, movement, transparency, shadowing techniques and/or blurring techniques.

4 Acknowledgements

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ADVANCED CONCEPT MAPPING: DEVELOPING ADAPTIVE EXPERTISE

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Abstract. We describe a novel cognitive science-based approach to concept mapping called Advanced Concept Mapping (ACMapping) designed to reliably enhance teaching, learning and research performance in both underperforming and highly accomplished individuals. ACMaps are logically constructed expert-like representations of the conceptual deep structure of a technical domain. The ACMapping methodology was designed around the key observation that expert-novice performance differences are overwhelmingly due to differences in the quality of domain-specific knowledge structures (Chi, 2006).

The motivating assumption behind ACMapping is that the ideal goal of education is to promote the development of adaptive expertise i.e. the ability to apply meaningfully learned knowledge in a flexible and creative manner (Hatano, 1982). Elite performers invariably exhibit adaptive as opposed to routine expertise. To facilitate this goal ACMapping is taught within the context of a novel theoretical taxonomy of educational objectives, the Advanced Critical Thinking (ACT) Framework, a model of the key elements of adaptive expertise.

The skilled meaningful learning process of autonomously constructing expert 'connected understanding' using ACMaps is referred to as 'Knowledge Engineering'. In Knowledge Engineering the learner employs the fundamental thinking skills of abstraction, analysis, synthesis, and inference to explicitly construct integrated, hierarchical, expert-like knowledge structures implied by the surface features of expert productions. The use of the advanced knowledge engineering techniques of Deep Structure Analysis and Heuristic Analysis to 'reverse engineer' the deep-level understanding and adaptive problem solving strategies of elite experts is also discussed.

Trinity College Dublin, Ireland is currently using this accelerated learning approach to enhance the thinking skills of academic staff and postgraduates across the sciences and humanities. We also briefly report on ongoing research into the effect of this training program on student thinking skills and the quality of the research output of scientific research groups.

1 Introduction

Cognitive psychologists distinguish two types of expertise; routine and adaptive expertise (Hatano, 1982). Routine expertise manifests itself in the ability to efficiently solve standard, familiar problems. Adaptive experts, in contrast, exhibit highly developed metacognitive skills that facilitate development of ad hoc problem solving strategies and procedures for non-standard problems (Bransford et al., 2000). Elite experts within a domain are invariably adaptive experts. We believe that the ideal goal of education should be to facilitate the development of adaptive expertise through meaningful learning.

We present an innovative approach to concept mapping called Advanced Concept Mapping (ACMapping) designed to promote the development of adaptive expertise. In order to clearly focus pedagogic attention upon the key aspects of adaptive expertise, ACMapping is taught within the context of a novel theoretical taxonomy of educational objectives, the Advanced Critical Thinking (ACT) Framework. We designed the ACT Framework to provide a normative 'conceptual scaffold' for integrating and structuring the logical and metacognitive thinking skills characteristic of adaptive expertise. Briefly, the ACT Framework embodies the conventional definition of an expert as an individual with superior knowledge and superior problem solving skills (Chi, 2006) augmented with critical thinking skills (abstraction, analyticosynthesis, and inference) and the reflective, metacognitive skills characteristic of adaptive expertise (Baroody, 2003).

This approach is currently being taught to staff and postgraduates in the form of generic and subject-specific accelerated learning courses run by the Centre for Academic Practice and Student Learning (CAPSL) in Trinity College Dublin (TCD). In this paper we briefly review the rationale behind this novel approach to learning and problem solving and outline some of the associated methodologies.

2 Nature of Expertise

Expert-novice differences in performance are overwhelmingly due to differences in the quality and extent of domain-specific knowledge structures, or schemata, held in long term memory (Chi, 2006). Novices typically possess fragmented, non-hierarchically organised knowledge structures, whilst expert knowledge structures are generally highly integrated and hierarchically organised around deep principles within their domain (Chi, 2006). The superior comprehension, problem solving, recall and learning abilities of experts arise directly from their superior knowledge organisation (Bransford et al., 2000). The conventional progression from novice to expert, as described by research in cognitive psychology, is therefore typified by a qualitative transformation and a quantitative extension of the individual's knowledge structure, as illustrated in Figure 1A.

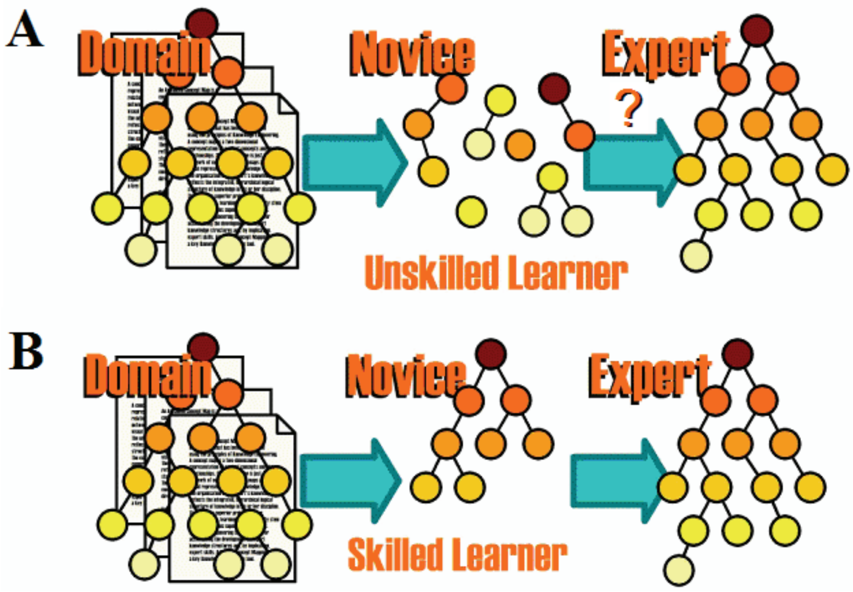

Figure 1. A. The conventional development of expertise. The unskilled learner slowly progresses from early fragmented, non-hierarchical conceptual representations towards the integrated, hierarchical representations characteristic of experts. B. A proposed ideal sequence of development of expertise. The skilled learner uses advanced critical thinking techniques, such as knowledge engineering to construct an integrated, hierarchical, 'mini-expert' representation from the earliest phases of learning.

We argue that this conventional developmental trajectory of performance is founded upon an inherently unskilled approach to learning and is, consequently, both inefficient and unnecessary. An ideal alternative progression based upon the skilled learning approach advocated in this paper is depicted in Figure 1B.

3 Critical Thinking Skills and Advanced Concept Map Construction

Since the latent conceptual structure of technical domains, such as physics, economics, and psychology are logically organised, and the development of expertise within a domain is largely the process of internalising this latent conceptual structure, we devised Advanced Concept Mapping (ACMapping), a modified version of the concept mapping approach (Novak and Cañas, 2006), to expedite this process. ACMaps explicitly extend the traditional constructivist focus of concept maps (Ausubel et al., 1978) to include the use of the logical thinking skills of abstraction, analysis, synthesis, and inference to critically and creatively construct and restructure knowledge representations. *Prima facie* support such an approach includes evidence that the deliberate use of abstraction to drive thinking upwards towards more integrative conceptual levels is associated with enhanced levels of learning transfer in domains as diverse as mathematics (Kaminski et al., 2008), motor skills (Judd, 1908), and analogical reasoning (Gick and Holyoak, 1983). Significantly, Aristotle considered this ability to 'see similarities between dissimilars' as the 'mark of genius' {Aristotle, 1996}. The techniques outlined here are also designed to enable problem solvers to systematically transcend apparent limitations in human creativity (Ward et al., 2004).

3.1 Construction of ACMaps

The standard steps for building an ACMap are:

- SELECT
  1. Identify key concepts
  2. Organise related concepts into small groups
- CONNECT
  3. For each group link the terms into a logical micro-map
- INTEGRATE
  4. Link the micro-maps into a larger concept map (where necessary, inferring implied concepts)
  5. Edit and evaluate the macro-map for logical soundness
  6. Search for creative cross linkages between distal concepts

The explicit use of critical thinking skills to actively infer the existence of deeper integrative relationships and concepts is simply illustrated in Figure 2. This figure shows how an organizing principle of business can be extracted from a basic definition of 'capital' taken from an introductory business studies dictionary.

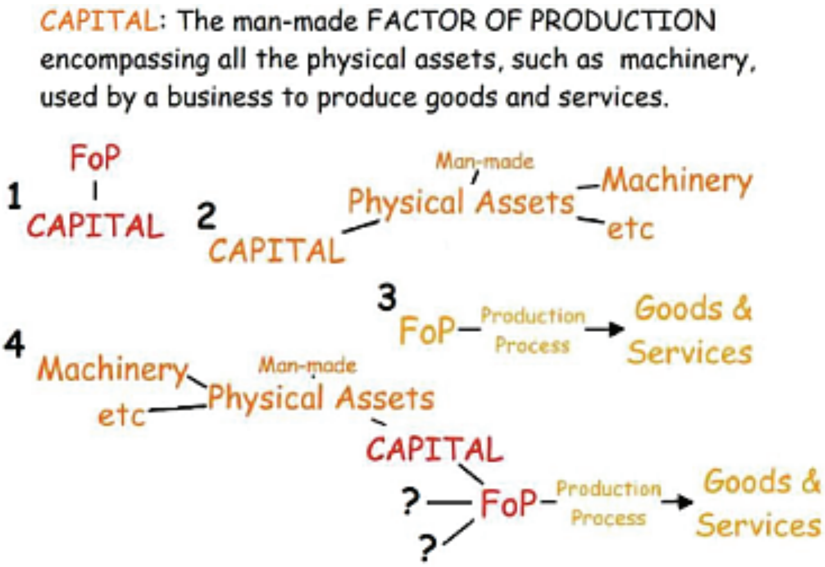

Figure 2. ACMapping in action: Mapping 'Capital' 1. This first micro-map clarifies that capital is defined in terms of the more abstract concept of factor of production (FoP). 2. Capital is also a type of physical asset, of which machinery is an example. 3. Although a superficial reading suggests that capital is used to produce goods and services, micro-map 1 implies that it is more accurate to say that FoPs are the appropriate level of generalization at which to describe inputs to the production process. 4. This point is amplified when the micro-maps are merged to produce the final map. Capital is seen to be simply one of several types of FoP that feed into the production process. In this macro-map the key organizing feature that naturally emerges is the fundamental business concept of the production process. Note that this structure is logically implied by the definition and that minimal prior knowledge is required to elicit a fundamentally deeper understanding. Note also that although ACMaps generally follow the CMap convention of top-bottom hierarchical organization they optionally augment this scheme with left-right hierarchies as well. For visual clarity and speed of development, relationship labels are optional in ACMaps.

4 Knowledge Engineering

We refer to the process of explicitly modelling expert knowledge and problem solving heuristics in order to accelerate domain learning as knowledge engineering (a pedagogic variant of the definition traditionally used within artificial intelligence). Thus defined, it is closely related to the notion of knowledge recovery (Hoffmann et al., 2007), the process of extracting meaningful information from documents and other resources and representing them as concept maps. The key differences lie in the directed application of informal logic to extrapolate latent conceptual deep structure, and the goal of fostering adaptive expertise.

A corollary to deep structure integration is conceptual restructuring driven by the discovery of logical flaws or explanatory limitations in superficially coherent knowledge structures. The fundamental importance of such restructuring to human cognition is indicated by its ubiquitous presence across the gamut of problem solving activities: from the humorous surprise of suddenly 'getting' a joke, and the revelatory 'aha!' moment of insight problem solving, to the magisterial sweep of Kuhnian paradigm shifts within the sciences (Kuhn, 1996).

An interesting 'advanced' application of knowledge engineering is that of Reverse Engineering of Expertise (RevEng). RevEng is the use of knowledge engineering techniques to expose the latent knowledge structures (deep structure analysis) and problem solving heuristics (heuristic analysis) of elite experts for the purposes of comprehension, evaluation, and extension. By abstracting away from the surface details of the productions of domain virtuosos, the underlying declarative and procedural structures utilised by an elite expert can be inferred and made explicit. The utility of such an approach is highlighted by the remarkable historical improvements in both the average and peak performance levels within domains as diverse as physics, chess, and music. These improvements have largely been driven by advances in education and training methods made possible by explicating the mechanisms by which the feats of elite experts are accomplished (Ericsson and Charness, 1994). The Reverse Engineering of Expertise approach simply places this approach on a more systematic footing.

The potential effectiveness of the knowledge engineering approach for improving thinking and learning skills is suggested by the results of a recent pilot study in which first year Humanities undergraduates demonstrated significant pre-post gains on an untrained test of critical thinking ability ($t_{0.05(19)} = -2.25$, $p = 0.036$, 2-tailed) following a 14 lecture ACT course (Delany, 2008).

Since the citation impact of a paper is correlated with conceptual depth (Chen, 2004), we are currently also conducting research on the effects of subject-specific instruction in knowledge engineering on the conceptual depth and quality, and citation impact of the research output of scientific research groups within TCD.

5 Summary

In this paper we have reviewed an innovative cognitive science-based approach to developing elite expertise. This method is based upon the use of informal critical thinking skills of abstraction, analyticosynthesis and inference to explicitly construct visual representations of expert-like deep structure knowledge from the earliest stages of learning within a field. Although this approach has obvious implications for enhancing the effectiveness of student-centred learning, and improving the quality of lecture and curriculum design, perhaps the most exciting possibilities are raised by the prospect of extending the abilities of accomplished individuals.

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AN APPLICATION OF THE *HISTORICAL MODEL* IN *CMAP*

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Abstract. We propose to develop an understanding of the basic principles that give sustenance and consistency to the comprehension of a historic structure, under axles of thematic structure. In this case, the thematic structure is based in a disciplinary approach, in which some of the basic scientific disciplines [astronomy, physics, chemistry, geology, biology and social sciences (anthropology, history, sociology, psychology, economics)] are displayed, situated and defined. This is formulated in our digital interactive program called: *Kronos,* which was developed in two platforms: *CmapTools* and a *Web Based-Platform (HTML).* The main idea is to use, as the thematic structure, the basic notions that constitute the scientific disciplines, through a historical projection. The program, *Kronos*, recognizes four major constituent and consecutive historical periods: 1) Astronomical times: origins of the universe and formation of the solar system. 2) Geological times: evolution of earth and life. 3) Human times: origins and evolution of mankind (social times). 4) Present times: our current situation (today, here, you, me, us). The program *Kronos* is a system of multiple representations, interactive, articulated with hyperlinks to cyberspace sites. Through a visual representation (A), which creates links to a concept representation (B), a visual – concept card (AB) is created, which in turn contains channels leading to cyberspace through hyperlinks. Then students have to create their own representations, both visual and conceptual, by building a concept map.

1 Problem

Basic education, which corresponds to compulsory education, includes in Mexico the first nine years of schooling (Primary - 6 years and secondary - 3 years), and assumes a set of knowledge that everyone in society should learn. The biggest problem, we could say, is that this knowledge is excessive, broad, extremely ambitious, unstructured, isolated, without an integral vision, generating and promoting rote learning based on memorization without understanding. This knowledge is very narrow in meanings, with reduced cognitive operability and of little or no significance for the student. This reduces the possibility that students develop their own and creative thinking.

We believe that when designing a curriculum for basic education it is necessary to take into account structural and fundamental principles, since otherwise it is impossible for a student to learn the huge amount of knowledge that is being taught. The dominant pretension, assumes exhaustive learning of contents of knowledge of a wide thematic dispersion, only promotes rote learning instead of meaningful learning. Knowledge itself constitutes a huge universe of information that is increasing day by day, constantly expanding at an extremely fast rhythm, which is a characteristic of the contemporary world. We wonder: What should we teach? Which is the basic knowledge? Can we define the core competences for contemporary life?

2 Theoretical approach

We have a psycho-educative perspective in which it is assumed that the cognitive process of appropriation of knowledge requires that the student constructs and develops his own schemes of assimilation of knowledge as pointed by Piaget. The human capacities for assimilating knowledge are restricted to a gradual process in which the structures that allow comprehension develop. Learning requires to be conceived as a slow process of assimilation, under constant iteration of knowledge structures that are operative and allow constructing the meaning of new knowledge, as assumed Bruner, in a progressive spiral.

Active and meaningful learning happens when the learner selects the relevant information and organizes it through a representation that is congruent with the schemes of previous knowledge, under a set of principles that allows him to combine and to articulate in systems of multiple representations, such as: images, graphics, illustrations, animations, written texts, narrations, sounds, music, etc. The cognitive theory of multimedia learning of Mayer (2001) proposes different ways for processing information, that can be visual (iconic) or verbal (conceptual).

Coll, Engel & Bustos (In press) consider that representation systems constitute an operative part of cognitive processes when forming structural functional relationships. These symbolic systems become observable in the form of concept maps, diagrams, pictures, writings, musical notation, and so on. Representations are instruments of the cognitive apparatus that are mediators of both thought and communication. Zhang & Norman (1994) argue that the use of different formats for representing the same information can promote various cognitive processes, which can hinder or facilitate understanding.

On the other hand, Olson (1998) maintains that the impact that representations can exert on knowledge structures and ways of thinking is remarkable, because knowledge constitute intellectual instruments that facilitate thinking, as well as retaining or memorizing in an active way what is being learned. Kullberg (1996) has pointed out that the use of images in chronological sequences, in which the students can interact by selecting precise images within an interactive environment to obtain information, allows illustrating historical information from a multitude of points of view, in both general and specific levels. Our experiences indicate that the use of images and verbal representations in the teaching of history has a great power of evocation, which allows performing a substantive function in the teaching-learning process (Tirado, Fuentes & Gómez; 1996).

3 Proposal

We propose to adopt a series of principles that promote the development of basic structural knowledge. Basic because is the foundation for the comprehension and learning of new knowledge. Structural as it allows a concept organization that generates a global network of knowledge. We assume historical model organized since the origin of the universe to the present day and vice versa, from the present to the origin of the universe. This is prioritizing the knowledge that allows understanding the nature and origins of the student (Tirado, 1983). The idea is to identify principles from breaking points in history, from the fundamental events that transform history, which classify historical periods. Thus the student requires to identifying events, recognizing the most relevant of them and placing them in time, forming through this process his own representations.

In past experiences we have applied the *historical model* of our proposal in digital media by using playful means and complementing them with museum visits (Tirado & Bustos, 1998). However, in these experiences we appreciated one significat limitation, although the students played an active role, it was not a creative one. They did interpret representations, but they did not build their own ones. Therefore, the proposal of this new model has a more constructivist approach, as it demands the students to build their own concepts and representations in a digital media, by means of images and written texts.

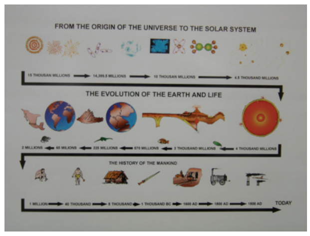
One principle that is universal and that enables to organize all the events that have occurred and will occur is the order of happening. This is the main principle that we use in our program called Kronos, in which events or phenomena are ordered in historical sequence, as they emerged; from the beginning of the universe to the present time, constituting thus a reference structure for placing events. History can be conceived as a comprehensive discipline in which various events might be distinguished in chronological order, recognizing how ones influence, condition or provoke others, forming thus contexts which allow understanding history. Times must be remembered in periods, in sequences, distinguishing the most relevant and contrasting events. The historic chronological sequence has been widely used as a means of systematic presentation of knowledge (Foreman & Gillett, 1997).

One problem that has been appreciated in students is that it is very difficult to create patterns of representation of time, because of its abstract nature, in which there is a lack of direct perceptive representations (Hodkinson, 1995), which makes it difficult for children to conceive events in a sequence of temporal order (Partington, 1980). The present time is a particularly important point of reference for the student, as it signifies the historical episode in which he has specific references to form himself a representation of history, from his own history. Thus the learner can incorporate his own images, starting with the most familiar ones, so that the articulation of historical representations becomes clearly linked to his present. Pedley et al. (2003) investigated the use of personal time lines that were built with the visual images of significant events in the life of the students, which enabled them to a better understanding of the historical chronology.

We propose to develop an understanding of the basic principles that give sustenance and consistency to the comprehension of a historic structure, under axles of thematic structure. In this case, the thematic structure is based in a disciplinary approach, in which some of the basic scientific disciplines [astronomy, physics, chemistry, geology, biology and social sciences (anthropology, history, sociology, psychology, economics)] are displayed, situated and defined.

The idea is to use, as the thematic structure, the basic notions that constitute the scientific disciplines, through a historical projection. The program, *Kronos*, recognizes four major constituent and consecutive historical periods: 1) Astronomical times: origins of the universe and formation of the solar system. - 2) Geological times: evolution of earth and life. - 3) Human times: origins and evolution of mankind (social times). - 4) Present times: our current situation (today, here, you, me, us).

The program, *Kronos*, also works in four phases that constitute different approaches, based on the historical periods. In the first phase it is proposed to assess and analyze the origin of the phenomena that become the object of study of the different scientific disciplines of knowledge. The sequence begins with the origins of physic phenomena, with the constitution of matter and its properties, followed by the constitution of the chemical phenomena, with the origin of molecular compounds, and so on, situating them within the great historic periods previously indicated: 1) Astronomical times: the origin of the physical and chemical phenomena. 2) Geological times: the origin of the geological and biological phenomena. 3) Human times: the origin of social phenomena that social sciences study. 4) Present times: the origin of technological phenomena, product of scientific knowledge and human creativity.



The second phase presents the firsts contacts between humans and the different phenomena that have become the subjects of study of scientific disciplines (physical, chemical, geological, biological, social and so on), which led humans to benefit and get advantage of the phenomena that, eventually, developed into knowledge that allowed primitive men to generate emerging technologies. We could say that this is the origin of primitive technologies, and corresponds to the origins of mankind in prehistoric times. The purpose of the third phase is to analyze the beginnings of the comprehension and systematic study of phenomena as the emergence of scientific disciplines, by recognizing and quoting some of the greatest thinkers who were precursors of scientific thought and founders of the disciplines. *Kronos* gives as an example the cases of physics and chemistry. The events are listed in the order of historical occurrence. The final phase is to present the different phenomena as part of contemporary life, which are manifested in the major technologies, by quoting some of the most important applications of scientific knowledge that exist in present times, giving examples such as, in the case of physics: atomic energy, space technology, ICT and magnetic resonance.

Cox (1999) emphasizes the remarkable difference that exists between reasoning and understanding a representation of knowledge developed by another, and to plan and build a representation of your own. We propose giving the student, through *Kronos*, a functional structure of visual and concept representations to support and serve as mediator or mind-tool for the student to organize, build and present his own ways of conceiving and representing what he has understood, so to say: to promote a series of idiosyncratic representations.

Finally, the proposal is to invite students to share with their peers their own representations, both visual and conceptual, of the different historical moments. The objective is to open dialogues and debates, mediated by the diversity of their own ways of conceiving and representing historical moments. Representations made by the students must be shared and discussed among them, so that this interaction develops into the collective construction of further representations. As Masterman & Roger (2002) suggest, students should be taught to browse and select the most appropriate representations.

The idea is to provide a cognitive instrument as a structure for knowledge construction in a virtual medium, from Kronos, supported theoretical and technological proposals of concept maps (Novak & Cañas, 2008) that offer a scheme of historical presentation under two modalities: a visual one by means of images, and a concept one, by means of text. Authors like Novak (2002) have said, in relation with these issues, that the most effective way to develop representations is by constructing concept maps, which provide meaningful learning, understanding and retention.

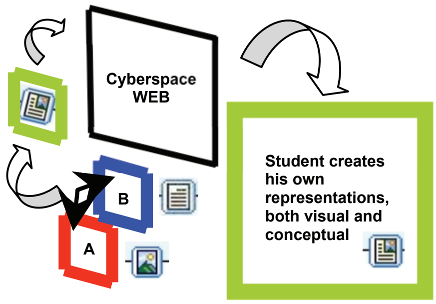


Figure 1. Kronos, promote the process for multiple representation

The objective is to generate representations that have a detonating effect on the constructive creativity of the apprentice, expressed within a field of digital resources (images, graphics, charts, drawings, text, pictures, diagrams, hyperlinks), so in such a way that the student interprets the representation and its meaning, and then develops his own ideas, navigates in the net and builds his own representation, embodied in a digital environment, using Internet hyperlinks.

The program *Kronos* is a system of multiple representations, interactive, articulated with hyperlinks to cyberspace sites. Through a visual representation (A ), which creates links to a concept representation (B ), a visual – concept card (AB ) is created, which in turn contains channels leading to cyberspace through hyperlinks (Figure 1 shows the process).

Then students have to create their own representations, both visual and conceptual, by building a concept map.

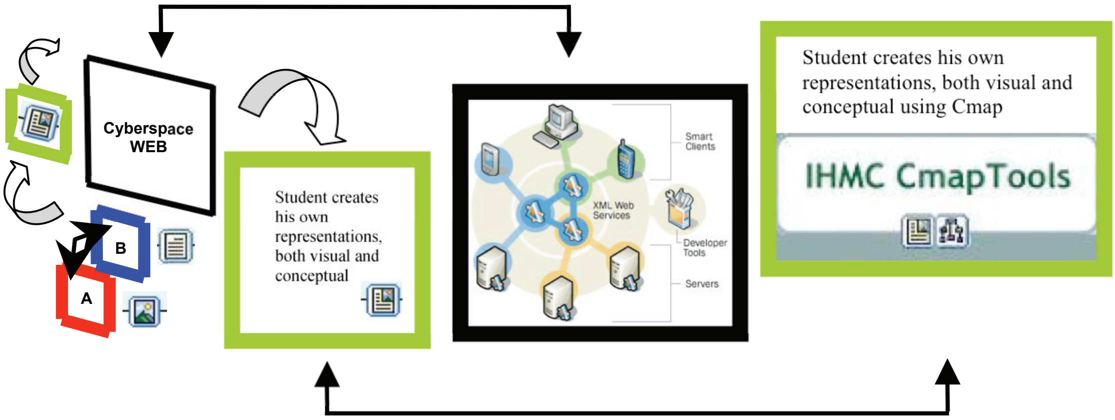


Figure 2. Kronos, the process for a system of multiple representations

The intention is to develop a cognitive instrument based on a computer program in which visual and concept processing is promoted, to traduce concepts into illustrations and illustrations into CmapTools in an interactive manner, either by browsing the Internet or by communicating with other students.

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BUILDING CONCEPTS AND CONCEPT MAPS

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Abstract. A group of teachers decided to create an Interdisciplinary Working Group stimulated by the students' curiosity and love for new experimentations. Their idea was that the student must be the actor of his/her personal learning process. It is a problem solving project that includes three steps: investigation, invention and discovery. Considering the childrens'inquiries on orienting and compass and their poor knowledge of these topics, teachers decided to study magnetism through experiments suitable for 9-10 years old students. Such a process gives the children an opportunity to make hypothesis, set up experimentations and verify them. Furthermore, they focus on basic concepts of this scientific topic and acquire its specific language. Assessment is of particular interest and importance for the implementation of this Interdisciplinary Working Group: it is continuous during experimentations, when doubts and questions arise, with continuous feedback among students and teacher, while students undergo evaluation tests at the end of the project. Thanks to concept maps and group learning, each student can follow his/her peculiar characteristics, has the opportunity to show acquired knowledge, and also explain the learned topics, thus highlighting his/her mental processes.

1 Overview

Teaching experience starts from the very beginning of the project: teachers of the scientific area (including mathematics, science, geography, physical education and information sciences) create an Interdisciplinary Working Group (IWG) for students attending the 5th grade primary school (10 years old). The IWG follows the guidelines given by the Members of the Teaching Panel of the School District they belong to.

2 Our experiences: learning process implementation – experimentation through investigation, invention and discovery

2.1 Experience magnetism: from Geography to Science

During orientation lessons the students asked: "How do we build a compass"? The experiment begins following the instructions of the science book used in the classroom and the story told by a student who saw a similar experiment on TV:

MATERIAL: a small basin with water, a cork stopper, adhesive tape, <u>*needle*</u>
After the failure of the experiment because of a needle that was not magnetized, students are induced to consider the meaning of the word <u>*magnetic*</u> and during the discussion we understand what is their knowledge of the <u>*magnet*</u>; starting from the question/hint *:''what are the strange forces of magnet ?"*students begin to study thoroughly this topic.

2.1.1 Experience magnetic attraction: "what is attracted to magnets?"

Let's try to bring close to a magnet a few different items and record the results.

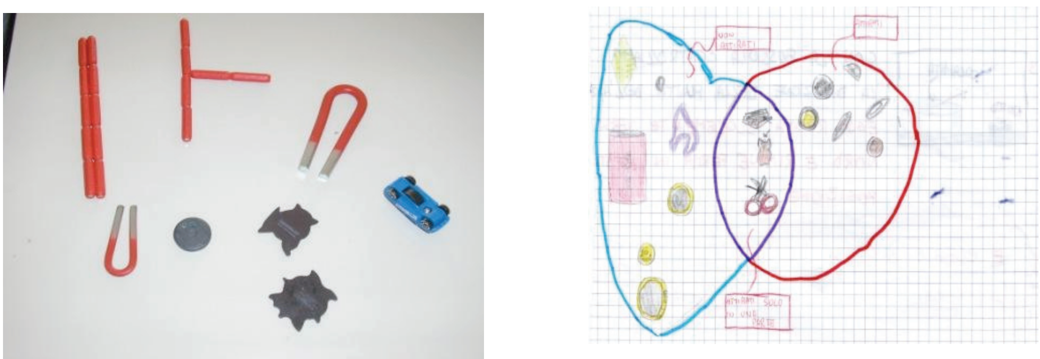


Figure 1. This picture shows different kind of magnets brought to school by students. With these magnets they tried to attract different items and then showed the results of the experiment through a Venn diagram.

2.1.2 Identify induced magnetism:“ Can an iron item become magnetic?”

After their investigations the students verify that iron can be magnetized by rubbing it or through contact, thus becoming a magnet itself. At this step of the experiment we introduce the specific term for this phenomenon: *induced magnetism*.

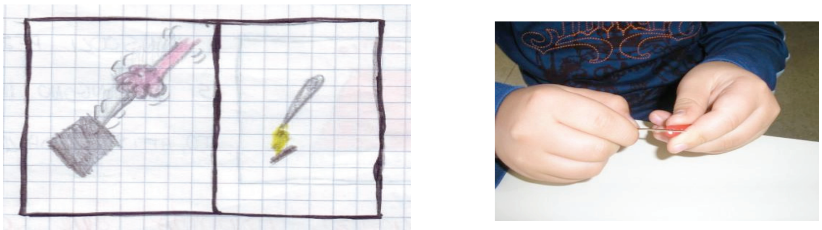


Figure 2. Students run the experiment and record it on their notebook.

2.1.3 History of magnetism

In order to learn more on this topic, the teacher together with the students starts this study from an easy text, records comments on the blackboard, creates a summary map of concepts following these main steps:

- reading comprehension;
- identify key concepts in each paragraph
- list key concepts paying attention to their order (write on the blackboard)
- find the most suitable linking words: the structure of the map appears once concepts are connected
- look for other possible connections among concepts
- students read the map, all the students must recognize their contribution
- log in the notebook and study.

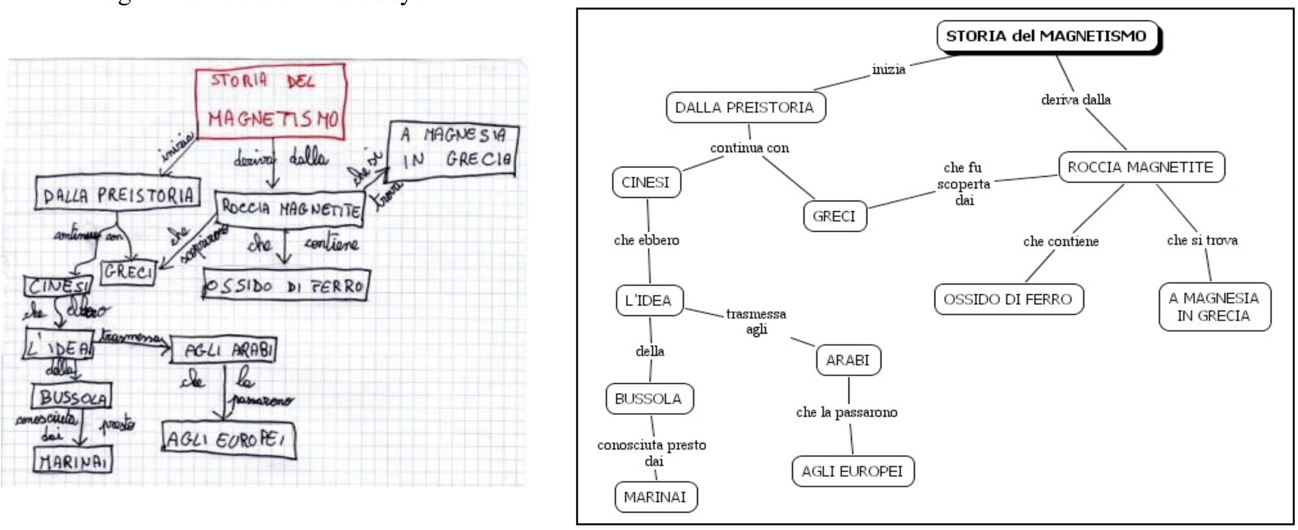


Figure 3. Building a summary map of concepts

2.2 Assessment

As described in the preliminary phase of the science IWG, the assessment is made on an experiment. Students will group in two and create a compass inducing magnetism, a new concept for them:

- magnetize the needle by rubbing it;
- fix the magnetized needle to the cork stopper;
- place the compass in a small basin with water, no matter what the position of the needle is, **we can see that the compass points towards north and comes to a rest.**

Figure 4. Building a rudimentary compass

All compasses are placed in water to verify if they work. Children are surprised because the compasses move in a row and are attracted one to the other!

Figure 5. Here are 10 compasses!

3 Concept Map: a tool to organize new concepts

The study of the geography IWG led to the learning experience described above. Concept map was used in order to bring to light new assumptions and above all to understand mental processes caused by the experiment itself.

First of all, the teacher starts brainstorming the whole class on key concepts as orientation and magnetism and continues by introducing scientific concepts, such as “interaction” and “system”. Students learned these concepts in the previous years following the guidelines of the “The words of science” project. Concepts are written on the backboard at random, all students participate, repetitions are not accepted, links among concepts are highlighted, science and geography concepts are on the same plan, they are: Earth, Force, Magnetic Field, Lines of force, Iron Oxide, Magnetic poles, Cardinal points, Intermediate, Magnetite, Induced magnetism, Magnetized needle, Chinese/Arabs/Europeans/Greeks, Objects, Orientation, Sun position;
CONCEPTS FROM “THE WORDS OF SCIENCE”: Interaction– System

Students are grouped in two, following the guidelines of cooperative learning: each student is responsible for part of the concepts, has to decide where on the map to write a concept and the words to link, sharing and verifying his/her logical choice with his/her classmate. The group/class is divided in nine pairs and one group in three (which includes a disabled student and two girls with learning problems, working with the help of the special education teacher). Each station will receive a sheet of paper with these instructions:

- elaborate a concept map summarizing knowledge and acquired concepts on *compass*, using all concepts on the board and adding new ones;
- elaborate a concept map summarizing knowledge and acquired concepts on *magnetism*, using all concepts on the board and adding new ones.

Students will be seated one in front of the other, will be given a pencil, an A3 sheet and can use their own notebook. When they are sure that their map is finished, it can be copied by both students. This step of the process lasts a few hours, not always in the same day. The teacher acts as a facilitator in case of different opinions between the students, but his/her role is crucial when one of the students does not participate and all the work is done by the other member of the group. Furthermore, the teacher reads the map with each couple so that students “may listen” if “it works”, thus stimulating changes and verifying that all concepts have been included. When the map is finished the students choose the colour of the concepts that are grouped in themes; arrows and linking words will be written in black to be more clear.

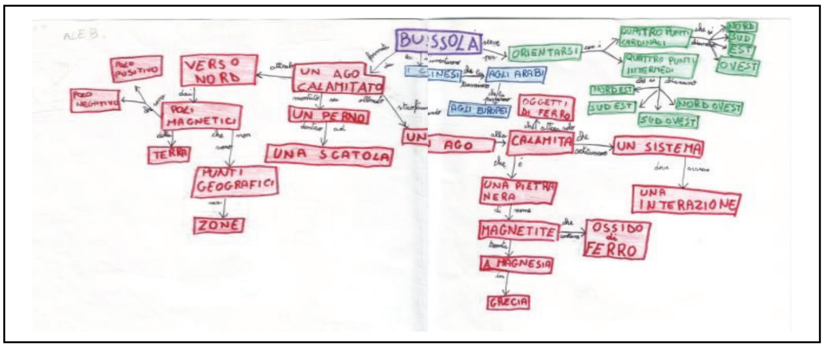
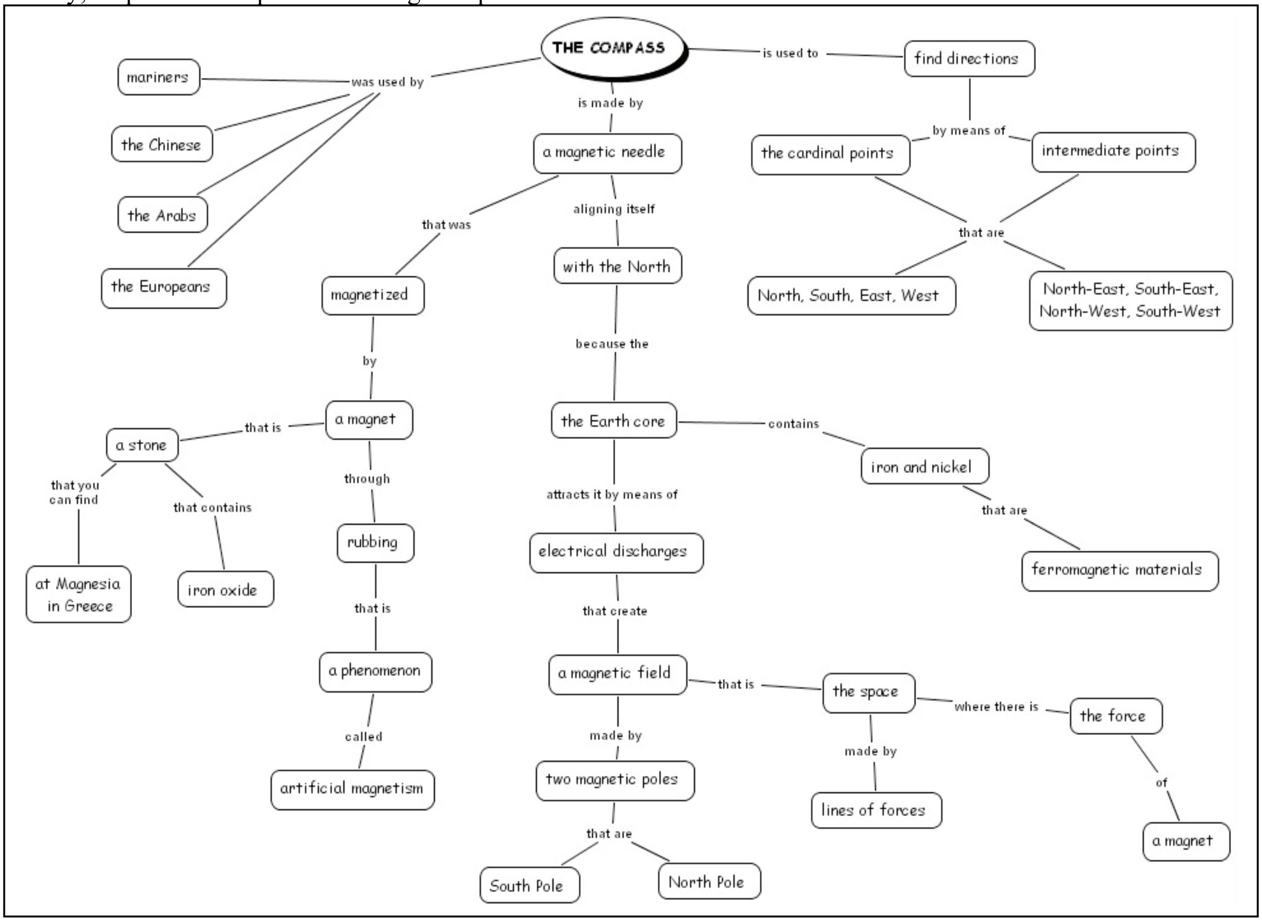


Figure 6. Example of a coloured map realized by a couple of students.

Finally, maps will be reproduced using CmapTools:



The final explanation and discussion take place at the end of the process. Each station presents its map. The students and the teacher discuss the importance of experimentation, research, study, debates and brainstorming in the process of learning and teaching. During this phase the specific language that till now was only used during experiments becomes the expression of everybody's thoughts. Every student applies the newly acquired abilities and skills, enriches his/her classmate, corrects his/her poor knowledge, strengthens his/her learning strategies.

The differences among the maps allow the teacher to understand if the project accomplished responds to the needs of the students and at what extent the process objectives have been met.

4 Summary.

For the first time, the teachers have carried out an interdisciplinary project based on problem solving, concept maps and cooperative learning. The project has been completed in different grades and the maps were introduced in 3rd grade classes (8 years old students). Thanks to “The words of science” students and teachers learned how to build a map in a different learning environment, above all acquiring a method of study (through text summaries, schemes, etc.) and a model of summary, at the end of an IWG in different areas (such as geometry, geography, etc... It was an enriching and stimulant interdisciplinary experience for students. They became the actors of their own learning process and, most of all, were aware of their knowledge made of concepts acquired in the past and of new ones (metacognitive awareness). The concept map shows the way each student progresses and gives everyone the opportunity to say something; it joins and links notions that are too often set apart in traditional school organization.

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CMAPS: AN USEFUL TOOL FOR IMPROVING A NATIONAL ENVIRONMENT MONITORING SYSTEM DESIGN

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Abstract. In this paper are presented the results obtained using concept maps, created with CmapTools software, in order to improve the design of a National Environment Monitoring System (NEMS). The initial design of the NEMS, described in a document called "Strategy" was mounted on conceptual maps and discussed with representatives from information-producing entities and target audiences (scientists, decision makers, stakeholders and public), before being presented to the competent authorities for its approval. Among the main lessons learned in this process are the following: concept maps facilitate to identify gaps in the programmatic documents; the possibility of visualize the whole NEMS within a PC screen and the use of colors for differentiation of concept-propositions categories and its hierarchy, facilitates the understanding of the proposal by producers and users; the apparent "schematic and informal" nature of concept maps promotes the exchange and elicitation of expert knowledge; CmapTools software is an appropriate tool for collecting, representing, preserving and sharing with wide public scientific knowledge.

1 Introduction

Decisions for the sustainable use of the environment should be based on high quality and opportune environmental information. The Environment Agency (EA) began working on the design of a National Environmental Monitoring System (NEMS) in 2006. The initial design of the NEMS was described in a document called "Strategy" and began the search of a way for representing the system that allowed the easy understanding for different actors. In 2007 the NEMS was represented as concept maps, using CmapTools (Cañas et al, 2004). The election was based on the possibilities of this software to represent visually a complex system (for the amount of integrating elements and for the diversity of Natural Sciences fields that they belong to), in a compact and relatively simple manner (Cañas, 2000; Coffey, et al., 2004; Novak and Cañas, 2006). Starting from this moment a process of consultations began with producers of environmental information and with diverse users (scientists, decision makers, stakeholders and public), before being presented to the competent authorities for its approval. The results of the employment of CmapTools and the main lessons learned are presented.

2 The Case

The design of the National Environmental Monitoring System (NEMS) was based on the ecosystem approach by means of which the environment is analyzed by components (land, water, biodiversity and atmosphere), like management units (water sheds and coastal zones), (UNEP, 2008).

The NEMS concept maps facilitated identification of information gaps in the programmatic document of the system, called "Strategy".

Every session for presentation of NEMS to the environment information producers and users became a knowledge elicitation process (Bowen, 2007), probably propitiated by the apparent "schematic and informal" nature of concept maps.

The structure and function of the NEMS are represented in the Figure 1. Three categories of concepts and propositions were included:

a) Structure (based on nodes);

b) Outstanding information (Strategy, Concept framework, Objectives);

c) Outputs (Operational products and Users).

The structure of the Complementary and Main Nodes is shown in Figure 2. The Monitoring Protocols for land, water, biodiversity and atmosphere are added to each concept map.

An important characteristic of the NEMS is that it is oriented to meet the user's needs. That is why the outputs of the system are organized by sectors and by territories (Figure 3).

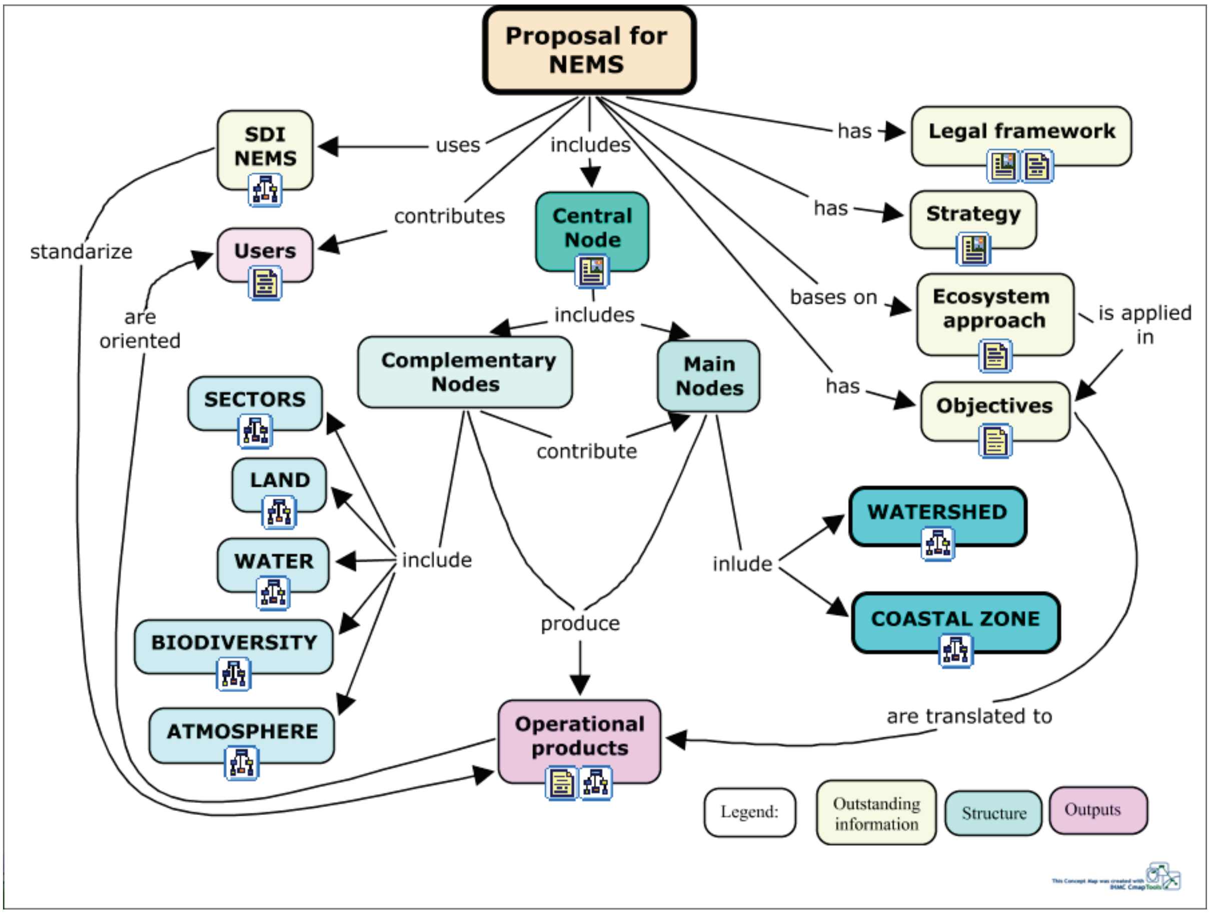

Figure 1. Structure and Function of the National Environment Monitoring System (NEMS) Legend: SDI: Spatial Data Infrastructure

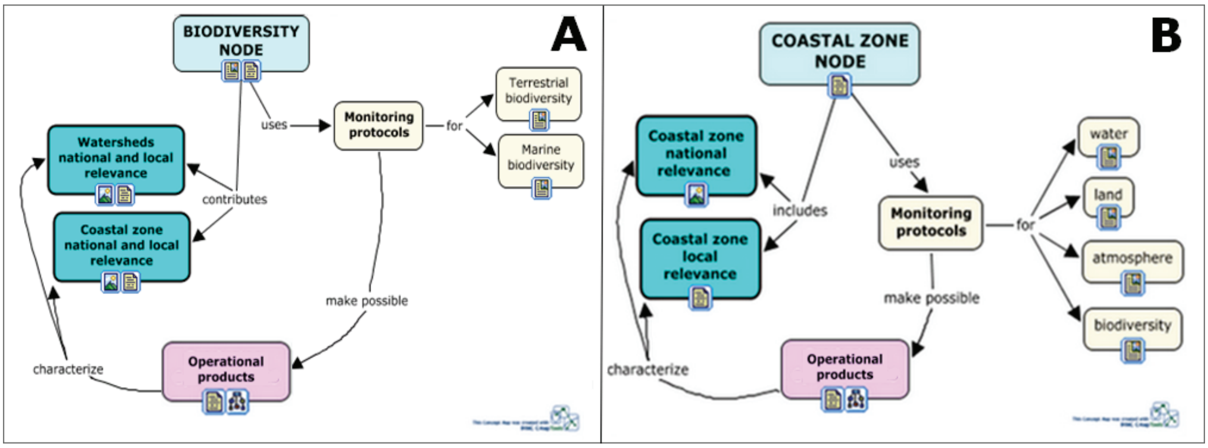

Figure 2. Structure and Function of the Complementary Nodes (A) and Main Nodes (B).

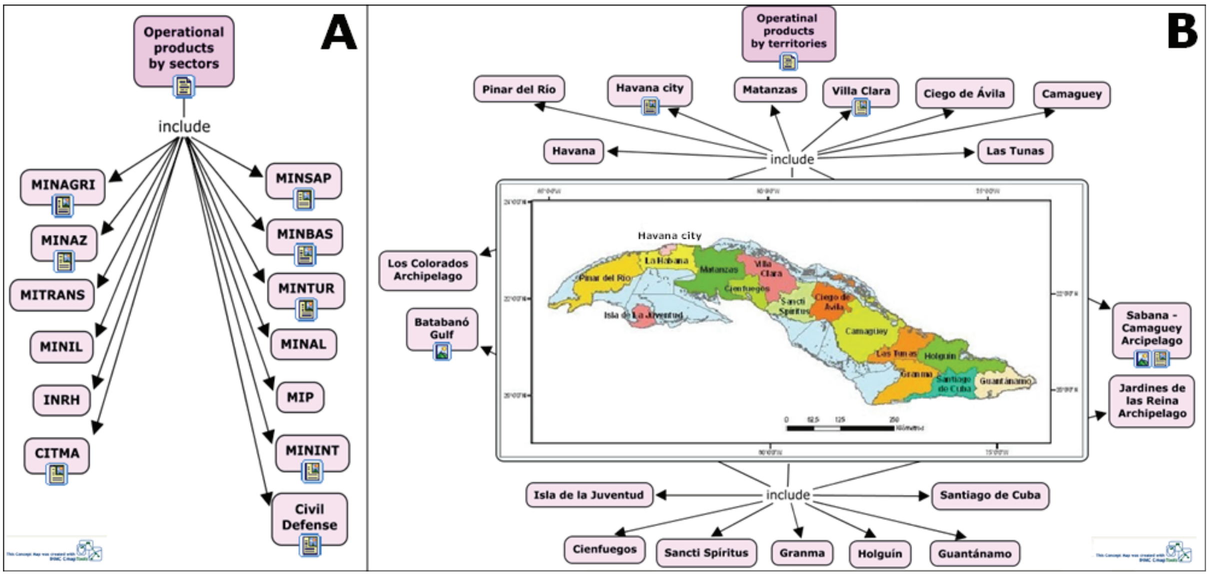

Figure 3. Output of the NEMS, by sectors (A) and by territories (B).

Legend: MINAGRI: Ministry of Agriculture; MINAZ: Ministry of Sugar Industry; MITRANS: Ministry of Transport; MINIL: Ministry of Light Industry; INRH: National Institute for Water Resources; CITMA: Ministry of Science, Technology and Environment; MINSAP: Ministry of Public Health; MINBAS: Ministry of Heavy Industry; MINTUR: Ministry of Tourism; MINAL: Ministry of Food Industry; MIP: Ministry of Fisheries; MININT: Ministry of the Interior

3 Lessons Learned from the Study

- There are some characteristics inherent to CmapTools software that facilitate the understanding of the monitoring system proposal by producers and users:
  - The possibility to visualize the whole NEMS within a PC screen, which facilitates understanding of inter-relationships among system components, the essential component for sound environmental systems assessment and planning
  - The use of colors for differentiation of concept-propositions categories and their importance.
  - The options to export and visualize the cmaps as web pages or images.
- Concept maps facilitate the identification of gaps in the programmatic documents.
- The apparent “schematic and informal” nature of concept maps promotes the exchange and elicitation of expert knowledge.
- Is not necessary to be previously familiar with the concept map theory to understand them.
- Although the web environment (html format) was used in most of the cases to present the obtained Cmaps to the actors of the system, in some cases it was necessary to insert the Cmaps images (jpg format) in more well-known Power Point presentations.
- CmapTools software is an excellent tool for collecting, representing, conserving and sharing with wide public scientific knowledge.

4 Summary

This paper presents the results obtained using concept maps, created with CmapTools software, in order to improve the design of a National Environment Monitoring System (NEMS). Concept maps facilitate the identification of gaps in the programmatic documents; the possibility of visualize the whole NEMS within a PC screen and the use of colors for differentiation of concept-propositions categories and its hierarchy, facilitates the understanding of the proposal by producers and users; the apparent "schematic and informal" nature of concept maps promotes the exchange and elicitation of expert knowledge; CmapTools software is an appropriate tool for collecting, representing, preserving and sharing with wide public scientific knowledge.

5 Acknowledgements

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COLLABORATIVE LEARNING AND CONCEPT MAPS, IMPLICATIONS FOR DEVELOPMENTAL DYSLEXIC LEARNERS

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Abstract. Learning difficulties concept is frequently used in Venezuelan educational levels to describe a wide variety of characteristics that could obey to student individual differences. Undiagnosed bright dyslexic students stay behind in various levels of educational system. They pass unattended, tagged as lazy or dumb, without the special care that defines this group of students, and never arrive to Special Education attention. Qualitative research goal is to understand the singular characteristics of the psycho - educational and family factors that contributed to the successful evolution of one developmental dyslexic case; establish patterns in 8 similar cases; design and implement educational intervention that benefits a group of dyslexics in an integrated classroom. Literature revision is centered in dyslexia, its etiology, diagnosis, process and educational strategies of attention. Results show the reconstruction of protective and risk psycho – educational and family factors that lead to success and school intervention characteristics. The results show that instruction centered in cooperative and collaborative learning enhance social skills; concept mapping oriented towards expansion of semantic networks, definition of relationship between concepts and hierarchic construction, challenge knowledge, contribute to enhance vocabulary and word retrieval and allow expression of complex ideas. These are desirable skills for dyslexics, who benefit from educational intervention, as well as non dyslexic.

1 Introduction

This article shows particular trend in learning for people with dyslexia -a specific learning disability that impair many students to express their thoughts by writing and acquire knowledge by reading- and develops how concept mapping and collaborative learning build strengths in their learning process.

Constructing semantic networks that contribute to build paths to word retention and word retrieval that are prominent weaknesses in dyslexia; understanding and promoting valid and logical relationships between semantic webs and promoting social skills where dyslexic use their strengths to enhance these networks, concept maps and collaborative learning are the best ways to learn. If learning for the dyslexic is a process of enhancing academic skills that may be deteriorated by written or reading expression, a graphic way to express new ideas centered in logic organization –one of many strengths in dyslexia- should be an adequate way to communicate learning experiences, and according to the functions of concept maps, a way to learn. If concept maps are effective tools to build semantic networks in a logical way, and logic and social skills are strengths in dyslexics, a program based in concept mapping and collaborative learning should optimize learning outcomes. Dyslexic skills can be strengthened by concept mapping, especially for the reason of promoting hierarchic relations through meaningful connections. Associated with this tool, concept mapping allows dyslexic extraordinary ability of parallel thinking to flourish and contribute to express their outcomes in collaboration without relying in writing expression.

2 The Research

Currently Venezuelan children with notable differences in their learning processes coexist in the classrooms, sharing the same routines, programs and curricular activities, treated with a degree of uniformity, disregarding their differences. Teaching experience points to the idea that bright students, able to get the best academic results, share the same system of those diagnosed with dyslexia, learning disabilities, or both, and apply patterns that could be effective for some and deepen differences in others. Thus, there is concern on alternatives that protect and empower those whose cognitive strengths do not focus on traditional developed and evaluated skills in school. Hence stems the study of new educational approaches that focus on the concept of intelligence as multiple potentials, develop differential strengths and not only those who excel in Language and Mathematic areas.

The first experience was the search of alternative explanation to understand the development of a case diagnosed with visual and auditory dyslexia at 8 years old, who grows to have a Master degree in Mathematics with control of two languages at the age of 24, (Acedo, 2004) Elements that allowed resiliency formation - human beings capacity to transform their risk factors in protective factors for development- (Maddaleno, 2000, Krauskopf, 2003) are pointed out and verified in 8 similar cases. Once this process is described, regarding its main characteristic, a series of actions that lead to learning are designed based on teaching strategies that could benefit both, students with similar problems as those who show no evidence of problems or whose results are outstanding. Strategies are explored for the purposes of establishing their relevance to produce specific learning outcomes in classroom context, under a scheme of action research, in a group of last year of Diversified Medium Education level, in a subject matter specially designed for the purpose of filling the cultural references and educational cognitive needs detected in students who begin their university studies.

Educational intervention takes place with an instructional design that incorporates the factors that made up resilience in the case studied, especially cooperative learning, collaborative learning and concept mapping. This design is implemented in a private integrated classroom with two dyslexic students and four undiagnosed, but suspected to be dyslexic. The number of students is 17, ages 16 to 18.

Goals of the study were:

- Identify areas favoring successful development of a case diagnosed with developmental dyslexia related to resiliency.
- Design a set of teaching strategies that promote resilience formation in students with learning difficulties and to implement them in a school group with integrated classrooms.
- Explore teaching strategies that promote learning as a way to be resilient and determine benefits in students with and without learning difficulties.
- Proposing a line of beneficial teaching strategies for students with learning disabilities.

3 Discussion

Dyslexia needs special instruction, due to the difficulty not only in reading or writing, but understanding. Instruction should be individual an adequate to learning styles (Pujol, 2003; Alonso, Gallegos & Honey, 1997). When inquiring about learning styles in successful dyslexics with the same diagnosis and treatment as the first case studied, they become compensated which is coincident, in time, with expertise in learning. This indicates that there is plasticity in dyslexia, toward the learning process. Therefore the condition might be changing the way to learn, due to instruction. In fact, if there was no special instruction in these successful dyslexic students, and they were able to compensate their way of learning in order to achieve this success, then, teaching should promote this compensation through proper instruction.

Social skills are key in dyslexics and were commonly found in the cases studied. Shaywitz (2003) has described dyslexics as sensible children that understand many sides of the same problem. They are capable of being empathic with others points of view, regardless the complexity of the position. This is a suggestion of parallel and complex thinking in spite of their poor reading, writing and comprehension skills, which constitutes a paradox in the sense that how can somebody have comprehension difficulties and, at the same time being able to understand complex situations and being able to mediate between them? This paradox is their way of thinking. Competent dyslexic have this in common: once they find the path to understanding, they are capable of exceeding what is expected with knowledge. Therefore teaching is about helping to bridge, finding pathways, building scaffolding useful to link concepts, actions, procedures, principles. Since there is very limited appropriation of the reading process and, at the same time, limited comprehension, especially oral interpretation is needed. If they explain, they will learn. Instead, if they have to read o write, failure appears.

As previously stated, the main difficulty in dyslexia is communication. A dyslexic person has tremendous difficulties retrieving adequate vocabulary for expressing ideas, extracting meaning from reading, producing writing to express ideas and, finally, due to this difficulty with words, comprehension. Therefore instruction should promote these trends to facilitate communication. Communication process, especially of academic matters should not be isolated from social skills, where dyslexics are strong. These social skills are beneficiary for communication and dyslexics have much strength related to them, such as being able to understand many sides of the same problem, when properly oriented. In addition, dyslexics can easily understand modeling and how simple procedures can be applied in many situations. Concept mapping is an excellent tool to build these modeling not only because it enhances vocabulary in semantic networks, but also they force the student to build a definition of the tasks that represent linking between concepts.

Concept mapping in dyslexic students contribute to motivation to learn and challenge to create relations between concepts. Due to word recognition and retrieval difficulty, since concept mapping is oriented to symbols more than words, they benefits dyslexics: Organizing information in a logic and hierarch way are characteristics of concept maps and strengths in dyslexia. Concept mapping will rely then in dyslexic strengths. Even though other graphics such as Venn Diagrams, cause effect diagrams, and others, are useful tools, the student is not asked to think of the nature of the relationships established between concepts. Just and in a simple way, students are asked to place information in one side of the graphic or the other. The problem with this instruction is that it does not produce the expected learning when there is no analysis of the nature of the associations. In a way, concept mapping forces the student to analyze the nature of relations and when they do, learning outcomes are richer and more accurate.

When expressing ideas, substituting reading with sharing symbols that can obey to the meaning of a given word, phrases or more complex sentences, typical in concept mapping, learning can be expressed and understood by others if they had negotiated these meanings. Thus, not only communication process is promoted, but communication for dyslexics. In this sense, diagnosis of previous knowledge, following construction of new knowledge and being able to formative assessment of students work is an outcome when using concept maps. For the most impaired, substituting writing with graphic organizers, especially concept maps, and oral communication is the best way for diagnosis and evaluation of their knowledge and school progress not taking in account their limitations or disabilities. This process can even substitute writing process for the most impaired and help these students, who are bright and socially able, to live a full productive life, to cope with school requirements without reading and writing skills and finally to express their exquisite thinking.. The power of making links or connecting concepts by mental processes that describe high thinking tasks, implies that the dyslexics and non dyslexics have a common ground where to express their construction of knowledge allowing these students to share meaning in a cooperative way in which non dyslexics benefit from dyslexic way of processing and producing knowledge, while dyslexics benefit from writing and reading skills of non dyslexic.

Online technologies such as *CmapTools* and other commercial firms that promote this hierarchic organization of new knowledge are adequate tools since they allow sharing meaning in learning environments. However, these tools need to increase their potential to organize features when building connections, guaranteeing that linking conditions are understood by all. For example, using maps to elaborate inclusions, cause effect, and other relations that can be explained by themselves, such as analyze, meaning dividing the whole in pats according to a criteria, may be explained and extend in depth in different levels but always the same procedure. Students should be able to point out the principle to analyze whereas the process by itself would be pointless without the proper specification of the limits of the higher thinking process that involves the task.

4 Conclusions.

Describing successful learning processes in dyslexia – first one case, verifying findings in 8 other subjects- followed by an active research to explore teaching strategies focused on generating resilience in a group of students; show that intervention was beneficial for both, students with learning disabilities and those who have never shown to have this kind of problems. This qualitative analysis is complemented with summative assessment analysis. Thus, in all evaluations applied, there was an increase in averages, while maintaining dispersion, compared to scores averages obtained prior to implementation. This evidence show that treatment is beneficial for both, more advanced and less advantaged students, since the extremes improved their grades in the same intensity. .

When analyzing retrospective learning process, dyslexic characteristics change over time. These changes are coincident with the maturation of learning processes. In fact, learning styles become compensated at the same time higher level thinking skills appear, such as autonomous learning, creative thinking or decision taking takes place. This could be evidence of plasticity of the dyslexic learning condition when is affected by learning process, meaning it changes and is moldable when learning occurs. In this sense, concept maps are a way of monitoring and diagnosing faults in this process, and allow meta-cognitive activity that allows to determine ways to control and improve cognition. Additionally, when teaching strategies focused on control of risk factors, they became protective factors, and when applied to the extensive group of students, they become desirable thinking skills. In fact, one of the outstanding achievements is that strategies oriented to holistic and non linear thinking are beneficial, both for regular students and those with difficulties.

It was also revealed the ability of students with dyslexia to provide creative solutions to problems. These outcomes became one of dyslexic most prominent advantages when cooperative and collaborative learning was assessed. To accomplish this, it was necessary to introduce principles of systematic critical and reflective thinking to ensure their autonomy. It is hoped, in the long term, that regular student apply the strategies that help dyslexic cognitive processing, since they increased their autonomy in critical and reflexive thinking, and contributed to recover their interest for certain academic subjects. Non dyslexic students, when understood dyslexic way of processing and producing information, due to the use of concept maps as mean of communicating knowledge and meaning, changed their mental model based on reproductive and convergent learning, to be active participants in construction of knowledge. They replaced their reproductive practice for a productive learning community; differentiate essential content and associate it with new content to become strategic apprentices.

Finally, and as a primary purpose of the investigation, it is hoped that, through a deliberate pedagogical action that include collaborative learning and concept mapping, students with learning disabilities, specifically dyslexia, transform their risk factors into protectors, in regard to their learning abilities. This approach allows to confirm the assertions of Eden and Lyon exposed as findings in the context of VI International Dyslexia Conference, organized by the British Dyslexia Association (BDA) that what is good for dyslexia is, is good for all students. Furthermore, any diagnosis or intervention in dyslexia must be preceded by an adequate educational practice.

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COMBINED USE OF CONCEPT MAPS AND DATABASE AS MIND TOOLS TO HELP INTERDISCIPLINARY TEAMS TO SOLVE REAL CASES BASED ON THE THEORY OF COGNITIVE FLEXIBILITY. EXPERIMENTAL STUDY

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Technologies modify the way to face the challenges of learning by widening our biological capacities. This use of technologies as mindtools, cognitive reinforcers, activators of psychological functions, can determine the turning point to consider its unavoidable incorporation into interdisciplinary working processes, problem resolutions and shared building of knowledge. Training of experts to face real cases compels to reach competences such as learning to learn; learning environments must not only make transformative learning processes easier, but also facilitate learning in cooperation and cognitive flexibility to analyze the cases from different points of view. The use of information and communication technologies and specifically mind tools such as concept maps and database, can help to the achievement of expert learning. The investigation made with a sample of 63 students and speech therapists, psychology and pedagogy professionals is presented. They have to solve 11 real cases of children and non vocal adults that use communication augmentative in the cooperative work with computer resources. One of the groups handles the traditional protocols and the other concept maps and database. The novel groups of students learn the same way by using either protocols or database. Nevertheless expert students and professional improve their performance when their learning is managed by concept maps and database.

1 Introduction

Knowledge construction is an individual act, but, at the same time, it is a complex process that can be fostered by external tools. Technology can nowadays provide the teacher, the student and the learning context with certain resources and tools hat somehow disburden both the teacher and the students´ minds allowing them to undertake complex problem resolution that are frequently incorrectly structured, at last from an optimized point of view. As pointed out by Adell (2004): "The use of technology by itself does not improve teaching and learning. A good teacher is so with or without technology. However, when using the right technology, a teacher is much better indeed". Hence, it is tempting to extend this rationale to the student and the teaching context as well: that is, a good student (a good context) becomes much better in the presence of the appropriate technology. Most of the real problems faced by teaching professionals require a certain control over the apprenticeship itself, in order to take decisions, reflex, plan, evaluate resources and elaborate a new product. In this regard, many authors point towards the use of semantic networks in complex teaching processes as a simple tool in order to face the real problems from various points of view and then develop collaborative activities.

2 Cognitive Flexibility Theory

Cognitive flexibility theory (Feltovich, Spiro y Coulson, 1989; Lima, Spiro y Koehler, 2004) presents learning as the skill to represent human knowledge, insufficiently structured, from various perspectives. This multidimensional way of learning is considered the most adequate to move around the diffuse knowledge domains, in which the solutions to problem are not clearly delimitated, hence demanding the apprentice to face the problem considering various options and possibilities.

"By cognitive flexibility, we mean the ability to spontaneously restructure one's knowledge in adaptive response to radically changing situational demands. This is a function of both the way knowledge is represented and the processes that operate on those mental representations" (Spiro y Jehng, 1990: 165).

Most of the knowledge domains encountered by both teaching professionals and higher students possess significant degrees of complexity. This learning model affirms that the cases and problems of the world are unique and multidimensional, enclosing several aspects, hence requiring from the apprentice the adoption of a large variety of perspectives (Shapiro y Niederhauser, 2004). These fields of knowledge, which are ill-structured can be better undertaken from the simultaneous use of TIC, since because of its non-lineal access system and treatment of information, because of its hypertextual composition, facilitate the achievement of metacapacities of flexible thinking.

3 Mindtools

These tools are based upon the theoretical fundaments of cognitivism and constructivism. Part of the attraction exerted by conceptual networks lays on the similarities found by many authors with the performance of human mind or various forms of artificial intelligence, or even similarities with the hypertextual structure of the network of networks (Nó, 2004; Tiffin y Rajasinghan, 1975). There are numerous tools in the Internet (semantic networking tools) that allow the generation of semantic networks in a simple way, and they even facilitate ways of navigation due to the inclusion of links to additional webpages or networks, and tools that permit the generation of network frameworks, communicate and share the generated products, etc. In the same way, a database allows the apprentice to organize the information according to various criteria, establish comparisons, analyse phenomena and make decisions. It must be built by the apprentice himself, preferentially in a cooperative working environment, since they guarantee the assumption of various perspectives in order to create the criteria. Several authors involved in the use of semantic networks and databases in learning processes (Jonassen, 2004; Jonassen, Howland, Moore y Marra, 2003) indicate that they are indeed some of the simplest mind tools and with a wider and popular use.

4 Experimental design

The aim of the present study is the examination of the development of critical thinking aptitudes, to learn how to learn and to learn how to teach, always applying these emerging capacities to contents positioned in the ill-defined borders of knowledge, generating pa learning environment capable of undertaking ill-structured problems, following working methodologies of cooperative work within a format of case solving format. This group of personal competences, grouped under the name "expert knowledge", would allow the student to supply innovative solutions during the resolution of problem cases. With that in mind, two comparison groups were established: "G1-mindtools" and "G2-matrices" in which young alumni worked with expert alumni and teachers in a collaborative way. The first group G1 used mindtools with a backup of databases and concept maps (figure 1) whereas group G2 used traditional instruments based on protocols.

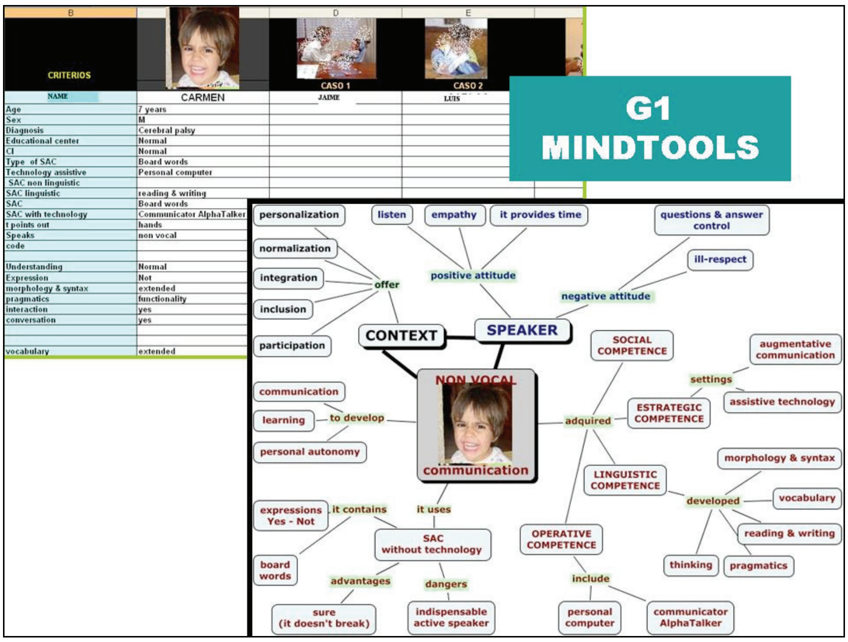

Figure 1: Mindtools: concept maps and database.

All of them were analysed and they solved 11 cases of kids, youngsters and adults with Brain Paralysis and non-vocals that tried to introduce improvements in their Augmentative Communication systems. These cases had been selected by a group of 15 experts, professionals that had been over 8 years working on the evaluation and intervention with Augmentative Communication users. These experts established the learning level to be reached by means of a questionnaire applied to study cases A and B in which 20 questions of low complexity and 20 questions of high complexity were proposed. The degree of approach to expert knowledge defined by these experts would be the criteria to be used in order to evaluate the learning degree of the students.

With the aim of assuring the control and internal validity of the experiment both groups and subgroups were positioned in a same spatial and temporal context, hence guaranteeing the equivalence of both groups during the experiment. A special car was taken on the fact that both groups would receive the treatments at the same time. In order to assure that the treatment times were identical in both cases the various phases were marked by means of the projection in a big screen of the videos corresponding to the 11 practical cases, with independence of the fact that each group might or might not want to go over them during their cooperative working. Two computers connected to the Internet were provided to each group, one intended for the visioning of the cases and for the analysis of the clinical histories and the other to develop the different proposals by means of the two types of instruments previously described. During the phase of design, special care was taken so that the working visual environment would mimic the system followed by the professionals that have to appraise and decide over the various cases presented. With that in mind, 11 cases of kids, youngsters and non vocal adults who were using Assisted Communication Systems were presented, complementing the environment with clinical history data, real videos, comments from teachers, parents, evaluators or people from the surroundings, with the main intention of focalizing information, improve reflection, motivation and active style. The first (A) and last (B) of these cases were taken as reference in order to obtain data regarding the learning level in three different moments (figure 2)

- Situation previous to the applying the learning programme, after analysing the first practical case A: Observation PreA.
- Situation posterior to applying the learning programme, after analysis of case B. Observation PostB.
- Situation posterior to applying the learning programme in which practical case A is again calculated. Observation PostA.

G1-mindtools	**Noveles** **Medios** **Avanzados**	**O1** **Observation PreA**	**X11** **Programa flexible**	**O2** **Observation PostB**	**O3** **Observation PostA**
G2-matrices	**Noveles** **Medios** **Avanzados**	**O4** **Observation PreA**	**X12** **Programa rígido**	**O5** **Observation PostB**	**O6** **Observation PostA**

Figura 2: Rationale of the proposed research.

5 Analysis of the results

As shown in figure 3 there are differences in the progression towards expert knowledge which favour the alumni that used mindtools, specially when the results obtained from the most advanced subgroup are compared.

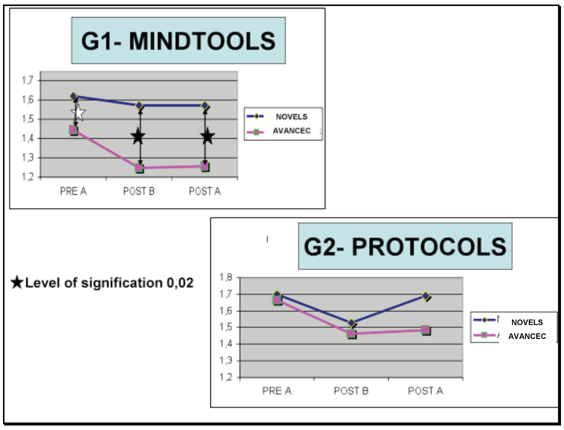

Figure 3: Progression towards expert knowledge (0 score) of both inexperienced and advanced students.

No significant differences were found in the resolution of low-complexity between G1 groups (using flexible tools) and group G2 (using rigid tools). Low complexity tasks were solved with efficiency both by group G1 participants, with flexible tools, and by group G2. Nevertheless, the protocols are not adequate in order to work with high complexity knowledge (figure 4). The use of rigid tools matches immediate responses and time. Knowledge simplification diminishes the personal attitude to solve insufficiently structured problems, hence diminishing the search for alternative solutions as well.

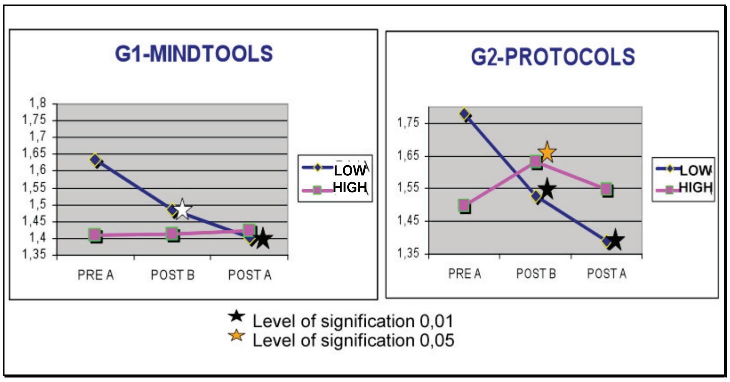

Figure 4: Comparison of G1 and G2 groups low and high complexity contents.

6 Conclusions

The aim of this study is the construction of knowledge through ill-structured problems, by means of Information and Communication Technologies (TIC) use.

The research hypothesis exposes the comparison of two learning/teaching environments based on TIC and applied in a university context in order to provide solutions to real clinical cases. The so-called "decision-making protocols or matrices" environment uses a more rigid, convergent and traditional approach. On the other hand, the so-called "mindtools" environment follows the contributions of the knowledge flexibility theory, allowing the use of databases and conceptual networks hence providing an improved flexibility and facilitating the multi disciplinary approach. The experiment was performed with 63 psycopedagogy, mastery and logopedy students with a varied previous formation (inexperienced, middle and advance) who agreed to participate in an intensive course of evaluation and counselling of kids, youngsters and non-vocal adults using Augmentative Communication Systems.

The conclusions of this study demonstrate that the traditional rigid environments only allow the inexperienced students to progress whereas the more flexible environments improve the learning skills of inexperienced, middle and advanced students. In the same regard, it is shown herein that the more complex and diffuse knowledge require flexible tools. Advanced students, with an initial knowledge that more closely resembles that of professionals, require flexible environments in order to face insufficiently structured, high complexity problems.

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COMPARISON OF LEARNING WITH CONCEPT MAPS AND CLASSICAL METHODS AMONG MEDICAL STUDENTS

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Abstract. Education in medical faculties is generally long and tiresome compared to other faculties. The aim of this study is to compare learning with concept maps and classical methods among medical students. For this reason, the successes of the fifth year medical students who are taught "Burn Management" in Plastic Surgery course either using classical methods (Group-A) or concept maps (Group-B) are analyzed. At the end of the Plastic Surgery course, the examination scores of Group-A and Group-B was 76.7 and 88.4, respectively. The difference between groups was statistically significant ($p < 0.05$). Using concept maps in learning may facilitate understanding and may help analytical and critical thinking. As a conclusion, we believe that concept maps should be widely used in medical education, in order to promote meaningful learning.

1 Introduction

The goal of medical education is to prepare physicians who are ready to serve the fundamental purposes of medicine (Anderson, M. B., 1998). Medical sciences must always be responsive to evolving needs of the society, practice patterns, and scientific developments (Anderson, M. B., 1998). During their training, medical students are faced to a large amount of continuously increasing knowledge. This makes medical education even more difficult for both teaching and learning. If medical education is to serve the goal of medicine, medical educators must develop learning objectives that reflect an understanding of those attributes.

Novak's and Gowin's work on the nature of knowledge and learning explored factors that influence students' understanding of science and the acquisition of concept meanings (Novak & Gowin, 1984). Thus concept mapping is used as a learning strategy to understand key concepts and relationships between concepts. If concept maps are used in medical education, meaningful learning of the students can be promoted (Hinck S. M, & Webb P. P., 2006).

2 Materials and Methods

A randomized controlled prospective study is designed at the Department of Plastic Reconstructive and Aesthetic Surgery of Medical Faculty of Dokuz Eylül University. Since 2002, Problem-Based Learning (PBL) and Objective Structured Clinical Examination (OSCE) are used and in our Medical Faculty. At the end of Plastic Surgery course, with OSCE system, clinical skills are tested rather than pure theoretical knowledge. Our medical students take Plastic Surgery courses at their fifth year for 2 weeks. According to this study, students are divided into 2 groups and learning with concept maps and classical methods are compared.

2.1 Design of the Study

One hundred twelve fifth year medical students are divided into 2 groups. In Group-A (n=56), classical method such as MS PowerPoint presentations based on texts is used in order to teach "Burn Management." In Group-B (n=56), concept mapping was the method of teaching.

2.2 Teaching Methods

2.2.1 Group-A

There were 56 fifth year medical students in this group. During their Plastic Surgery courses, "Burn Management" course was taught using MS PowerPoint presentation. Theoretical knowledge written as a text and patients' pictures were containing in the presentation. A sample of slides of this presentation is seen in Figure 1.

Figure 1. MS PowerPoint presentation used in Group-A

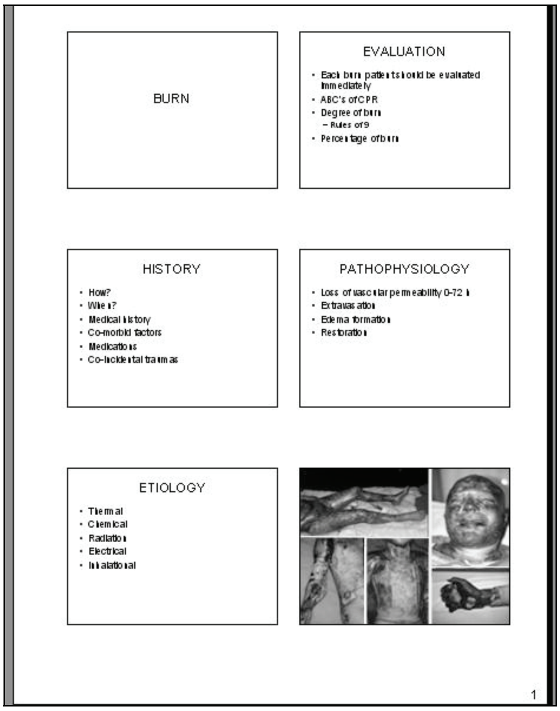

Figure 1. MS PowerPoint presentation used in Group-A

2.2.2 Group-B

There were 56 fifth year medical students in this group. Concept mapping is used in order to teach the approach to a burn patient. Web addresses of the concept maps are given to the students. Thus, they were able to check on their own the entire concept map including its links. The related concept map can be seen in Figure 2. Notice that each primary or secondary nodes of the concept map contains further links such as concept maps, pictures, documents, presentations, and/or web pages.

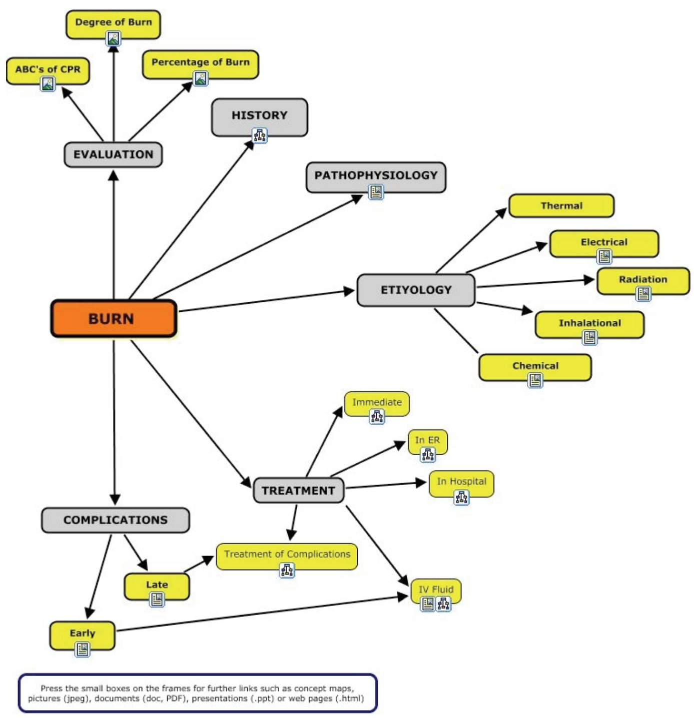

Figure 2. The concept map designed to teach the approach to a burn patient in Group-B

2.3 Evaluation

Each student was taken an Objective Structured Clinical Examination (OSCE) at the end of the Plastic Surgery course. OSCE consists of several short (4 minute) stations and each is examined on a one-to-one basis with real burn patients. In each station, students are assessed how they use their theoretical knowledge in the evaluation and treatment of burn patients. There was also a 20-question burn written exam. Students received 5 points for each correct answer. The top score was 100.

2.4 Statistical analysis

Each student score for both groups are calculated and analyzed statistically. Student *t* test is used in order to find out if there was a statistical significance. *P* values over 0.05 were taken as a significant.

3 Results

The mean score for the Group-A (classical method) was 76.7 (ranging from 58 to 86). When the scores of the students in Group-B (concept mapping) were analyzed, the mean value was 88.4 (ranging from 69 to 95). When the scores are analyzed with Student *t* test, a statistically significant difference was found ($p < 0.05$).

4 Discussion

Since Novak and Gowin introduced concept maps into literature, concept mapping gained widespread acceptance in education (Novak & Gowin, 1984). Construction of concept maps provides the opportunity for students to break new knowledge into small parts (concepts), arrange and order concepts to make sense, and make connections between and among concepts (Irvine, 1995; Novak, 1990). In these circumstances, using concept maps in medical education might be very helpful for both students and medical educators. Since medical education is very complicated, concept mapping may facilitate understanding and may improve analytical and critical thinking.

In this study, learning how to approach burn with concept maps provides students to realize the whole process. As the students get into more specific concepts, for example the etiologic factors of burn, they also get the chance of come back to the starting point. This helps students to realize the main braches of the topic as well as the details.

At the end of Plastic Surgery course, the students who were taught "Burn Management" with concept maps reported that this system was more understandable comparing to the classical system. Students indicated that the maps helped depth thinking and the connections of concepts. This is similar with other research on concept maps and it is a very encouraging finding that students notice the value of concept mapping in medical education. The students also reported that the maps facilitated pattern recognition and provided a greater understanding of differential diagnosis. This can be explained by how the maps functioned in linking theoretical information to clinical practice. The result of their exams also approves their feedbacks.

From a student's view, concept mapping encourages them to think independently, produces more self-confidence and provides an increased awareness of finding connections between different topics. Teachers reported that concept mapping assisted students to become active learners and organize theoretical knowledge in an integrative manner or conceptual framework (Boxtel et al. 2002; Harpaz et al. 2004).

When the whole medical education is considered, this might be relatively small study, however, we believe that concept mapping can be used in many areas of medical education. This method can also be used in practical courses of medical education as well as theoretical courses.

As concept mapping gets popularized, we believe that will have a wide acceptance among medical educators.

5 Summary

This is a study about the use of concept mapping in medical education. A controlled randomized study has been designed in order to compare classical teaching methods and teaching with concept maps. As a result, students

in concept mapping group received higher scores comparing to other group. The difference was statistically significant.

6 Acknowledgements

We thank Professor Dr. Mustafa Yilmaz who set up CmapServer at Dokuz Eylul University.

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CONCEPT MAP APPLIED TO THE DEVELOPMENT OF NURSING STUDENTS' CLINICAL JUDGMENT

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Abstract: The present study associates the construction of Concept Maps (CM) in the resolution of a clinical case, as an educational strategy for a Nursing undergraduate course. Objectives: To set guidelines for the construction of clinical cases for the development of the Nursing students clinical reasoning, with the construction of a CM; studying the criteria for the evaluation of this CM; to know the perceptions of the students about the development of the strategy. Methods: exploratory study on the experience of a qualitative educative intervention. Results: the data collected made evident the feasibility of such a strategy for the elaboration of the clinical case, as well as items to be considered in the evaluation of the CM. From the students' point of view, it brings stronger senses and meanings to the clinical process of decision-making. Conclusion: The CM is confirmed as a relevant strategy and as a way to integrate multidisciplinary contents involved in the teaching and learning processes of the healthcare area.

1 Introduction

The educational process is an issue that is increasingly occupying spaces within health sciences, and one of the objectives of Nursing undergraduate teaching is the development of critical and reflective professionals that are able to develop actions guided by clinical reasoning and an evidence-based practice (De Domenico & Ide, 2005).

The **Concept Map (CM)** is one of the teaching strategies aimed to enhance the construction of knowledge in a multilinear way, since it enables to understand how the student organizes the concepts from its cognitive structure, in a network of relationships with multilinear features, that is not restricted to Cartesian thinking (Struchiner, Vieira & Ricciardi, 1999).

In the process of building the clinical reasoning, the proposal is to provide to the student a clinical case, composed of a set of data regarding the patient clinical and psychosocial condition (medical diagnosis, signs and symptoms, exams results, the proposed treatments, in addition to Psychological, Social and Cultural data) so that the student can articulate and demonstrate the inter-relationship of the concepts, the process of selection of relevant data, the diagnoses that emerge from this analysis, as well as the clinical decision-making able to articulate different nursing demands and skills.

According to the above, a pilot study was developed in order to evaluate the appropriateness of a proposed clinical case according to its content and guidelines for correction, as well as obtaining the students views on the experience to solve that clinical case using the concept map (CM) strategy.

2 Objectives

- To improve the guidelines for the construction of clinical cases in order develop the Nursing student clinical reasoning, from the construction of a CM;
- To establish the criteria for the CM evaluation;
- To know the students perceptions regarding the development of this strategy.

3 Methods

3.1 Type of research

This is an exploratory study on the experience of an educational intervention, based upon a provisional plan consisting of four stages, as described in Section 3.5. The nature of the research was mostly qualitative.

3.2 Subjects and Place

Nursing undergraduate students regularly enrolled in the 3rd year and attending to the *Adults and Elderly Health Nursing* course at the Federal University of Sao Paulo, in the city of Sao Paulo, Brazil.

3.3 Data collection

3.3.1 Research Ethics Committee approval

This research project was approved by the Institutional Ethics Committee of the Federal University of Sao Paulo and data were collected through the participants signing a *Statement of Free and Informed Consent*.

3.3.2 Operational Steps

- *Phase 1 - Planning*: after reviewing the literature, preparation by the researchers of a representational diagram of the components of clinical reasoning for the solution of a case (Figure 1). Development of a case. Inclusion of the CM as an educational strategy of the referred Discipline.
- *Phase 2 - Action:* students were instructed to individually carry out a CM at the beginning of the Discipline and another at its end.
- *Phase 3 – Follow-up and Description:* development of a Focus Group at the end of the delivery of each CM
- *Phase 4 - Evaluation:* use of recorded and transcribed testimony of the students; correction of Conceptual Maps from the criteria set for its implementation. (obs: this approach was essentially quantitative, not described in this phase of the project)

The theoretical reference for qualitative analysis of the data was based upon the proposal of concept maps construction (Novak & Gowin, 1984) and the development of clinical reasoning permeating the idealization, planning and evaluation of this educational strategy, as summarized in Figure 1, which brings the components observed in the solution of a clinical case.

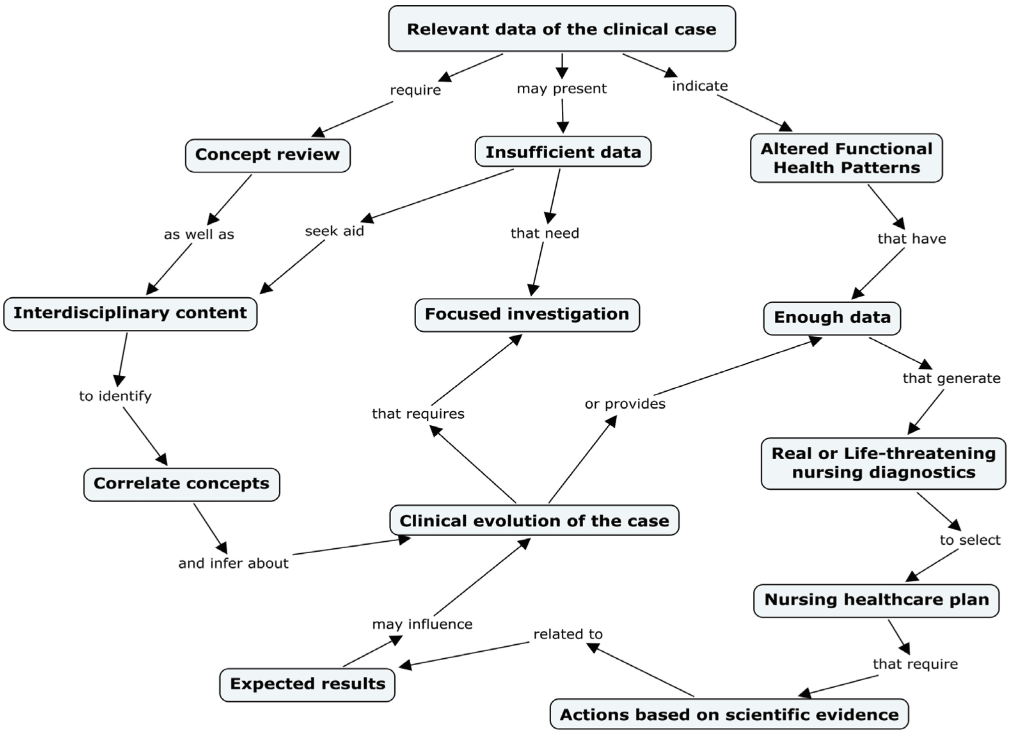

Figure 1. Representative diagram of the use of Concept Maps for the resolution of the clinical case. São Paulo, 2007.

3.3.3 Data Collection

Focus Group: the use of this technique aimed to the understanding of the students' educational experience in performing the activity of building the CM (Gomes, 2005). The guiding questions sought to encourage verbalization on different aspects of building the CM. Key question: ***Talk about your experience of building CM*** (points that helped the execution of the task; aspects that hindered it; assessment on the development of new knowledge, skills and attitudes; suggestions for improving the strategy).

4 Results and Discussion

Data were collected from March to June 2007 with 11 students who followed the steps outlined in the *3.3.2 Operational Steps* item. The analysis of the verbal testimonies and the qualitative comparison of the two concept maps developed by the participants generated the following results:

4.1 Case Study for CM: guidelines for preparation

The clinical case built by the researchers was presented to the participating students and during the stages of action, follow-up and description (item 3.3.2), the case contents have been assessed in relation to their ability to reproduce the components of clinical reasoning contained in Figure 1.

The analysis of the clinical case evidenced the suitability of its contents for the development of clinical reasoning. The guidelines to be improved are:

- Selection of a theme for the creation of a clinical case (Example: a pathological process, a social problem), and related data that are based upon the content taught in the discipline and the content previously shown in other disciplines of the curriculum matrix.
- Organization of data guided by the clinical relevance and the expected outcomes, identifying the total number of elements of each outcome in a consensus meeting with the teachers responsible for the implementation of the strategy (e.g.: 8 relevant clinical data are chosen and the presence of such data in the case is assessed).
- Selection of several contents, which, under the interdisciplinary perspective, aim to integrate psychosocial and spiritual data that need nursing actions in the care, education, research and management dimensions.
- Prior assessment of the students' knowledge degree on the operational and theoretical Nursing models to be used before the proposition of the strategy for preparing the case. Gordon's Functional Health Patterns (Carpenito-Moyet, 2005) and NANDA Taxonomy II of Nursing Diagnosis (NANDA, 2007) were chosen for this case.

4.2 Criteria for the Correction of CM

Criteria (Table 2) have been adapted from the main axis and objectives of the CM presented in the reviewed literature on that strategy, considering the Novak & Gowin (1984) proposal, and improved from data obtained with the implementation of *Phase 4 - Assessment* (item 3.3.2). The use of criteria is based upon the determination of clinical case content to be evaluated both in quantitative and qualitative aspects.

Table 2: List of criteria for the correction of CM in the *Adults and Elderly Health Nursing* course - Sao Paulo, 2007.

Criteria for Correction of CM	Scores
1. Presentation of data: selection of relevant data	Maxim Score 2.0 points 75%: 1.5 point 50%: 1.0 point 25%: 0.5 point Minor: zero
2. Hierarchy: Data are presented so that those with greater specificity are properly related to the general concepts, resulting in the identification of altered Functional Health Patterns (Gordon In: Carpenito-Moyet, 2005).	Maxim Score 2.0 points 75%: 1.5 point 50%: 1.0 point 25%: 0.5 point Minor: zero
3. Correlations: the map shows valid connections between a hierarchical segment of the map and the other, allowing the establishment of nursing diagnoses, with their defining characteristics and related factors. (Consider the associations between the cases's biological concepts with the psychosocial and spiritual context)	Maxim Score 2.0 points 75%: 1.5 point 50%: 1.0 point 25%: 0.5 point Minor: zero
4. Analysis of data insufficiency and proposal of focused assessment	Maxim Score: 1.0 point 75%: 0.75 point 50%: 0.5 point Minor: zero
5. Quality of Care Planning and Nursing Prescription: are the actions related to the Nursing Diagnoses? Is the action based upon scientific evidence (including identification of the literature reference)?	Maxim Score 2.0 points 75%: 1.5 point 50%: 1.0 point 25%: 0.5 point Minor: zero
6. Display of expected outcomes (that will guide nursing evolution)	Maxim Score: 1.0 point 75%: 0.75 point 50%: 0.5 point Minor: zero
Total	10.0 points

4.3 Students' perception on the CM development

All the students pointed out the CM as a strategy that made them search for and associate several previously learned contents, allowing them to think about how they could solve the patient problems when planning nursing care. They also pointed out the need for the knowledge of nursing process phases and the clinical decision making. In their report on the factors that hindered the tasks implementation they mentioned the lack of familiarity with building a concept map, the difficulty of determining the relevant data of the clinical case and the process of nursing diagnoses identification.

Five students reported that the scheme offered as a model for the construction of the map did not help in understanding the task, and they agreed that the guidelines from teachers were essential to clarify doubts. Such an evaluation was the cause for the improvement of a second diagram of representation. Everyone informed the ease and satisfaction with the final product that the construction of the second conceptual map generated.

5 Conclusion

The clinical case developed for the construction of a concept map requires a process of planning, implementation and evaluation by the teachers, as it needs to settle the thinking skills necessary for the best decision making. This act is essential to the construction of a clinical reasoning that will induce actions, in the context of practice with autonomy and responsibility. In this sense, the concept map favored the clinical reasoning because the student could, objectively and clearly, visualize priorities and identify relationships among the patient's clinical data, review concepts and demands for care. These were mental operations that subsidized the process of decision making.

The use of guidelines for the construction and correction of the CM based upon the resolution of a clinical case proved to be important for the student to build diagrams (CM) containing data that generated diagnostics and nursing interventions, as well as to facilitate the correction of the diagrams by the teachers, based on the suggested scores.

The use of the strategy to solve a case through the Concept Map was evaluated by students as motivationally favorable for the development of clinical reasoning. Therefore, the CM is confirmed as a relevant strategy for the resolution of case studies and as a way to integrate the interdisciplinary contents involved in the teaching and learning process in the healthcare area.

6 Future possibilities

The exploratory study allowed the initial immersion in this field of study, allowing the continuation of research with a design that can assess the impact of its use in the expression of the students' clinical competence.

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CONCEPT MAP AS A LEARNING STRATEGY OF HISTORY IN SECONDARY SCHOOL IN MEXICO

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Abstract: Teenagers from 12 to 14 years old attend secondary school in Mexico, whereby they are taught history during the three years of secondary school's duration. At this stage, history is normally taught in a mechanical manner and kids make use of procedures that are useful to memorize specific facts but not to learn meaningfully. As a result, the outcome of this process does not match the optimal expectation. In order to improve the outcome, the necessity to assess and compare different teaching techniques arises. The scope of this analysis is to compare the use of concept maps in opposition to the current procedures used in history teaching process. The results obtained from the comparison demonstrate that concept maps are better tools than the current ones used to teach history in secondary school. Therefore, the spread usage of concept maps should be increased.

1 Introduction

Secondary school in Mexico is attended by kids from twelve to fourteen years old, whereby history is taught throughout the three years of its duration. The first year course goes from prehistory to the 16^{th} century, the second year course goes from the 16^{th} century until the 20^{th} century, and the third year course deals with Mexican History. Supposedly, the use of timelines, chronological schemes, oral or written references, historical maps, museum guided tours, information or communication technology, among other resources, could aid the learning process. However, nor the use of the previously mentioned resources, nor the use of concept maps are used.

Although history has vital importance throughout teenagers education, the outcome obtained from the learning process is not desirable. Therefore, in order to improve teaching methods, the analysis of alternative techniques becomes a necessity.

2 History learning throughout secondary school

History studies and explains, in a rational and clear manner, past facts and changes in society that have contributed to a progress of humanity throughout time. It is not a plain description of the past, nor a relation of relevant dates, nor an explanation of what well known individuals did at their time, nor a narration of tales or anecdotes (Gallo, 1999). Essentially, history studies human kind, societies and their changes (Florescano, 2000).

In order to be taught, several methods have been proponed; such as simulation, cause and effect analysis (Boleo, 1998); critical oriented research, interpretation, explanation, and reconstruction (De la Torre, 1996); deciphering, reproduction, and interpretation of books' images (Deceano, 1997); evaluating problems focusing on subjects, facts, present and past relations, and social phenomena (Gallo, 1999); provocation of constant cognoscitive disequilibrium (Garduño, 2001); usage of timelines, narrative texts, biographies, novels, popular songs, newspapers, and museums guided tours (Lerner, 1998 and Sánchez, 2000). Although some of these are considered within history courses, teachers normally base their lessons on the textbook and their own explanations (Mora, 2001).

On the other hand, students normally make use of the following studying techniques: textbooks reading and underlining, summaries elaboration, specific facts questionnaires answering, facts memorization, and chronologies elaboration (Suaste, 2000). Such strategies are used from a sole source: the textbook (López, 1996); which besides having a traditional focus (Mayorga, 1998), includes encyclopedically oriented themes (Lerner, 1997).

Although the utility, in natural and social sciences, of concept maps has been proved during teaching, learning, and evaluation has been proved; they are not used within our country's secondary school history courses. Due to its inexistence, there is not available data referring to its viability either. Therefore, the purpose of the following investigation is to provide information regarding the utility of concept maps as a teaching and learning strategy compared to other current commonly used techniques.

3 Subject definition

Two intact third grade groups from a secondary school of Mexico City were included. Each group was conformed of twenty students which were randomly divided in halves to take conform four groups of ten students. The motivational and grade averages were analogue (Figure 1). All of the four group students were taught the same history subject by the same teacher.

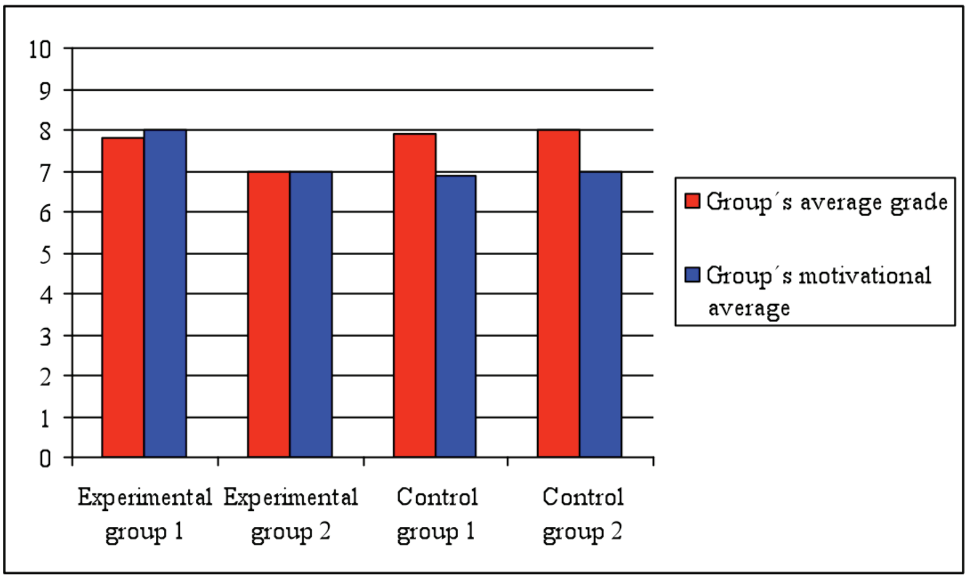

Figure 1. Motivational and grade average.

4 Procedure

Two of the four groups were randomly labeled as experimental, and two of them as control groups. Students from an experimental group, as well as from a control group, were applied a pre- test. Both of them consisted in the same eight, long answer questions. The assessment is similar to the one used to evaluate students´ performance in class. Although for this analysis four groups were formed, the class is normally taught in two groups by the same professor and strategy, whereby this strategy is usually different from the one that professors are supposed to follow. According to a questionnaire outcome, the studying strategies used by students were underlining, summaries elaboration, and specific facts questionnaires response.

Prior to the post-test, the experimental groups took part of and intensive concept map elaboration course. Each student belonging to this group had the assignment of making a concept map at home about the class. The rest of the groups were only asked to perform traditional assignments, not related to concept mapping. In that sense, the only difference between control and experimental groups was the studying and assignment completion procedures.

5 Results

The mean resulting from the pre-tests were equal. This affirmed the existence of equivalence among history knowledge, as well as the motivational and grade average did (Figure 1). This situation was not the same at the pos-test results, where experimental groups obtained higher grades than those of the control groups. Table 1 displays this situation.

Table 1:
Mean and standard deviation of each groups' pre and post test

Group		Pre-test		Pos-test	
Experimental	with pretest	Mean	4.9	Mean	7.1
		Std. dev.	1.74	Std. dev.	1.69
Control	with pretest	Mean	4.9	Mean	5.9
		Std dev.	1.31	Std. Dev.	1.78
Experimental	without pretest			Mean	6.4
				Std Dev.	1.64
Control	without pretest			Mean	5.2
				Std Dev.	.96

To determine whether group differences were significant or not, a one-way ANOVA was applied. The following results were obtained:

Table 2:
Results from ANOVA within and between groups.

	Sum of Squares	df	Mean Square	F
Between Groups	20.833	3	6.944	2.890*
Within Groups	88.507	36	2.403	
Total	107.340	39		

*$p<.05$

The t-test, of mean differences, between experimental groups, with or without pre-test; control groups, with or without pre-test; and between control and experimental groups, showed relevant differences only in the latter ones with a probability of $p<.0$.

The result synthesis graph clearly demonstrates that the usage of concept maps as a learning tool improve history learning and teaching processes compared to the ones used in secondary school.

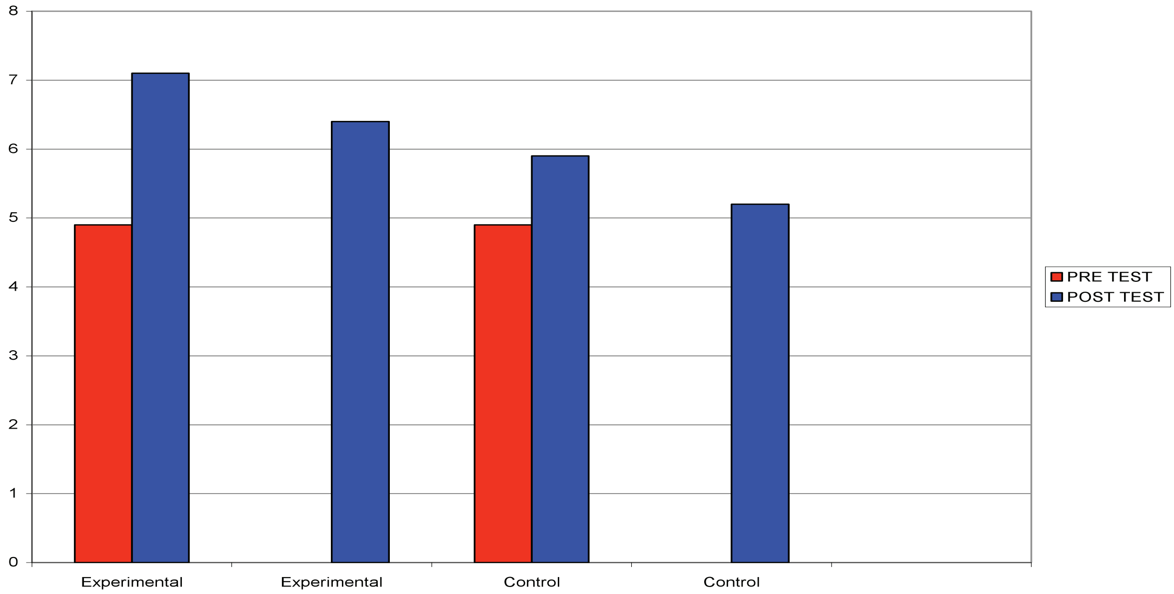

Figure 2. Groups' mean in pre-test and pos-test

6 Conclusions

Concept map is a useful technique to learn history for students in secondary school. With its usage, students obtain performances than with the practice of procedures teachers normally promote. In that sense, memorization will be diminished until the extent that students use learning strategies that allow them to understand the significance of knowledge in history and other related subjects (Florescano, 2000).

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CONCEPT MAPPING AND EXPERT SYSTEMS: EXPLORING SYNERGIES

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Abstract. Concept maps and expert systems are both in the soft toolbar of knowledge modelling. We have spent nearly two decades developing our expert system shell "Doctus". Several years ago we have seen the first concept mapping solutions and started using them very soon. Frequently we have found ourselves using both tools in a particular research or consultancy project and started to wander how the two could be combined to achieve synergies. We came up with several ideas, typically when we have faced a situation which called for one of the potential synergies. In this paper we present the first of these ideas in elaborated form of a conceptual model and we also mention few additional ideas as our plans for future research. In this first idea we combine different kinds of concept maps and our expert system in order to map organisational knowledge. The expert system here is used in machine learning mode, i.e. the resulting concept map will be capable of learning – this is our intelligent concept map.

1 Organisational Knowledge Map

Let's try to construct an organisational knowledge map. In the first part of it we will combine ideas from the various mapping approaches. The first is the cognitive mapping, a form of which has been developed by Eden (see Eden, 1988 for historical summary) based on Kelly's (1955) conception of personal psychological constructs and the Repertory Grid developed by Fransella and Bannister (1967). (See also Eden & Ackermann, 1998; Bryson et al., 2004) These cognitive maps can be, in a sense, considered as subsets of more extensive use of causal mapping, e.g. in the case we are mapping knowledge of a group of people. (Ackermann & Eden, 2004) A product related to this approach to cognitive mapping is Decision Explorer[1]; Eden and his colleagues typically use it for supporting managers in structuring their problems for better understanding. Those who developed the various approaches to mapping knowledge typically agree that our concepts form some sort of hierarchies. Buzan's (e.g. Buzan & Buzan, 1995) approach puts this feature into the focus; this is why his mind maps always branch out from a single central concept. He claims that this represents the natural organisation of the human memory, which assertion would be in line with the previous discussion about taxonomies. The product developed in by Buzan is called Mind Map[2]; it harnesses the full range of cognitive elements – words, images, numbers, logic, rhythm, colour and spatial awareness – into a single whole. The third approach we want to discuss here is a form of concept mapping pioneered by Novak (see e.g. Novak & Gowin, 1984; Novak, 1990). In concept maps we have one concept as a unit of the map and by connecting these concepts we get patterns of concepts that pretty much resemble Bateson's (op cit) conception of patterns. In this approach Novak (ibid: 29) defines the concepts *"… as a perceived regularity in events or objects, or records of events or objects, designated by a label."* The propositions formed by linking two or more concepts are personal psychological constructs. This means that in a sense Eden's cognitive maps and Novak's concept maps can be regarded as different level of description about the same sort of reality: a proposition here would be a unit of mapping in the previous. The tool associated with this approach is CmapTools[3].

We start from a knowledge/problem area that we want to map (leftmost on Figure 1). We give it a label and start breaking down hierarchically (as in a mind map); for clearer distinction we call the first level topics and the next ones keywords. The concepts in the left part of the map should be connected (similarly as Novak's concept maps) in a way to form propositions. This means that we will form semantic structures as described by Quillian (1968) based on previous work by Chomsky (1957).

For the sake of simplicity, we suggest using only nouns as concepts and only verbs as connections; we know that this is a limitation as we may be excluding such propositions as "grass is green". However, we believe that this less harmful than it may seem at first glance and also brings the great advantage of being simpler and faster. We argue that it will be less harmful than it seems because if "being green" is important for the particular knowledge area then "greenness" will also appear as a noun and thus it will be included as a concept in the map. This is how we can cover the existing knowledge in the area. Assume that the knowledge available at that part of the organisation where we are creating the knowledge map about the knowledge area is incomplete; in this case there will be keywords that are not covered. If we already know something about these keywords,

[1] www.banxia.com
[2] www.mind-map.com
[3] cmap.ihmc.us

we can describe them by attributes. In this case, however, we cannot define such sophisticated relationships between the concepts to develop semantic structures; we will only be able to identify implications. Implications will mean causal relationships and, as we can expect, these will not be very clear. We will be able to say that a particular keywords can be describe using such and such attributes but the more subtle nature of these relationships cannot be defined. Therefore this second part of the map is a causal map. In order to continue building the map we need to include the expert system – therefore in the following section we introduce the Doctus expert system and then apply it to finish the map.

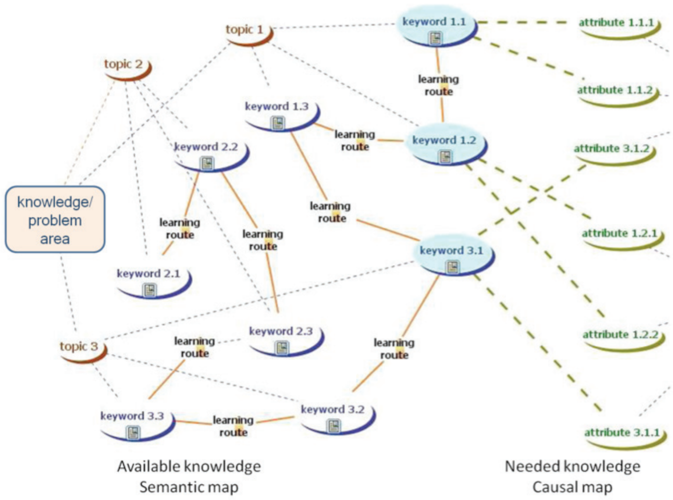

Figure 1: Organisational knowledge map - the first step

2 Doctus Expert System

We have been developing the Doctus knowledge-based expert system shell for nearly two decades. The term 'knowledge-based system' (KBS) indicates that there is a representation of knowledge in such systems; these representations are called knowledge bases. We also speak of 'expert systems' (ES) emphasizing that we build knowledge bases of experts' knowledge; we usually combine these two terms into the 'knowledge-based expert system' (KBES). Although the three terms differ in emphasis, in this paper they are used interchangeably. As we never believed that people think in numbers, we based Doctus on symbolic artificial intelligence (AI). Nobody thinks that the beautiful is 3.6 times better than the ugly. In symbolic AI the representation consists of concepts, acquired from the experts, which are connected by logical rules in «if... then» format. In this representation the concepts are treated as symbols hence the names 'symbolic logic' and 'symbolic AI' are used. During the nearly two decades of development we have used Doctus in over 140 consultancy project; the vast majority of these was providing support for top level executives. The process of building knowledge bases is called knowledge engineering and the person who facilitates it with the expert(s) is the knowledge engineer.

In *deduction* or *rule-based reasoning* (RBR) the expert articulates the aspects using which (s)he can describe the «cases». The «cases» can be anything the expert can describe from all relevant aspects; in the case of the organisational knowledge map we are developing, these will be the keywords. The aspects are described as «attributes» that have grades of satisfying, the «values». The «attributes» are then organized into a multi-level hierarchy called «rule-based graph» or RBG (Figure 2); a set of «if... then» rules is defined in each node of the graph to connect the values of the attributes. As the last input step, the expert needs to define the «cases» using the «values» of the «attributes» – these are the «case features». Finally we can apply the previously defined rules to the «cases» to get an evaluation. Once the knowledge base is thus build, it need to be fine-tuned until the expert agrees with what the knowledge-based system represents and produces – i.e. all the evaluations as well apart from the components (s)he explicitly described.

In a sense the *induction* or *case-based reasoning* (CBR) is the opposite of deduction. The expert needs to articulate the «attributes», their «values» and the «cases» the same way as in deduction; only this time, apart from the «case features» (s)he also tells the outcome for each «case». Doctus uses a machine learning algorithm to infer the underlying rules that can describe all the cases from the expert's experience; this is based on a modified ID3 algorithm (Quinlan, 1986). The result is displayed in the «case-based graph» from which the rules can be read from the root of the graph towards each leaf. One of the important characteristics of induction is that the number of initial attributes (typically around 50 at the outset) is reduced (typically around 5-7 remain). Similarly to deduction, the last stage in induction is the fine-tuning and here it is even more important and less trivial than there.

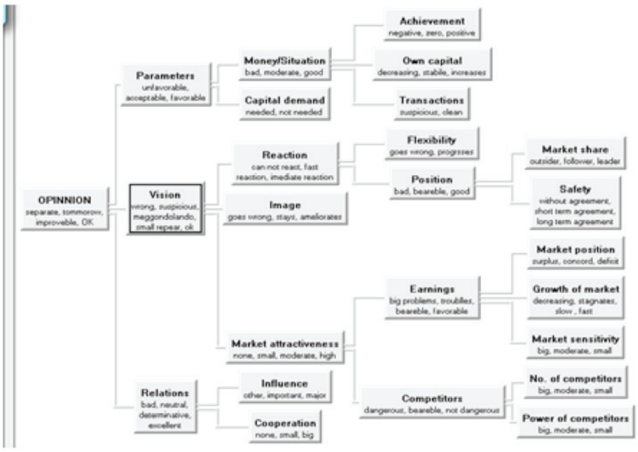

Figure 2: Rule-based graph in Doctus

Reduction is not a standalone reasoning type; it starts from an accomplished inductive knowledge base. It means taking the case-based graph and converting it into a single-level deductive knowledge base. The resulting deductive knowledge base will give the same outcome for all the cases as the expert articulated, only by using fewer «attributes»; thus the name of this type of reasoning, the number of attributes becomes reduced. We have found this type of reasoning particularly useful for supporting delegation of decisions and teaching novices about the most significant aspects of a knowledge area.

To make a concept map intelligent, we need inductive reasoning – this is how we finish our previously started organisational knowledge map. We have started from the left to the right, from a knowledge area we identified topics and subsequently keywords, these were then connected into a semantic map. The last layer of keywords we described by attributes and these were connected into a causal map. Now in the last step, we can apply the inductive reasoning of Doctus. This will have the benefit of reducing the number of the attributes to what we call the most informative ones. If we assume, using Miller's limitation of the short term memory (Miller, 1956; Baddeley, 1994), 7±2 topics for the knowledge area, 7±2 keywords for each topics and 7±2 attributes for each keyword we will easily end up with more than two hundred, which appears to be another memory limitation (Davenport & Prusak, 2000); we can add to this that very frequently we will not be able to acquire such dense knowledge in the last keyword layer and thus will have significantly larger number of (redundant) attributes. So it can be really useful to reduce the number of these attributes. However, we can do more than this. By smartly formulating our cases we can also identify the occurrences of the attributes; these may be people, knowledge bases, document bases and even (although rarely) databases. This way, our organisational knowledge map is complete (Figure 4).

We can make further use of applying Doctus to our organisational knowledge map. If we apply the reductive reasoning to the attribute list got from induction and this way get a single-level deductive knowledge base. By fine-tuning this new inductive knowledge base we can gain sufficient understanding of the patterns to be able to connect the causally described concepts into a semantic network and go further to identify new keywords at the causal layer. Three things need to be noted for the end: (1) None of these processes will happen by only plugging in the machine; we will need the expert(s) and the knowledge engineer working on it. (2) When we fine-tune the reduced knowledge base and learn about our knowledge area enough to be able to extend the semantic network to our just described concepts original semantic map will usually also change – it is not a part of knowledge in the area that is changed but also the whole knowledge. (3) As it can by now probably be understood, this is a never-ending process: we restructure the semantic network and include the additional concepts, we define new causally described concepts, then we understand these better and include them into the semantic network, which is then again restructured and new keywords defined, and so forth.

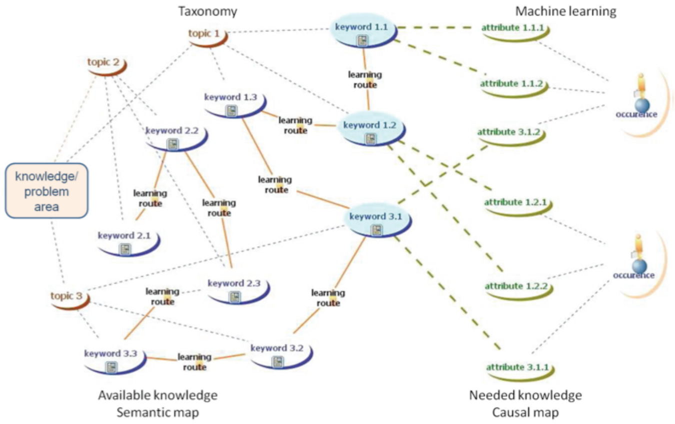

Figure 3: Organisational knowledge map - the complete picture

3 Conclusions

We have examined two branches of soft modelling tools using which we can support the achievement of meaning; we were interested how these two types of approaches and tools can be used together to achieve synergies. Particularly, we have examined one combination, the case of creating an organisational knowledge map; we say that by using the expert system we developed an intelligent concept map. We have a couple of further ideas which (more precisely some of which) make part of our forthcoming research. We outline three of these very briefly, only to set off imagination.

Almost trivially, we can use various concept mapping techniques to structure a problem and if this could be exported in a form to be importable into a knowledge-based system it would be possible to use the two tools in a sequential way. A more sophisticated way of doing this would be integrating the two tools. This is, however, not a scientific research problem but rather a software development project. Typically ES in deductive reasoning cannot contain recurrences/iterations as these would lead to infinite loops. To the contrary, we have noticed that 'concept mappers' become excited when they discover such loops in their diagrams as they usually mean something special. The two tools types could be combined or expert systems could simply learn from concept maps how to handle the positive, negative, or combined feedback loops for the benefit of the experts. Finally, the concept suggester component (Leake, Maguitman & Cañas, 2002; Leake et al., 2003) of the IHMC CmapTools may probably also be enhanced by adopting an inductive and possibly inductive+reductive reasoning from expert systems. The idea for this research builds on the observation that there is no way of passing between lexicons, i.e. there is no translation due to context dependency. The context, however, can be described by the rules induced from cases and perhaps further enhanced during the fine-tuning in reduction.

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CONCEPT MAPPING AS AN ASSESSMENT TOOL IN HIGHER EDUCATION ACTIVITIES

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Abstract. Concept mapping can be used as an assessment tool and it can be as flexible as it is needed. The authors propose at least three categories for concept maps used in assessment: maps with open propositions, maps with closed propositions, and maps with semi-open propositions. In this paper we report the application of the categories proposed through the use of concept maps in three activities developed at the University of Costa Rica.

1 Introduction

Due to its flexibility, concept mapping can be used to organize, represent, capture, and share knowledge. Moreover, it can be used as a tool for the evaluation of courses, seminars, and other activities held in higher education. For example, Novak reports he used concept maps to evaluate learning as well as the students' affective responses (1998, 192).

Depending on the purpose of the activity, there are many ways to build a concept map that could be used to assess such activity. We propose at least three possibilities, which are related to the construction of the propositions: open, closed and, semi-open. According to this, we present two concept maps with open and closed propositions, as well as a third option displaying a map with semi-open propositions.

2 Concept map with open propositions

At the closing session of the Second International Conference on Concept Mapping CMC 2006, held in San José, Costa Rica, organized by the University of Costa Rica, the local organizing committee gave attendees a concept map to evaluate the conference (Figure 1). This map presented two open propositions indicating whether CMC 2006 "accomplished" or "needs to improve". Then, there were six blank shapes that the evaluator could fill according to what he or she thought were pros and cons of the activity. At the end of the map, there are blank lines for additional comments.

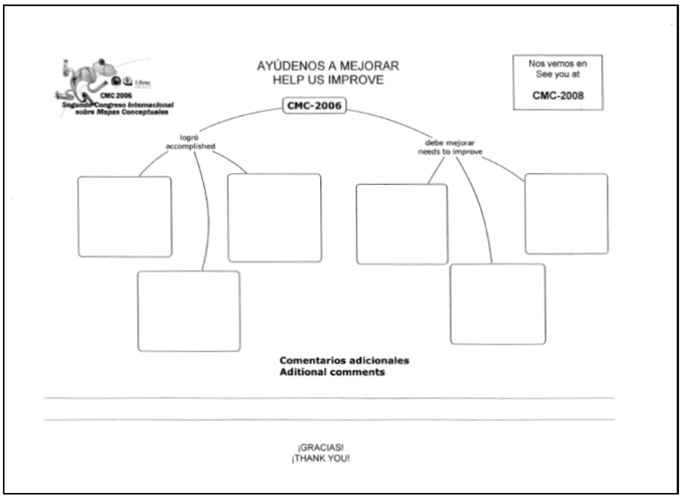

Figure 1. CMC 2006 evaluation concept map. San José, Costa Rica, September, 2006.

The main advantage of using a map with open propositions is the possibility of free communication of ideas and opinions, without the organizers preconceptions. However, this map had a notorious disadvantage, which was the large amount of answers received. At the end, the organizers spent a significant amount of time in classifying the answers and interpreting the results.

3 Concept map with closed propositions

The Vice-presidency of Teaching at the University of Costa Rica opened the Office of Information and Communication Technology supporting Teaching (*Unidad METICS*)[1] in 2006. This office manages the University program of e-learning platforms for students and teachers. The office also advises teachers on improving their teaching skills.

Among its duties, Unidad METICS conducts workshops on using the University virtual classroom involving academic staff. The workshops consider b-learning, virtual learning, planning courses with the support of Information and Communication Technologies, and the use of the University virtual classroom *Mediación Virtual* (http://mediacionvirtual.ucr.ac.cr), among other topics. Thus, researchers of Unidad METICS produced two maps to assess contents, methodology, organization, and participants' achievement (Figures 2 and 3). These maps are used by teachers participating in the workshops.

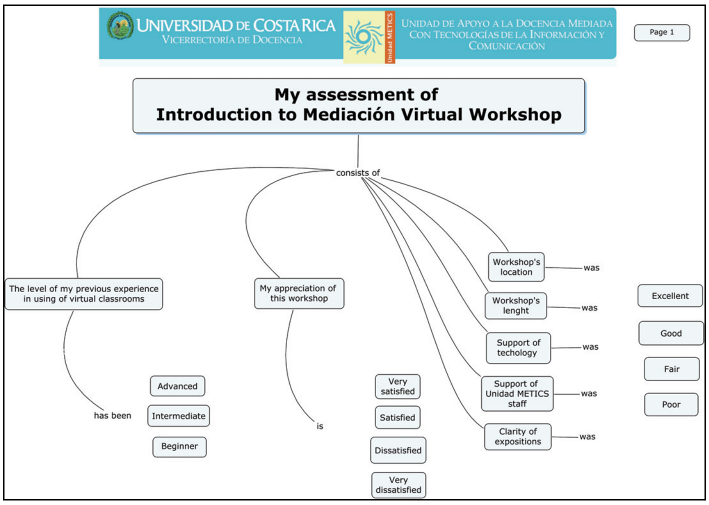

Figure 2. Assessment of Introduction to the *Mediación Virtual* Workshop - Page 1. Adapted from Chacón & Araya, 2008.

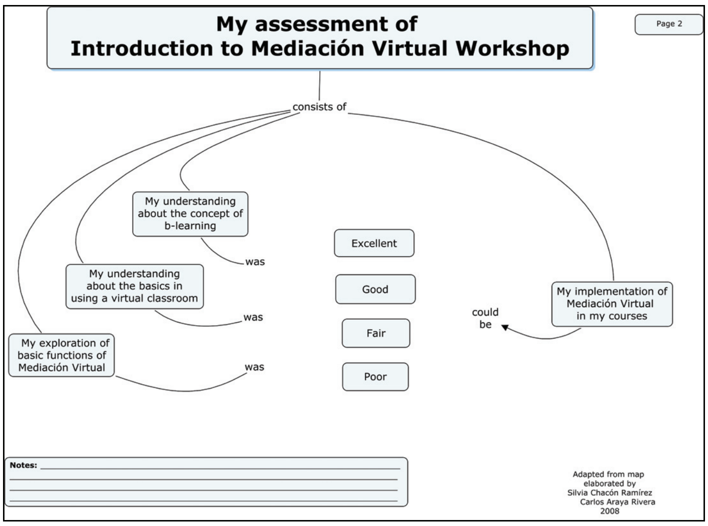

Figure 3. Assessment of Introduction to Mediación Virtual Workshop - Page 2. Adapted from Chacón & Araya, 2008.

Two advantages of these closed-propositions maps are their clarity and usability. A person may easily complete a proposition, by drawing the missing line from the linking phrase to the option better completing the sentence. There is also a place to write additional notes about the activity. However, it may be a disadvantage that the most of the propositions are not quite simple, especially in the first concepts, as it is shown.

[1] Translated from spanish original name: *Unidad de Apoyo a la Docencia Mediada por Tecnologías de la Información y la Comunicación (Unidad METICS)*.

Nevertheless, the purpose of these maps was to assess a very specific activity like a course or a speech, no longer than 3 - 4 hours, and the researchers needed to obtain the participants opinion in such an efficient way.

4 Concept map with semi-open propositions

CONTRASTES is a weekly radio magazine produced by students at the School of Mass Communication Sciences, University of Costa Rica, since 1990. This program is the longest college radio experience en Costa Rica and it is broadcasted on Radio U 101.9 FM, the University student radio station. The program focuses on the information needs of prospective and freshmen students at the University. Consequently, CONTRASTES includes information about University services, undergraduate programs, and interviews, as well as rock and pop music. Every week, the producers attend to a meeting to organize work, evaluate the last program, and confirm details for the program that will be on-air in the present week.

To help students in improving their radio production skills, the program has an academic adviser who is a professor at the School of Communication. As a manner of supporting the participants learning, the professor uses a tool to assess different elements of the production process, specially the program itself. This tool has been mentioned in several publications (Araya Rivera, 2000; 2005) and it is based in the concept of pace. For radio producers, pace is an efficient distribution of the radio language elements and it is defined in two dimensions, internal and external pace. The first reflects the way the research and the writing were made. On the other hand, the external pace reflects the interaction of voice, music, and sound effects in the radio program.

In this paper, the authors adapted the pace assessment tool to a concept map with semi-open propositions, in order to propose an alternative in using concept maps to assess higher education activities. Validation of the proposal is pending (Figures 4 and 5).

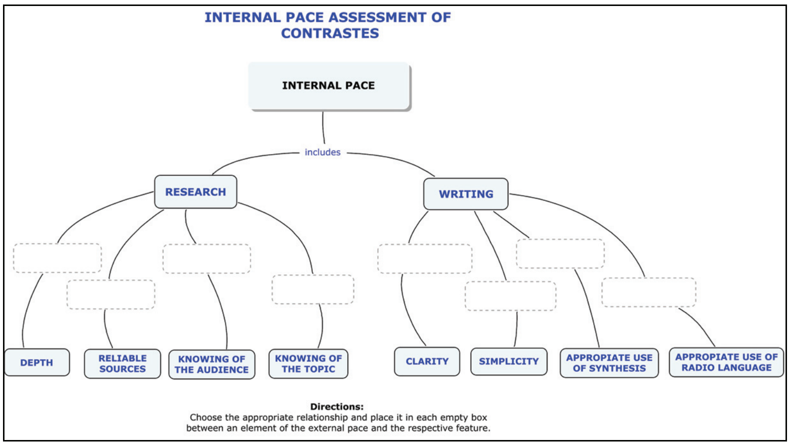

Figure 4. Internal Pace Assessment of CONTRASTES. Translated from Alonso & Araya, 2008.

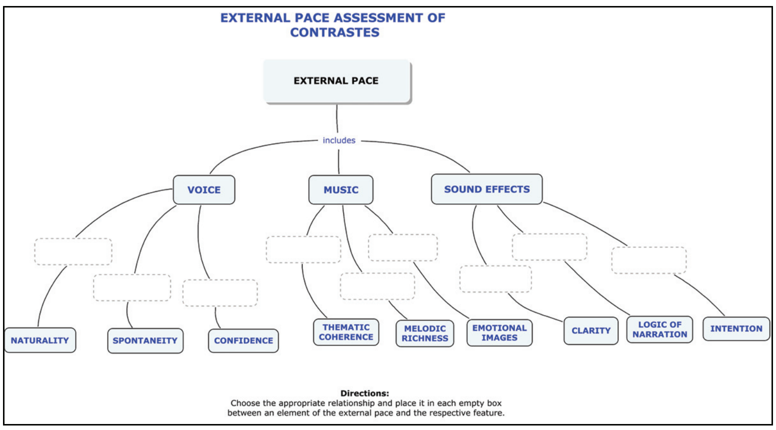

Figure 5. External Pace Assessment of CONTRASTES. Translated from Alonso & Araya, 2008.

The proposed semi-open propositions concept map shows the elements of internal and external pace (Research, Writing, Voice, Music, Sound Effects), then the features of each element, and in between there are empty boxes representing the linking phrases the evaluator has to complete. Although the linking phrase could be the same in all the propositions, these maps are flexible and allow the evaluator to use a different phrase in each sentence (e.g. some alternatives are: *showed, did not show*, *had, had not*). The primary advantage of this proposal is that participants could share and compare their maps to decide the best relationship between concepts.

5 Summary

The application of concept maps in the activities described, show the following:

- The effectiveness of the tool in assessing different kinds of higher education activities.
- The need to adjust and rebuild the assessment maps, considering the topic and the particular characteristics of each activity, as well as the people attending the activity.
- The moment of the application of the tool should be decided according to the higher education activity.
- Concept maps should be clear.
- The target audience should be sensitized with the exposure to the concept map methodology.

Concept maps with open and semi-open propositions are more flexible that those with closed propositions. However, the decision of which concept map should be used, depends on the intention of the evaluator as well as the purpose of the assessment.

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CONCEPT MAPPING IN KNOWLEDGE INTENSIVE PROCESS

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Abstract. Knowledge intensive processes such as research and development, innovation, new product development, design and product design are often driven and constrained by the mental model of experts. Often, this knowledge is not explicit but tacit. In order for the knowledge sharing to happen, it requires communicating tacit knowledge. CM functions as an externalization tool to facilitate this transformation and support knowledge construction. It has demonstrated best in domain knowledge construction and elicitation process during conceptual design. CM too functions as a storytelling and guide ideation process. In the same way, as Personal Knowledge Management tool, CM encourage individual to externalize their knowledge and contribute to collective intelligence across community of practice.

1 Introduction

Many describe Concept Map (CM) as an idea generating tools, some even classify them as an innovation tools. CM has proven successful in various areas; from a broad range of education fields, engineering, business processes, knowledge management (KM) to semantic and ontology design. Eppler (2001) described CM as a complex knowledge mapping techniques that merely as an enabler, as a vehicle for expressing and releasing the knowledge, creativity, and energy that lies within every group. However, this knowledge is always tacit in nature, subjective, personal and context- specific. In order for the knowledge sharing to happen, it requires communicating tacit knowledge. CM functions as an externalization tool to facilitate this transformation (Fisher, Wandersee and Wideman, 2000) while supporting knowledge construction.

To make tacit knowledge explicit, individual need to be aware of his or her style in managing their knowledge or thought process. In KM, a system that is designed by an individual for his or her own use, facilitates knowledge acquisition and assists in managing information overload is called Personal Knowledge Management (PKM) (Frand and Lippincott, 2005). CM was introduced as one of the PKM tool. Dorsey (2000) viewed PKM as a set of problem-solving skills that have both a logical or conceptual as well as physical or hands-on component**.** He defined seven core PKM skills as retrieving, evaluating/assessing, organizing, analyzing, presenting, securing, and collaborating around information. As such CM is beyond nodes and links but as a vehicle to demonstrate knowledge, understanding and performed as a window into one mental model. They implied the *deductive thinking* and *inductive thinking* style (Harris and Caviglioli, 2003) where *deductive thinking* deals with problem from the whole view before breaking into parts while *inductive thinking* see things from parts to whole.

Knowledge intensive processes such as research and development, innovation, new product development, design and product design are often driven and constrained by the mental model of experts. Often, this knowledge is not explicit but tacit, thus it is difficult to describe, examine and use. Designers or creator spent more times and deals with him or her thinking internally before reach to the final output (Dörner, 1999). As a result, knowledge developed during a design project often traps within individual designers and their artifacts (Schon, 1983). At the same time, designers usually conduct collaborative discussions and verbal critiques that influence the design of the final artifact with others; however this knowledge is rarely captured. The design process too always contributes to new development product, thus foster new knowledge in many ways (A.Rahman.KAA, Sugiyama, Watanabe 2001).

In every design process, the most difficult and important process is to conceptualize what we want to create and articulate why we want to do so (Preece, Rogers and Sharp, 2002). A conceptual design represents the structure of the system, as perceived by the user (deltamethod.net). The process includes the construction of *conceptual models,* that is " a description of the proposed system in terms of set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended" (Preece, Rogers and Sharp, 2002). Similarly, the early stage of innovation includes idea generation process and development of conceptual understanding (Thoben, 2007). Some describe this stage as the *ideation* where it refers to the preverbal idea stage. However, it is always happens that the *ideation* one have is not reflected into their *expression* - where the translation of those ideas into formal systems of communication take place. In some way, the idea they plan is lost during the transition to the executable form (Marlia, 2006). CM was then introduced at these stages to construct domain knowledge in knowledge acquisition phase as described in section 2. Consequently, it will guide the *ideation* process, used as storytelling and metaphors to codify development process.

2 Concept Map in Design Process

Learners (designers) in design and technology need a range of abilities and skills- the same abilities as designers and technologists in real life do (Petrina, n.d.). Lawson (1990) believes designer should own a good understanding of the technology in his field, a well-developed aesthetic appreciation, and an understanding of the project users' needs as they are involved in knowledge intensive process - turning the idea into product that creates experience. Concept Mapping was tested to 66 design and technology learners. The goal was to create an interactive multimedia application that stimulates creativity and expression using digital media technology. The application must apply user experience goals and usability principles, while CM was introduced in conceptual design. The process follow through threes stages; *The Knowledge Elicitation Method* (Ford and Sterman, 1997); The *Positioning Phase*, *Description Phase* and *Discussion Phases*.

2.1 The Positioning Phase

The Positioning Phase is where context and goals is established. Learners explore the design problem by going deep into the subject matter. This involved research on the problems by conducting precedent studies on what others have done, find similarity and differences from various solutions. Learners were involved in knowledge elicitation process by actively building domain knowledge. The understanding was then illustrated in concept map as a structure or 'organizers' of information. The relations among nodes connect the construction of tacit understanding. The theory deals with organizing information for easy retrieval. However, various versions of concept maps were produced to formulate the final focus on the domain knowledge. Learners went through a process of information seeking as a series of thoughts, feelings and actions described by Information Search Model (ISP) by Kuhlthau. Table 1 summarized the context formulation process elicited using CM and mapped to ISP model.

INFORMATION SEARCH PROCESS (KUHLTHAUS'S MODEL)	AFFECTIVE LEVEL: FEELINGS	CONTEXT
1. Initiation	Uncertainty	The problem of pain
2. Topic Selection	Optimism	Physical type, Mental type, Spiritual type, Emotional type
3. Prefocus Exploration	Confusion, Frustration and Doubt	Negative Consequences of Pain, Positive Consequences of Pain
4. Focus formulation	Clarity	Why and How Pain make one strong
5. Information collection	Sense of direction/ confidence	Why suffering is Positive
6. Writing	Satisfaction or dissatisfaction	Finalized Concept Map: " When I am Weak, Then I am Strong"

Table 1: Carol Kuhlthaus's Six Stages Model of Information Search and the context formulation using CM

With concept mapping adopted at this stage, learners implied their understanding and mental model of the subject while allowing collaborative discussion, organizing concepts and determining the relations between concepts more clearly and focus, aware of main ideas and supporting detail, understand the relationships between them, and are able to use them appropriately. Learners whom struggling to create a good CM was themselves engaged in a creative process that promotes creative thinking. As a result, a clear understanding of knowledge domain gained from the CM has positively contributed to the visualization of idea in the next phase.

2.2 The Description Phase

The Description Phase is where visual description (see visual in your mind) formulated from The Positioning Phase. It will be supported by verbal description, textual and graphic including design of the interaction that will take place. CM benefits from explanation or by telling a story. Conversely, telling a story paints a picture; it creates a model in the mind of the listener. As such, CM became a planning tool or as an alternative to essay writing, storytelling and storyboarding. Figure 1 explained metaphors used to indicate the domain knowledge of 'obstacles of life'. The two main relations - situation and indication, link its main concepts. As an example- the situation where the sheep turned into a wolf indicate the broken trust or betrayal of friends.

This flow of ideas creates a visual description which then turned into visualization of sketches in Figure 2. From the visualization, the digital interactive application was developed. The user interaction one has with the application defined their personal user experience. CM has become a guide to formulate domain knowledge and ideation process in this knowledge intensive process.

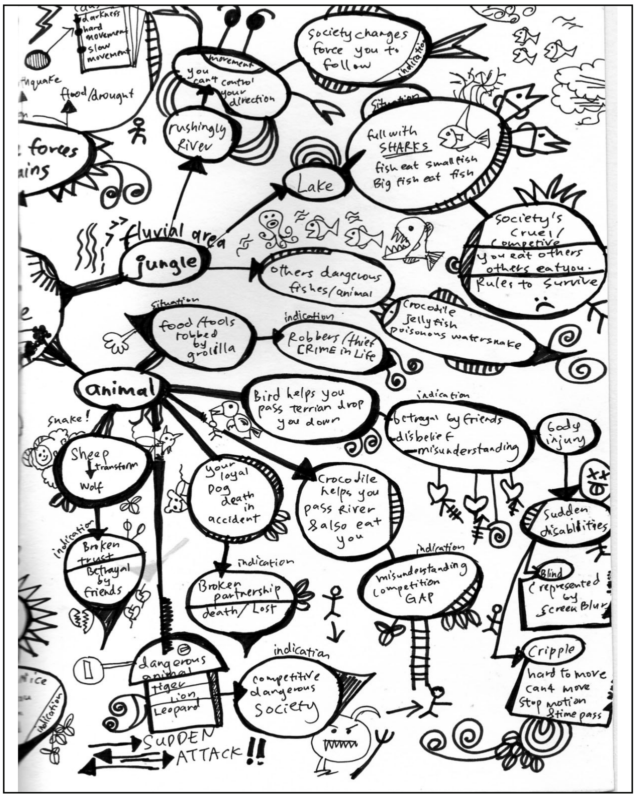

Figure 1: Concept Mapping on metaphor of domain knowledge

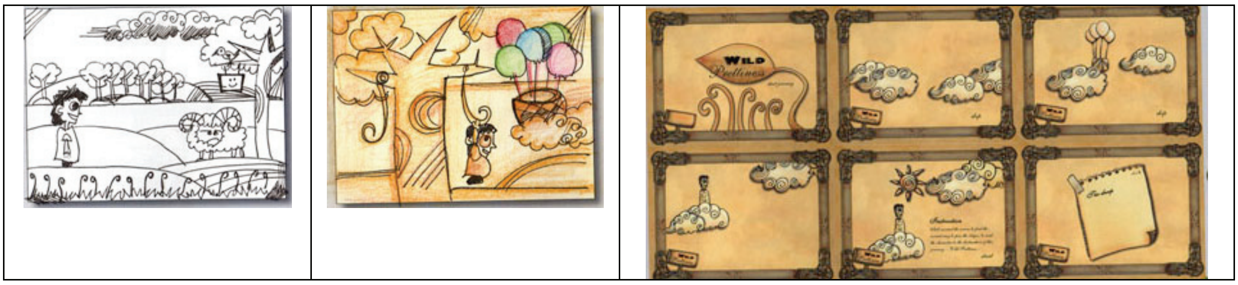

Figure 2: Conceptual Design to Final Application

2.3 The Discussion Phase

The Discussion Phase is where discussion takes place iteratively in between Positioning Phase and Description Phase. Tacit knowledge is externalized in CM, shared with others, internalized feedback and refined design process. This phase executes the full knowledge cycle of SECI model by Nonaka – Socialization, Externalization, Combination and Internalization.

Knowledge Process	Learning Activities
***S**ocialization*	Learners communicating and exchanging their idea verbally, either with peers or teachers.
***E**xternalization*	Learners presented their understanding in explicit artifacts – sketches, photographs, written, video, diagram and *concept mapping*.
***C**ombination*	Explicit artifacts are use as a mean of communication, discussion and exchanging ideas between teachers and learners and between learners and learners.
***I**nternalization*	Verbal critique and formative evaluation conducted, the feedback will help learners to improvised and make decision on their design

Table 2: SECI model and learning activities in multimedia development process (Khalid, Woods and Rafi, 2006)

3 Results

To gauge the use of CM in conceptual design of knowledge intensive process, a questionnaire with Likert scale of 1 to 5 distributed to 66 participants. The result has demonstrated a positive acceptance of using CM in design process (Table 2), particularly in building domain knowledge and storytelling of ideation process. The use of CM in relating every concept involved in the domain knowledge scores the highest. It also allows knowledge construction and elicitation process been conducted from various perspectives. Thus, learners became more aware of main ideas and supporting ideas involved in the domain knowledge while raise their confidence level for verbal explanation.

CONCEPT MAPPING IN DESIGN PROCESS	Mean
Domain Knowledge Construction	
CM allows to see how things relate to each other	3.85
CM helps to see things from various perspectives	3.80
CM allows awareness of main ideas and supporting ideas	3.77
CM support verbal explanation	3.77
CM helps understand better of the domain knowledge	3.72
CM useful in visualizing thinking	3.72
CM allows to see things critically	3.67
CM helps organized thoughts	3.62
CM freely expressed thinking	3.55
CM allows to focus on the domain knowledge	3.55
CM helps defined problem definition and preparation	3.52
CM allows easier collaboration	3.43
Ideation Process	
CM can be a storytelling to explain ideas	3.65
CM helps to focus the ideation process	3.55
CM helps ideation flow	3.55
CM in ideation process can guide visual development	3.53
CM become a constant reference to stay focus with idea developed	3.48
CM encourage critical thinking	3.47
CM helps to demonstrate understanding	3.42
CM function as a graphic organizer of content	3.22

Table 3: Results of the Questionnaire

Accordingly, CM in ideation process shows the highest mean that CM can be a storytelling to explain idea. CM too function as a guide to visual development while became a constant reference to stay focus with the idea developed.

4 Future Work

Knowledge intensive process or activities are the essence of research and development (R&D) organization. Researchers and engineers collaborate in knowledge-intensive work that involves significant number of informal communications. However, this knowledge are rarely capture formally. Based on the above experiment with CM in conceptual design process, CM thus proposed as a personal knowledge tool that encourages problem-solving skills to support knowledge-intensive processes in R&D organization.

4.1 Concept Map and Collective Intelligence

As a part of Community of Practice (CoP), members will connect together and share their CM in '*Think Space*' to form collective intelligence. '*Think Space*' allow groups to learn faster, visualize new possibilities, and reveal tacit knowledge (Figure 3) within and across community. The Collective Intelligence will be a foundation to build knowledge model as a mean of sharing knowledge among domain experts and users. CM will be shared collaboratively on the network and link to other maps as sharable content objects.

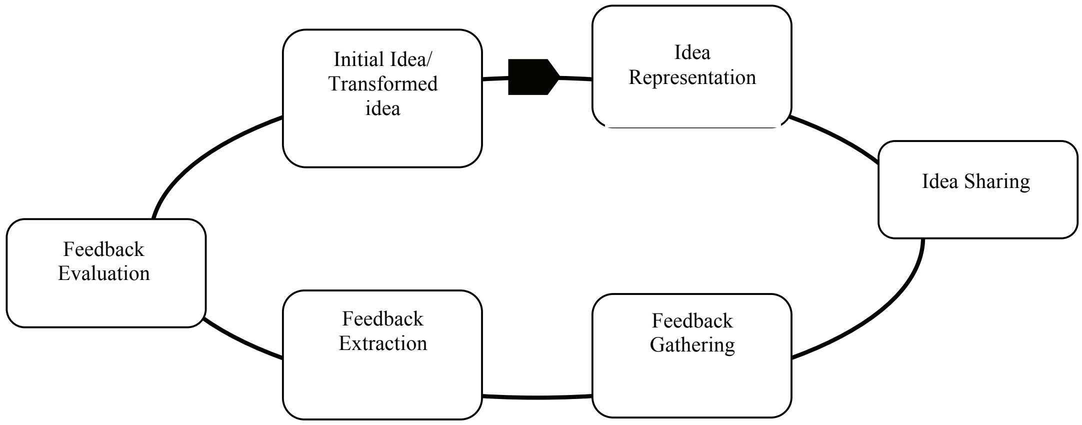

Figure 3: Personal Knowledge and Collective Intelligence

5 Summary

This paper has discussed and suggested CM contribution in knowledge incentive process. CM has demonstrated best in domain knowledge construction and elicitation process. It allows deep understanding and exploration of domain knowledge while encourage critical thinking. CM too functions as storytelling and guide ideation process. Both phases are shared similar doings with the front end of innovation process. Thus, CM can benefit research and development organization by encourages collective intelligence of shared CM to enable rich knowledge sharing among community.

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CONCEPT MAPPING IN KNOWLEDGE ORGANIZATION THROUGH A SEMIOTIC LENS

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Abstract. Concept maps (which show the relationship among concepts) are often discussed in the field of education as elements that facilitate the learning experience. In this study, I analyzed whether the concept maps used by knowledge organization researchers employ semiotic theory. I examined the following conference proceedings in their entirety: *The International Society for Knowledge Organization* (ISKO) and *Advances in Classification Research: proceedings of the American Society for Information Science and Technology* (ASIS SIG/CR). My findings determined that Peirce's framework was the basis for the largest number of maps, that concept maps are the most frequently used form of visual representation, and that most researchers who use concept maps in their presentation use only one. Additional analysis revealed that the majority of contributors who used concept maps following Peirce's framework were employed in the United States as professors. I deployed content analysis as my methodology to measure the most frequently used terms.

1 Introduction

Concept mapping has been used in academic and business settings since the late 1980s to provide visual representations of knowledge structures and argument forms. Concept mapping is often discussed in the field of education as a device that facilitates the learning experience and provides teachers with a method of imparting knowledge. Friedman (2006) has found that content mapping is frequently used in academic conference papers by scholars in the field of knowledge organization. Given the growing popularity of the technique in conference proceedings, a better understanding of how knowledge is represented in the academic research environment is necessary. This study selected the field of knowledge organization as its unit of analysis. Knowledge organization is a domain concerned with the "ordering of what is known," particularly for information retrieval (Smiraglia, 2005). Nowadays, with the increasing variety of non-printed material, defining the field of knowledge organization has become more complex (Hjørland, 2003). Many researchers of knowledge organization study the philosophical and semiotic aspects of language to support their particular foci. By portraying the concepts inside the maps as signs, semiotics can allow us to analyze the relationships among a set of concepts (Friedman, 2006). The aim of this research is to provide greater insight into the role that "signs" play in the specific, cognitive procedures employed by knowledge researchers who utilize concept mapping. I hope it will both open the discussion about whether or not concept maps can be classified and examine the context of semiotic theory as an academic tool for representing new knowledge.

2 Methodology

I examined whether the concept of "sign" that Peirce and Saussure define could be enlisted to measure the concept inside the maps that presenters used in their research papers. I selected two major conference proceedings in the field of knowledge organization: *Advances in Classification Research: proceedings of the Special Interest Group for Classification Research of the American Society for Information Science and Technology (ASIS SIG/CR)* and *International Society of Knowledge Organization* (ISKO). While the former collection represents an annual meeting, the latter is biannual. Both conferences had their inaugural proceeding in 1990. The last printed publication of the *Advances in Classification Research* occurred in 2002.

The study progressed through four steps. First, I examined the entire contents of both sets of conference papers to discover the nationality and occupation of the authors who most often used concept maps. In the second stage, I measured whether or not I could identify and classify the concepts found in the maps according to Peirce's or Saussure's definitions of the "sign." The third stage measured the "most-frequently used" terms in Peirce's triangle and Saussure's dyadic classifications. In the last stage, I examined the most-used mapping formats in the entire proceedings of both conferences. By employing Peirce's and Saussure's classification, I hoped to answer a very important theoretical question: Is there a relationship between nationality, occupation, and the specific conceptual process that an author uses?

3 Literature Review

3.1 Introduction

Semiotics emerges from philosophical speculations on signification and language (Chandler 2004, 5). During the 19th century, two major schools of thought established competing interpretations of the term "sign." The American philosopher Charles Sanders Peirce proposed a triadic foundation of the term and argued that anything can be considered a sign as long as it refers to, or stands for, something other than itself (Peirce 1931-58, 2.302). Alternately, Ferdinand de Saussure espoused a "dyadic," or two-part model, of the term "sign." According to Saussure, the "sign" is made up of the *signifier* (the mark or sound) and the *signified* (the concept or idea). Peirce also discusses the terms "signifier" and "signified," but for him the theory of the sign is not about language, but the production of meaning. Peirce uses a triangular model consisting of object-sign-interpretant. He maintained that a "sign" is anything that stands for something in somebody's mind. The signifier, for Peirce, stands for the *Representamen*, which is the form, not necessarily material in nature, which the sign takes. The signified for Peirce is the *Object,* which is that to which the sign refers. Peirce adds an additional element, the *Interpretant*, which is the sense made of the "sign" (Peirce, 1931-58, 3.399).

The importance of semiotics to both knowledge organization and the field of education is that it provides a framework for the connection between language and its meaning with regard to knowledge representation. The use of concept maps by researchers in knowledge organization has never been examined through the lens of semiotics. Furthermore, no existing study has analyzed the demographics of authors who use concept mapping. This study corrects both of these deficiencies in the current literature.

3.2 Concept Mapping

3.2.1 History

Concept mapping was developed by Novak and Gowin (1984) in order to provide better tools for lecturers, teachers and their students. They describe the logic of concept mapping through the definition of three key terms in cognitive processing: concept, proposition and learning. According to Novak and Gowin (1984), concept mapping is a process for representing concepts and their relationships in graphical form. Lambiotte, et. al (1984) provide a different definition. According to them, the relationship between the nodes and arcs represents the relationship between the concepts. A relationship can be directed or undirected between two nodes. A directed relationship points from one node to another. Unlike Novak and Gowin, Lambiotte, et. al do not incorporate the learning processing. I used Lambiotte et. al's definition because of its close connection to the framework of semiotics.

Concept mapping has mostly been employed to facilitate collaborative learning in the educational paradigm (Roth & Roychoudhury, 1994). Kankkunen (2004) utilizes Peirce's framework to describe how to track a student's real progress in learning. In linguistics, Graesser and Clark (1985) have developed a method for analyzing argument forms in terms of structured concept maps that have eight node-types and four link-types. Following Graesser and Clark, Woodward (1990) has developed tools to extract such maps from provided texts. In the field of knowledge organization, Priss (2004) has studied the structure of programming language by using Peirce's definition of signs to examine the correlation between structured programming languages and concept mapping.

3.2.2 Current Research

Friedman (2006) examined the sixth and eighth ISKO conference proceedings with regard to Peirce's definition of the term "sign." He found that concept mapping was a standard element of cognitive processing at both events. However, I did not find any studies that employed semiotics to examine and define the frameworks of the author's concept maps.

3.2.3 Summary

Many researchers in the field of education use concept mapping to improve student comprehension. Even though many researchers use it as a presentational tool, few use it as a meta-theoretical practice to classify and organize information researchers used.

4 Study Findings

I examined the entire collection of conference papers in the field of knowledge organization. I reviewed a total of 652 papers that showed 327 concept maps between the two conferences (ISKO and ASIS SIG/CR). Out of the 158 papers in the ASIS SIG/CR conferences, 125 concept maps were found. In the ISKO conference series, 202 concept maps were found in 494 papers. Although the ISKO proceedings included more concept maps, the ratio of concept maps to number of papers per conference indicated that the ASIS SIG/CR presenters embraced concept mapping more readily. The reason for the difference is the relatively larger number of papers presented during each ISKO conference.

4.1 The characteristics of the authors in both conference proceedings

I first examined the nationality and line of work of each author who included a concept map. The line of work was divided into three categories: professor, practitioner, and student. Regarding occupation, I found no major differences between the two conference proceedings. In both series, the majority of researchers who employed concept mapping were professors: accounting for 227 of the 327 total maps. In addition, I examined the country in which the researchers worked. In both series, the majority of the participants who employed concept maps were based in the United States. This trend was more prevalent at the ASIS SIG/CR events, where the majority of presenters worked in the U.S. In distinction, the ISKO presenters were a more international group. Out of 101 ISKO presenters who used concept-maps, only 21 worked in the USA. Researchers from Germany ranked second, with 10 concept maps out of 42 presenters. In addition, I also examined the strategy those authors most often employed with regard to the number of concept maps in their papers and found that the majority of researchers used a *single-map-per-paper* strategy. In the combined proceedings, 129 out of the total 327 concept maps employed a single-map-per-paper strategy. The fifth ISKO (in 1998) shows the highest numbers of authors, 12, who included this single-concept-map strategy. In comparison, the highest rate of occurrence for the ASIS SIG/CR occurred at the 2000 conference, during which 4 authors utilized this method.

4.2 The semiotics framework and concept maps

The concept maps I analyzed fell into three categories: "Peirce," "Saussure," and "other." The "other" category was reserved for concept maps that did not adhere to either Peirce's or Saussure's structure. Using Peirce's triadic theory, I classified a total of 148 concept maps (81 from *ISKO* and 67 from the *ASIS SIG/CR* conferences), which represents 62% of the maps examined, making it the highest-ranking classification. The second-highest ranked category was "other," with a total of 117 maps (85 from the *ISKO* proceedings, 32 from *ASIS SIG/CR*), representing 35% of the total. The lowest-ranked category was Saussure's dyadic theory, with only 62 maps (36 from *ISKO* and 26 from the *ASIS SIG/CR*), representing 18%. Analyzing the terms inside the concept maps, I found 299 terms that I could identify as "signs" according Peirce's framework. Using Saussure's framework, I could only produce a total of 161 terms. Table 1 presents the top 5 terms that I uncovered using both semiotic frameworks.

	Term	**# of times**	**%**
Peirce	1. Knowledge	12	5.43%
	2. Organization	10	4.52%
Saussure	1. System	3	2.64%
	2. Document	3	2.64%

Table 1. The most used terms defined as "signs"

Future studies need to examine if those terms represent the nature of the field. In addition to studying the significance of particular "signs," I analyzed if the concept maps used most often by presenters could be applied to three types of maps.

4.3 The most used concept maps form used

Out of the 327 maps I reviewed, I found three main classifications: concept maps, mind maps, and conceptual graphs. Concept Mapping consists of text, images, and links, all of which describe the relationship between specific nodes and arcs that yield the semiotic essence of any given presentation. Mind Mapping is a diagram used to represent words, ideas, tasks or other items that are linked to, and arranged around, a central word or idea. Conceptual Graphs are systems of logic that are based on the existential graphs of Charles Sanders Peirce and the propositional logic. Table 2 presents the findings.

	Concept Maps	Mind Maps	Conceptual Maps
ISKO	128	23	51
ASIS SIG/CR	78	13	34
Total 327	206	36	85

Table 2. The form of concept maps most used

Accounting for 62% of the total, the concept map was the most-used format. Additional analysis revealed that presenters who used Peirce's or Saussure's classificatory schemes relied most heavily on concept maps. As the preferred method of displaying scientific information in *ISKO* and *ASIS SIG/CR* conferences, concept maps integrate graphics and text most efficiently. It is interesting to note that most researchers added further graphic representations to their maps, without providing detailed explanation of their meaning. This apparent oversight should be examined in future studies.

5 Conclusion

I found that concept maps have frequently been used by researchers in the field of knowledge organization to present their findings. The majority of concept maps that researchers used applied to one dominant model: Peirce's triadic theory. The importance of this study is that it is the first to examine the manner in which knowledge organization researchers' use of concept maps to illustrate their findings. More research needs to address how researchers used concept maps and how can we classified the concepts inside the maps and their formats of maps. In addition, more research needs to address whether or not researchers used Concept maps or any other software applications to illustrate their findings.

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CONCEPT MAPPING OF SCIENTIFIC PROPOSITIONS WITH ADVERBIAL PHRASES OR CLAUSES

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Abstract. The traditional concept mapping method developed for English causes problems in other languages. These problems are mostly caused by the limitation of the traditional concept mapping method in representing the complete meaning of the proposition compared with the natural language. This study investigates an alternative method to construct a concept map of a proposition that contains adverbial phrases or clauses that are difficult to make sense of with the traditional method. The study results in an alternative concept mapping method for the propositions which is easier to construct and has a clearer meaning than the traditional one. We also developed an online concept mapping program which can construct a concept map using the newly derived method. We applied the new concept mapping method and program to seniors at the university. The result was that 73% of the participants preferred the newly developed method for presenting adverbial phrases or clauses, and in reading, 79% of the participants preferred the new method to the old one.

1 Introduction

Since the late 1980s when the concept map was introduced in Korea, it has been used for several purposes including organizing and representing knowledge, determining a learner's alternative conceptions, and examining changes in the cognitive structure. In science education, especially in biology, a lot of research on the concept map is being accomplished. Through the continuing research, it has been revealed that the concept map is an effective learning tool for Korean students (Kim & Oh, 1995). Also, most middle school science textbooks contain concept maps to encourage concept mapping by students (Cho, So, & Kim, 2005). In order to encourage an effective and easy application of the concept map as a teaching and learning tool, an online concept mapping program and concept map evaluation program was developed (Ahn, So, & Kim, 2006; So & Kim, 2005).

However, with all these efforts, students are still experiencing difficulty with concept mapping: The four major difficult processes of concept mapping are: making hierarchy, finding relation between concepts, writing linker, and finding concepts (Lee & Kim, 2006). Thus we explored an alternative approach to 'finding relation between concepts' and 'writing linker.' Finally, we thought that the traditional method of representing an adverbial phrase or clause (AdvP/C) in the concept map was responsible for the problems.

2 Problem: Concept Map and Language

Though the concept map was invented in America for people who use English as their first language, people in other countries where English is not their first language are trying to use the concept map and it seems that they are using it with few difficulties in their language systems (Kilic, 2003).

On the other hand, syntactic difference makes it difficult to construct the concept map in Korean and Japanese (Lee, 1999), and it has been reported that the modification should be placed on the established English method of concept mapping when doing it in Turkish, which belongs to the Altaic languages along with Korean and Japanese (Kilic, 2003). Not only the difference between Altaic languages and English but also an error in the traditional method of constructing an English concept map for the proposition that contains an AdvP/C may cause difficulty when using the concept map.

2.1 Proposition of Scientific Knowledge that Contains Adverbial Phrase or Clause

Before we consider the error in the method of constructing a concept map for the proposition that contains an AdvP/C, let's think about the role and the meaning of the AdvP/C in the expression of scientific knowledge. Scientific concepts or phenomena are frequently explained or understood with many other conditions which limit them. So when we explain the scientific knowledge in a language, we use sentences and propositions that contain the AdvP/C, e.g., time, method, cause & effect, place, and degree, to limit and specify the meaning.

2.2 Problem of Concept Mapping a Proposition which Contains Adverbial Phrase or Clause

First of all, let's look at the linguistic difference between English and Korean. Table 1 shows that the word order is different. The English sentence is S(ubject) + V(erb) + O(bject), whereas the Korean is S(ubject) + O(bject) +

V(erb). This difference causes a difference in the construction and the interpretation of the concept map. Since Korean is an agglutinative language that has developed the postpositional word, it is relatively free from word order in forming the meanings compared with English. Therefore, it is simple to construct a concept map for the basic sentence ((a) of Table 1), and the linguistic difference can be easily overcome (Figure 1).

Table 1. Sentence of biological knowledge that contains adverbial phrase.

English	(a)	Green plants	make	carbohydrates		녹색 식물 = Green plants
		S	V	O		탄수화물= carbohydrates
	(b)	Green plants	make	carbohydrates	in chloroplast	엽록체 = chloroplast
		S	V	O	AdvP	만든다 = make
Korean	(a)	녹색 식물은	탄수화물을	만든다.		~은 : postposition for subject
		S	O	V		~을 : postposition for object
	(b)	녹색 식물은	엽록체에서	탄수화물을	만든다.	~에서 = in
		S	AdvP	O	V	

But if the proposition to construct contains an adverbial phrase that qualifies the predicate verb, the situation becomes more complicated. In English, the AdvP is added to the back of the VP (verb phrase) of the main sentence. But in Korean, it is inserted into the main sentence in front of the VP. The different positions cause a problem in constructing and interpreting the concept map.

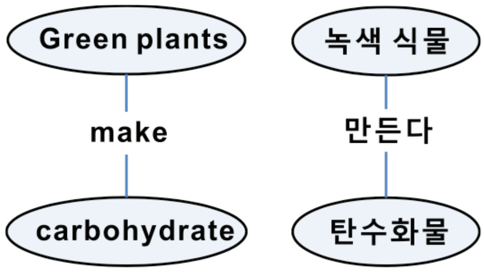

Figure 1. Concept map for a basic sentence ((a) of Table 1) that is easy to compose and makes sense in both languages.

Let's represent Sentence (b) of Table 1 as a concept map. Traditionally we construct a concept map like Figure 1 and then add the new concept 'chloroplast' to the second concept 'carbohydrates' simply by using the preposition 'in' (Figure 2).

Since this way of concept mapping for the AdvP - 'carbohydrates in chloroplast' - which contains the important concepts cannot form a meaningful proposition independently, the basic rule that every link between the two concepts should form a meaningful proposition is violated (Novak & Gowin, 1984; Wandersee, 2000). With all these violations, this expression has been connived and used because it is possible to form the original proposition - 'Green plants make carbohydrates in chloroplast' - when reading the concepts and connectives from top to bottom. But this way causes difficulty in representing the meanings because of the difference in the word order and the forming process of the meanings in Korean and some other languages.

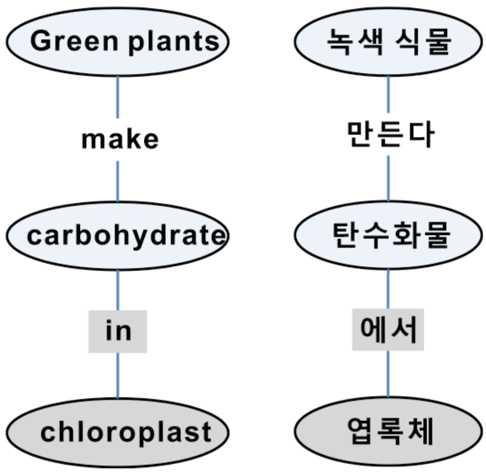

Figure 2. Traditional concept map of a sentence ((b) of Table 1) that contains an AdvP. In English, it matches the English word order. But in Korean, it is not a meaningful concept map. Also, in both languages, it is not possible to derive separated, meaningful propositions for each linker.

To avoid this problem, we can break the sentence which includes AdvP into several simple propositions and then construct a concept map from them. But this process of breaking sentence is too difficult for the students who faced a new scientific knowledge just now. It makes most students to feel difficulties in concept mapping. Also the concept map which constructed from broken propositions can't represent the full meaning of the original sentence.

Thus the traditional way of concept mapping needs to be improved so that students do not have any difficulties and can represent the proposition with full meaning.

3 Alternative Concept Mapping Method to Represent Adverbial Phrase or Clause

The traditional concept map organizes a meaningful proposition by linking two or more concepts with a linker. The linker was allowed only on the relation of concepts and this linker represents the relation between them. But as we have already seen, there are difficulties when expressing the AdvP meaningfully, which qualify the entire verbal phrase containing an important concept. To solve this problem, we have developed a concept map constructing method that allows the sublinker which links the main linker and concept (Table 2). By using this method, the proposition which contains an AdvP can be expressed meaningfully in Korean as well as in English (Figure 3).

Table 2. Alternative Concept Mapping Steps.

1. Identify scientific propositions (principles and laws). 2. Identify concepts and linking words in the propositions. 3. Arrange the concepts hierarchically. - From general at the top to specific at the bottom 4. Draw connecting lines among the arranged concepts to represent the relationship. - Each connection should be labeled with a linking word (linker) to represent the proposition. - If proposition contains adverbial phrase or clause which modifies the primary predication, link the phrase to the main linker and not the concept. 5. Find and draw cross-links to represent meaningful knowledge integration. 6. Add examples for the concepts. - Use "e.g." as a linker. - To distinguish examples from concepts, do not enclose them in circles. 7. Rearrange and revise the map to avoid being too complicated and let it be visually balanced.

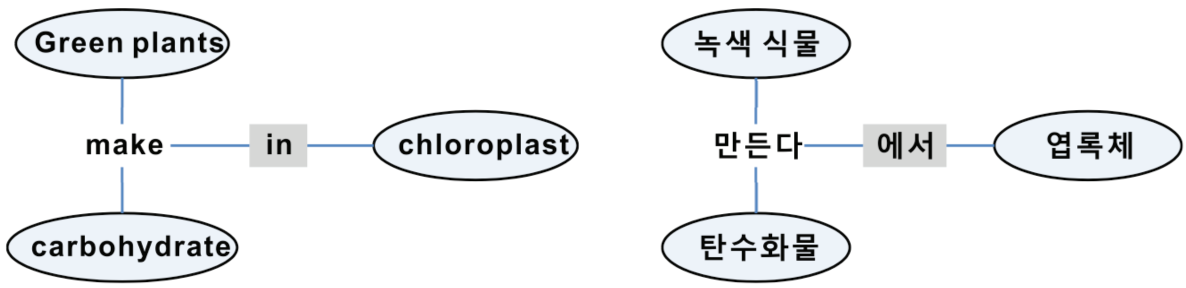

Figure 3. Concept map using alternative method for an AdvP. This is meaningful in Korean as well as in English, and it is easy to compose.

4 Online Concept Mapping Program to Construct Scientific Knowledge

By modifying the already developed online concept mapping program (So & Kim, 2005), we developed an expanded concept mapping program which supports an alternative concept mapping method that allows using sublinker to the main linker. Using this program, it is possible to construct a concept map not only in the traditional way but also with the new alterative way (Figure 4).

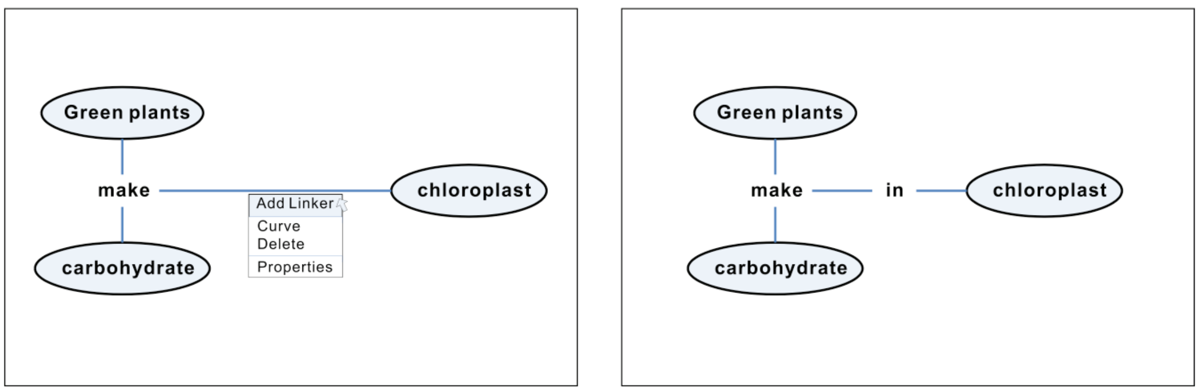

Figure 4. Expanded online concept mapping program (http://bioedu.snu.ac.kr/conceptmap/online).
New functions are added for the alternative concept mapping method on the popup menu (left). It is easy to construct a meaningful concept map (right).

5 Application and Result

To make sure that the alternative concept mapping method is really helpful to construct and interpret the concept map containing an adverbial phrase or clause, we applied the new concept mapping method and program to senior students majoring in biology education at university.

First, to examine which method was preferred, we asked them to construct a concept map for a proposition containing an AdvP. Twenty-two of the thirty participants, or 73%, constructed it as the expanded form by using the alternative method.

Next, we showed them a proposition containing an AdvP and two concept maps of the proposition which were constructed with the traditional method and the newly developed method respectively. We then asked them which one represented the proposition more clearly. Twenty-three of the twenty-nine participants, or 79%, answered that the concept map constructed with the newly developed method was a clearer representation of the proposition.

6 Conclusion

To solve learners' difficulties with concept mapping of scientific knowledge that contain adverbial phrases or clauses, we pointed out the problem of the traditional concept mapping method in this study. Through the investigation, we derived an alternative concept mapping method for the propositions which contain an AdvP/C; If proposition contains adverbial phrase or clause which modifies the primary predication, link the phrase to the main linker and not the concept. It is easier to compose and clearer in its meaning than the traditional one.

We also developed an online concept mapping program which composes a concept map using the newly derived method. By using this program, verification of the newly derived concept mapping method was carried out even though it has limitations. It is necessary to verify the newly derived concept mapping method with a more systematic study. It also needs to be applied and verified whether the new method is effective for the people whose first language has the SVO word order. Furthermore, investigation should continue about the influence of the newly developed concept mapping method on learning.

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CONCEPT MAPPING THE EXPERT KNOWLEDGE OF A UNIVERSITY LECTURER. A CASE-STUDY

Albisu García, Sagrario; González García, Fermín; San Martín Echeverría, Inés; Fiz Poveda, Mª Reyes; Guruceaga Zubillaga, Aranzazu; Pozueta Mendia, Edurne; Tabar Oneca, Mª Jesús; Gómez Laso, Miguel Angel. Universidad Pública de Navarra, Pamplona, Spain
Email: albisu@unavarra.es, fermin@unavarra.es, ines.sanmartin@unavarra.es, reyesfiz@unavarra.es, arantzazu.guruceaga@unavarra.es, edurne.pozueta@unavarra.es, mjesus.tabar@unavarra.es, mangel.gomez@unavarra.es

This paper presents a knowledge model of the good teaching practices of a university lecturer awarded the 2005 Spanish National Award for Educational Research and Innovation in the field of new technology application in university teaching. The model was created within the framework of an investigation being carried out by six Spanish universities. The paper identifies, analyzes, makes explicit and, with the help of CmapTools (Cañas et al, 2004) computer software, represents the pedagogical thinking and teaching practice of a university lecturer with a reputation for good practice. The resulting knowledge model of the good practices of this lecturer is readily accessible via the Internet and provides an excellent guide not only for new lecturers but also experienced lecturers who wish to improve the quality of their teaching.

1 Introduction

The changes currently affecting the University environment are common knowledge. In this context of change, the quality of university teaching is one of the strategic priorities of further education institutions the world over. In our setting, the successive declarations of Prague (2001), Berlin (2003), Bergen (2005), and London (2007) have named it as one of the basic referents of the process of convergence towards a European Space for Higher Education Superior (ESHE).

Improving teaching quality is without doubt a complex process in which numerous factors, ranging from educational policies and available resources to the traditions and cultures of individual countries, etc. play a role. The most decisive role of all, however, is, without doubt, that of teachers and the teacher training process. Some teachers believe there is no reason to change tried and tested methods: in this case, it is essential to revise existing ideas and test them against new approaches. Others believe in the importance of change but do not know how to ensure it is properly carried out: in this case, practical referents are required to enable such teachers to use the practice of their more experienced colleagues as an "example" or "point of reference". In any event, it is absolutely essential to break away from the inertia and close-mindedness that is prevalent in university teaching and "make visible" both the ideas and the practices of "good" university teachers. In this context, a project aimed at increasing the visibility of good teaching practices is being undertaken by several universities (Zabalza, 2004/08), among them the Public University of Navarra. This poster offers an example of one of the lecturers considered to provide a model of good teaching practice and awarded third place in the 2005 Spanish National Awards for Educational Research and Innovation "*Aulario Virtual: un nuevo espacio para la docencia y la armonización europea en la Universidad Pública de Navarra" (The Virtual Classroom: a new space for the harmonization of teaching in Europe).*

2 Methodology

The aim of this research was to identify, analyze and make explicit the pedagogical thinking and practices of University lecturers, from various disciplines, who have been assesses as providing a model of "good practice", and to visualize and contextualize these good practices using concept maps, with the aid of CmapTools (Cañas et al, 2004). The basic methodology can be described as follows:

1. *Prior interviews* with lecturers identified as providing a model of "good practice". Figure 1 shows the concept map created by research team member, Professor Fiz. based on the interview outcome.
2. *Video-taping of class sessions* (in any form: theoretical, practical, seminars, lab. work, tutorials, etc.).
3. *Creation of concept maps using CmapTools* (applied methodology) for each of the lecturers interviewed.
4. *Follow-up interviews* with the lecturers chosen for the study in order to go over the resulting concept maps and select appropriate links. They were also asked to talk through the taped classroom sessions and select whatever sequences they thought best illustrated their ideas.
5. The teaching materials chosen by the lecturers were digitalized and linked to the matching concepts on the maps, to provide us with a dynamic representation of the conceptual framework of each lecturer and enable us to link it to specific sequences from his teaching.
6. The work carried out by/with each lecturer was put on to a DVD to serve as database where university

teaching staff could find “examples” and “documentation” relating to various different courses and disciplines.

3 Discussion and results

The concept map in Figure 1 was based on the interview with the lecturer in question. The lecturer’s biographical details, teaching and research experience and general views and opinions of conditions at the university can be found by clicking on the corresponding icons. Two extra concepts can be accessed by clicking on the corresponding icon, one is the interview transcript and the other the remarks of the lecturer performing the research.

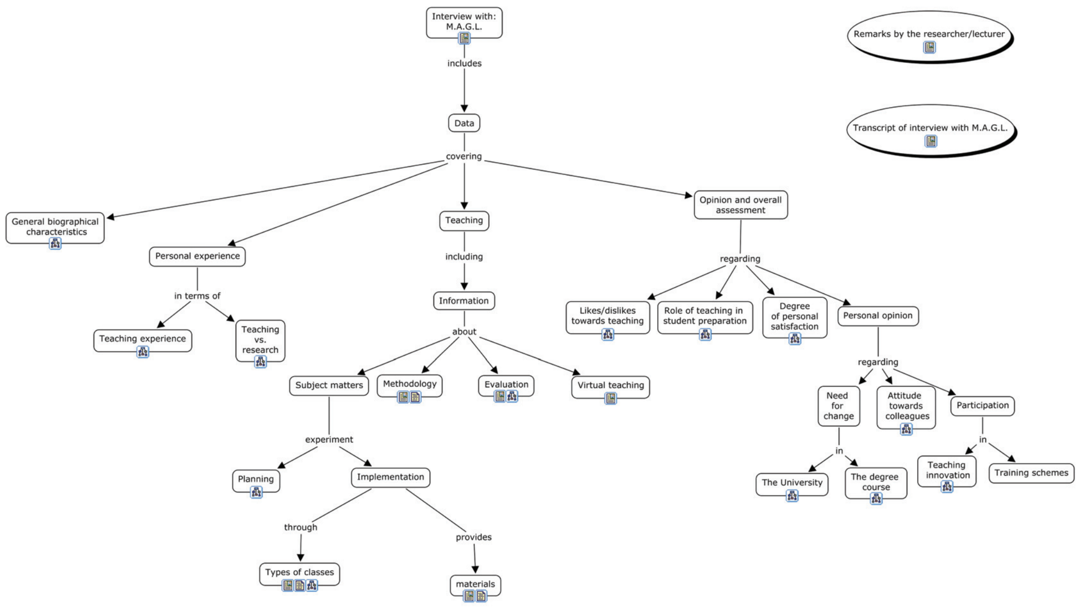

Figure 1. Concept map of the knowledge elicited from the "good practice" lecturer

Figure 2, which appears after clicking on the icon linked to “Planning” in Figure 1 shows a concept map of the subject planning made by the lecturer in question. The subject in this case is *Fibre Optic Networks (which is taught almost entirely in English),* and represents 4 ECTS (or 6 LRU credits) for the fifth year of the degree course in Telecommunications Engineering. The map shows the subject planning with several of the links from the related concepts left open. There is also a concept relating to the remarks on the subject planning made by the lecturer conducting the research. These can also be accessed by clicking on the corresponding icon.

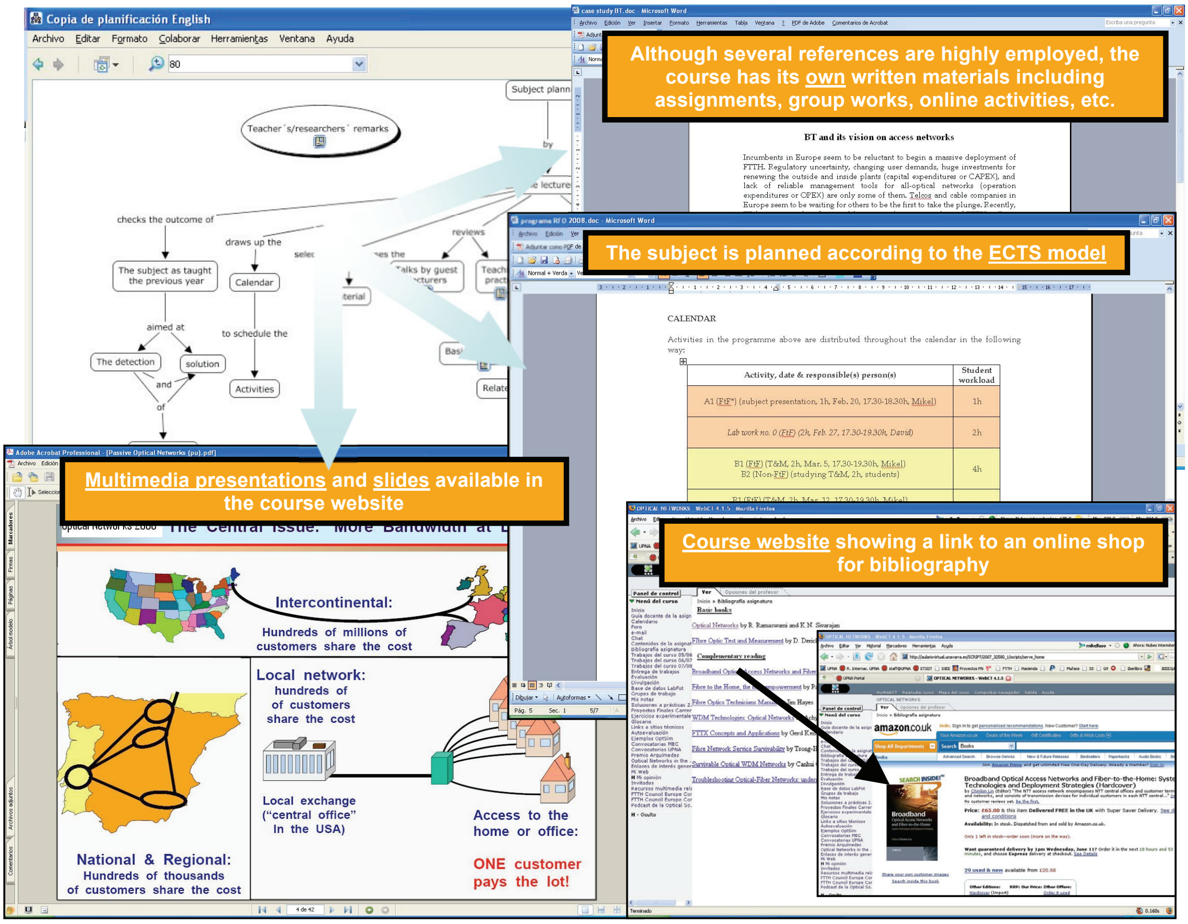

Figure 2 Concept map showing the subject planning with some of the links open.

Finally, figure 3 shows a concept map giving a detailed description of the organization of a lesson. It is easy to appreciate the good balance between theory and practice that has been achieved in this subject, together with the use of a varied methodology, intelligently designed to motivate students and maintain their pace of activity. It is also worth pointing out the use of new technologies in the form of computer simulations and animations. Continuous interaction among the students and between students and the lecturer was made possible by the elearning platform. Of particular interest from the point of view of teaching strategy is the habit of reviewing the content of the previous lesson in order to anticipate that of the next. The students' presentations enable us to visualize the way in which they transform information into useful knowledge. Note also the icons associated with the various concepts; these provide links with different resources and explanations.

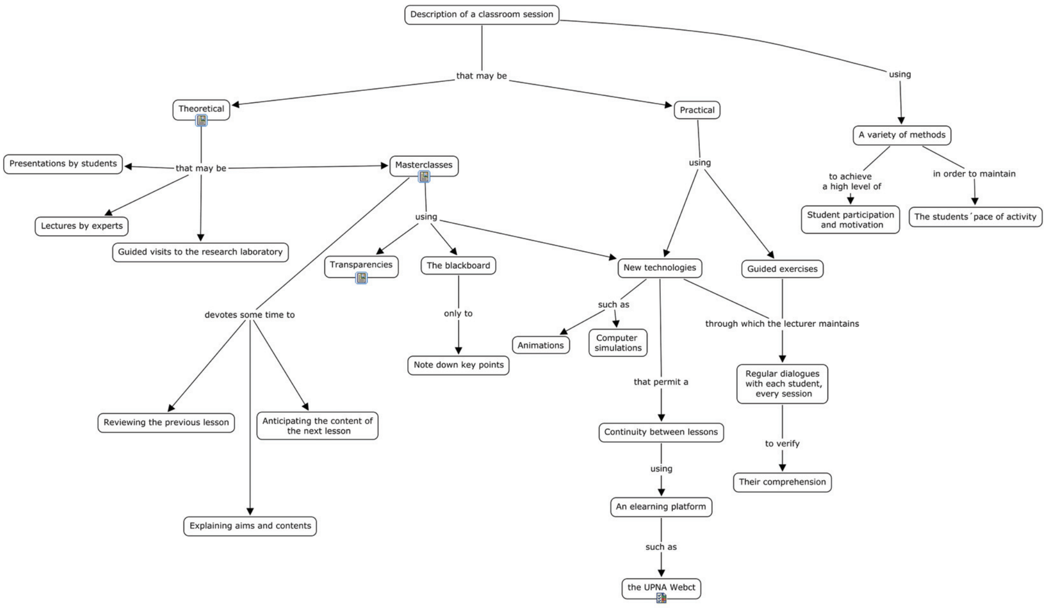

Figure 3 Concept map showing the elements involved in a classroom session

4 Conclusions

In the light of the data obtained, though with all due caution, it can be said that

- ✓ The maps effectively and efficiently reflect the lecturers' knowledge and the way they teach their subjects, as illustrated by the various concept maps constructed from the information provided by the lecturers. The maps have made their good practices visible.
- ✓ The iterative process of negotiating and sharing meanings in the various maps constructed in collaboration between the researching lecturer and the "good practice" lecturer has set up a constant flow of feedback leading to a clarification of the experts' own stock of knowledge.
- ✓ The CmapTools software has proved to be a powerful tool not only for designing the interview and managing the data but also for eliciting and then representing the knowledge.

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CONCEPT MAPPING: A TOOL FOR CREATING A LITERATURE REVIEW

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Abstract. Conducting a systematic literature review is an essential research activity in ensuring a good piece of research. However, students who are new to this research activity may find the activity highly challenging. This article presents the findings from a classroom research involving pre-service teachers on the use of concept mappings for conducting and creating a literature review. The findings indicate that students are overwhelmed by the vast amount of information that they encounter and often do not know how to identify and organize the information to be of use in their research. However, by using concept maps, the creation of a literature review becomes less daunting and more bearable throughout. Concept mappings are used for two purposes mainly that is, to summarize the information obtained from an individual source and to synthesise information obtained from the different sources.

1 Introduction

Having adequate knowledge of the relevant subject matter in the area of what one intends to study is a pre-requisite to producing a good piece of research. Adequate knowledge will ensure that the research is well justified in all aspects of its planning and implementations. One sure way of achieving such a knowledge state is by conducting a systematic review of what has been done in the area of interest that is, to conduct a literature review. So important is the literature review to the academic research endeavours that a section of a research article or a chapter of a thesis is allocated to the literature review documentation.

Creating a literature review is no easy task for students, as it demands multiple skills. A literature review is a multi-stage process that involves scanning the information, making notes of what have been read, synthesizing and structuring the information, writing a critical review of the literature and building a bibliography (Rowley, and Slack, 2004). Often, the literature review process becomes more demanding as the research gets more complex. The field of study can also have a bearing on the literature review as wisely noted by Boote and Beile (2005), "*... a thorough, sophisticated review of literature is even more important in education research, with its messy, complex problems, than in most other fields and disciplines*."

During the review process, the vast amount of information that is available to students is often the cause for high anxiety to many students especially to those who are new to the task. Rowley and Slack (2004) observe that "*Encountering the messy nature of knowledge*" while conducting the literature review can be "*One of the most intimidating aspects of a literature review…*" (p.1). Concept mappings have been suggested as one of the tools that can help in making sense of information while conducting a literature review (Carnot, 2006, Rowley and Slack, 2004). Rowley and Slack (2004) propose "*…concept mapping can be a useful way of identifying key concepts in a collection of documents or a research area*" (p.8). They suggest that concept maps can be used as a tool to "*…identify additional search terms during the literature search, clarify thinking about the structure of the literature review in preparation for writing the review and understand theory, concepts and the relationships between them*" (Rowley and Slack, 2004, p.8). What is more important, representing information in concept maps will provide a tool for potentially seeing the interconnections between areas that were not previously apparent (Novak, 1984). In this way thus, concept maps can be useful in creating coherence to the actual writing of the literature review. The objectives of this article are to identify the major challenges faced by students in creating a literature review, to determine what concept maps are being used for in the process and to determine their perceptions of the usefulness of concept mappings in the creation of a literature review.

2 Methods

The participants were a heterogeneous group of students (n = 47) from the Master in Technical and Vocational Education (MTVE) programme at Universiti Tun Hussein Onn Malaysia. The majority of students (~85%) were engineering graduates (civil, mechanical and electrical engineering) and the rest were information technology, business studies and hospitality graduates. The MTVE programme is a pre-service teacher-training programme and thus, the students have no prior teaching experience. The average age of the students was 24 years old and 40 out of the 47 students were females. The students were taking the research methods class taught by the first author which was offered in the first semester of this programme. The course required 200 hours of students' learning time.

As part of this course, each student was required to write a literature review on a topic of his or her choice, related to the technical and vocational education and training (TVET). A list of 11 topics pertaining to TVET and their sub-areas were given to students to assist them in determining a topic for their literature search. To help them focus on what information to gather, students were asked to write "research questions" related to the topic that they chose and to seek the answers to these questions from printed journals, online-journals and books. Suggestions were made on suitable questions such as, "what is the definition of…", "what are the advantages of …" and what are the benefits of…" Students were also taught how to use summary tables and concept maps for synthesizing and organizing the information that they had gathered. For the summary tables, they were asked to use summary titles such as objectives, sample, instruments and findings to focus their summarization efforts. All students were instructed to use the concept-mapping tool CmapTools downloaded from the website of the Institute of Human and Machine Cognition to construct their concept maps.

Before the mid semester break, students submitted three items for their literature review assignment namely, a five-page literature review on a topic of their choice, a journal describing their learning experience and a description of the process and activities that they had undertaken to create their literature reviews. They were encouraged to include flowcharts, tables and concept maps in the description of their literature review process. Students were also encouraged to share their thoughts in the journal on the difficulties that they faced as well as their perception of the usefulness of the three tools that they used. To verify whether concept mappings had any influence on the content and organization of their literature reviews, the drawn concept maps were compared to the written literature reviews. The three items were analysed to achieve the objectives of the study mentioned earlier.

3 Findings and discussions

Out of 47 students, only 45 students (96%) use concept mappings in the creation of their literature reviews. Of those who use concept mappings, 12 students (27%) make use of concept mappings to summarise information from an individual source as well as to synthesise the information that they have gathered while the rest use summary tables to summarise and concept mappings to synthesise information.

3.1 Challenges faced by students in creating a literature review

Analysis of students' journals indicates that many students find conducting a literature review is highly challenging. The first challenge for them is deciding on a topic for the literature search, "*..finding the topic is quite difficult because I am not sure of which topic that could catch my interest*" (GB186) and "*…cannot decide on the area to create the literature review* …" (GB018). Their lack of experience in teaching and thus of the educational issues makes it extremely difficult for them to come up with a topic that could catch their interests. Students tend to spend a lot of time and an effort before a final topic is decided. One student (GB007) who begins his search on women in TVET focussing on sexual harassment at the workplace changes his search topics several times before he finally decides that he likes to work on virtual laboratories and technology in TVET. Students typically read on three topics with five to ten articles on each before they can decide on the one that they feel comfortable with. This exercise can take them up to week six sometimes leaving them little time to complete their assignment. Once a student has decided on a topic, the next major hurdle that they face is their inability to identify the main ideas from the article that they read, as clearly exemplified by (GB215), "*… do not know how to extract the gist of the articles that I read*". For students who manage to extract the information that they feel they need, the next hurdle for them is how to organise and synthesise the information in a useful form that is, as lamented by (GB252), "*...I worry about how I'm going to add up all the information to make one essay that make sense…*". Therefore, making sense of the information that they have gathered is certainly not an easy task for students.

3.2 Uses of concept mappings in creating a literature review

Upon analyzing the concept maps and the description of the literature review process it is found that students make use of concept maps in three inter-related ways namely, to extract and summarise the important points from an article, to synthesize and organize information obtained from multiple sources.

3.2.1 Using concept maps to extract and summarize main points from an article

An example of a concept used for summarization purposes is shown in Figure 1. The author of this concept map writes in her journal of the difficulties that she experiences in extracting the required information from the materials that she has read, "*… do not know how to extract the gist of the articles that I read*" (GB215). This

particular student feels that concept mappings help her to overcome the extraction problem, "…*from the concept map of the individual article*, *I have identified the important points related to learning styles*…" (GB215). Another student who concurs with her states "…*concept mapping is a way to get an idea* …" (GB128).
The concept maps produced by both students are typically of the spoke type with a maximum of three levels of hierarchies. The structure of their concept maps indicate that they may not have a good understanding of the article that they have read. Nonetheless, by using concept mappings, they manage to extract some relevant key concepts and to reduce their anxiety relating to the issue of extracting information from a source.

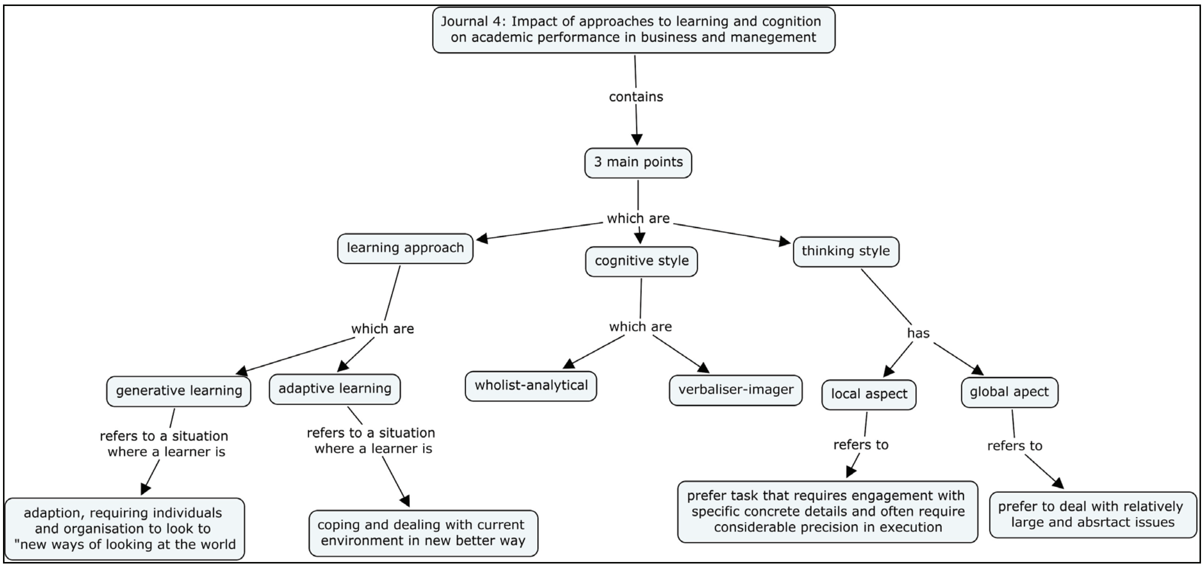

Figure 1: Important points and concepts identified from an article using concept mapping

3.2.2 Using concept map to summarise information

Quite a number of students use concept maps to summarise information obtain from multiple sources. The content of the summary depends on the question that underlies the concept map. One of the most asked questions is of the type "*What is the definition for* …" As stated earlier; these students have no prior experience in teacher education and therefore, are unfamiliar to most education concepts. Concept mappings help these students to construct the meaning of the concepts that they are interested in based on the information retrieved. Figure 2 is an example of a concept map constructed by one student who is interested in defining the concept of problem based learning (PBL). In this case, concept mapping produced is a network type showing the student's emerging understanding of the concept of PBL.

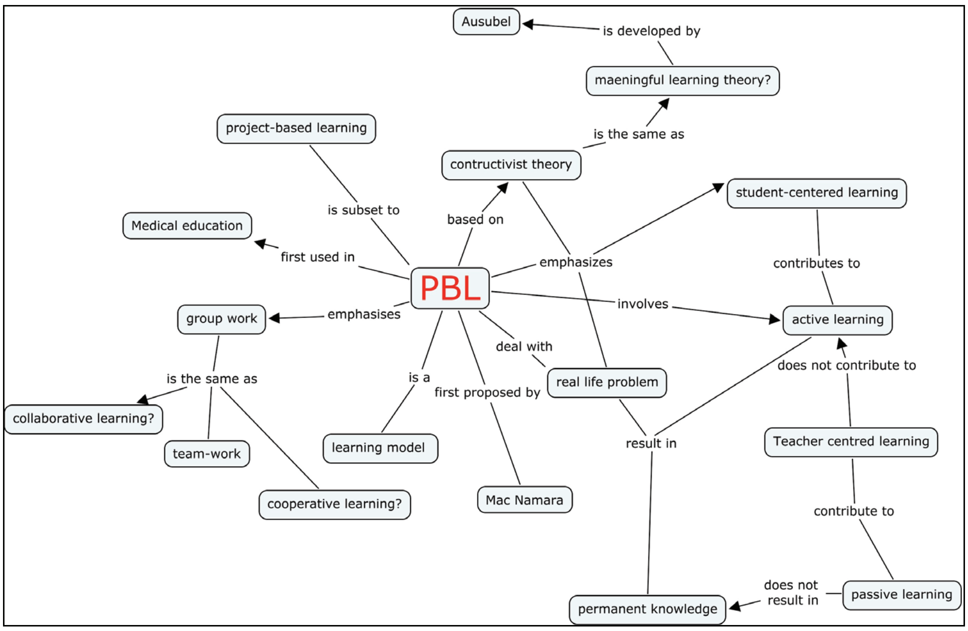

Figure 2: An example of a concept map used to elaborate on the concept of problem based learning (PBL)

3.2.3 Using concept mappings for organizing and structuring the literature review paper

When a concept map is used for organising and structuring a literature review paper, the structure of the concept map often takes the form given in Figure 1 where the hierarchy of topics and sub-topics are clearly illustrated. The top most concepts often become the title, followed by the next lower concepts as sub-headings and so on. The content, structure and organisation of the concept map is thus used as the framework for the literature review paper. The comprehensiveness and the quality of the concept maps content is however, determined not only by the guiding questions but also by the students' comprehension of the materials that they read. Therefore, a concept map that looks structurally good may not produce a good literature review paper.

3.3 Perception of students towards the usefulness of concept maps

Out of the 45 students who used concept mapping, 12 students draw concept maps first to summarize the individual journal articles before summarising the information using tables of summaries. The rest of the students use summary tables first to summarize information from the individual source, which is later represented in the form of concept maps. The decision to draw the concept maps or tables first could have been influenced by prior experience on concept maps, "*…I used concept map to summarize my journal articles because I believe that it is the best method … I have used it since my secondary school days*" (GB169). This particular student produced sixteen concept maps, one for each of the article that she reads. Another student felt that using concept maps help her in writing her literature review; "*I have found that concept maps used in this assignment has helped me a lot in writing a good literature review. I can plan what I'm going to include in the literature review by constructing the concept map. Concept map has saved my time and it's easy to understand"* (GB186). Some students with engineering background however, find that constructing concept maps is loaded with anxiety. One student states that "*do not know what words to use to make the connections as there were so many choices of words available*" (GB070). It appears that the open-ended nature of the concept mapping process may have caused high anxiety among some students. Not surprisingly, their past trainings as engineers could have pre-disposed them towards analytical-mathematical inclinations rather than verbal-analytical inclinations. Nonetheless, based on the concept maps constructed, the journals and the literature review paper that they submitted, concept mapping is perceived by students in general to be a useful tool in the creation of literature review.

4 Conclusion

Overall, most students find that creating a literature review is highly challenging with deciding on a topic, extracting ideas from a document and synthesizing and organizing information being the three major areas of concern. Nonetheless, evidence from the documents that students submitted indicate that concept mappings do help them to a certain extent in the three major areas of concern. It also observed that the content and quality of the concept maps are determined by the questions students ask as well their comprehension of the materials that they read and thus, the quality of the literature paper, which varies accordingly.

5 Acknowledgements

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CONCEPT MAPS AND KNOWLEDGE BUILDING DISCOURSE: A USER INTERFACE PROTOTYPES FOR THE NEXT GENERATION LEARNING TOOLS

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Abstract. This paper presents an idea of a poster with an interactive installation. The aim of the poster is to open discussion about the possibilities to combine the principles of concept map and knowledge building discourse techniques in a way that will benefit meaningful learning. The poster will include four design proposals and prototypes with the possibility to try out how a combination of concept map tool and knowledge building tool could work. The proposed prototypes are studies of the possible interaction among the participants aiming to achieve meaning on complex topics and gain higher cognitive and intelligence skills needed in a knowledge society.

1 Introduction

In a poster presented in this paper we will introduce four user interface prototypes that combine concept map creation and knowledge-building discourse techniques and tools.

The objective is to use concrete user interface prototypes to introduce new ideas about computer tools can support meaningful learning. The user interface prototypes are presented for the concept map research community to evaluate, to discuss and to build on. The prototypes represent explorations of possible new directions in the design of the next generation learning tools.

Even though the thinking behind concept maps and knowledge building come from different traditions of learning theories -- the first building more on individual cognitive learning theories and the second more on cultural psychology -- the approaches should not be considered as irreconcilable. In both approaches the emphasis is on meaning making in the sense of aiming to understand complex concepts and their relations in the world. The main differences between the two approaches are in the way they define knowledge: as an individual structure representing something that is (or not) "the truth", or something that is by nature contextual, culturally and historically embedded and as a such socially distributed and constructed.

2 Principles of Concept Maps in Learning

The idea of concept maps is a result of Joseph Novak's (1984) and his colleagues' work based on David Ausubels' (1963) theory of learning. According to Ausubel, making meaning is central to all human learning. Learning with meaning, or meaningful learning, requires the ability to structure ones knowledge and the ability to add new knowledge to existing structures. Concept maps aim to visualize knowledge structures in terms of conceptual elements and the relationship between them. The process of making concept maps is intended to help with conceptualizing and memorizing knowledge.

This way learning with concept map is usually based on the assumption that learning takes place by assimilation of new concepts into existing conceptual network (Novak & Cañas, 2008). This assumption requires a strong analogy between the concept maps as artifacts and the human conceptual network -- a cognitive state. It is, however, an open question if the analogy holds and if there are mental equivalents for processes students can do with concept maps and whether these processes benefit meaningful learning.

Following the cognitive learning theory of Ausubles (1963), Novak and Cañas (2008) distinguish between meaningful learning and rote learning. Novak and Cañas define three preconditions for meaningful learning: (1) The material to be learned is conceptually clear, (2) the material is combined to relevant prior knowledge, and (3) learner has chosen to do meaningful learning.

The CmapTools is the most widely used software tool for creating concept maps. Novak and Cañas (2008) offer a description of learning activities using CmapTools that is intended to produce meaningful learning. They define their approach as a "guided inquiry"-model, where instead of free form study projects the inquiry is based on expert skeleton maps. The expert skeleton maps are simple and sparse concept maps created by an expert of the subject field and they are intended to provide scaffolds for learners' concept maps. This is justified by noticing that as concept maps grow, false information and misunderstandings are often difficult to notice and correct, so it is better to have everyone begin building on a solid base. The building of concept maps should also be guided by a focus question, which sets the direction and limits of inquiry. Adding new concepts to expert skeleton maps can be done individually or from "knowledge soup", where learners add concepts to common pool, but concepts' links to other concepts are kept private. This allows keeping concept maps individual but comparable. Concept maps can also be edited and commented collaboratively.

A good concept map according to Novak and Cañas (2008) should consist of concepts with simple labels, but with exact relations between them. A concept node can contain links to other resources and a possible clarifying text. If the concept is itself a complex concept, which would benefit from a concept map to explain itself, this is implemented by cross-linking the concept to other map or subsection of a map. In a good concept map reorganizing and modifying the map is easier, as relationships and concepts are clearly separated: relationships between the concepts can be redefined without changing the concept itself. It is not, however, clear that human conceptual system has this kind of separation. With concept maps the common difficulty of learning to use "linking words" properly may be related to the nature of human semantic system.

Theories of human semantic systems (Jackendoff 2003, Pustejovsky 1995, Fodor 2002, Chomsky 2002) suggest that concepts in a human mind are anything but clearly defined. It is common for concepts to have at least several aspects that are invoked depending on what kind of action concept is participating: for example a bank is an abstract institution and a building, and the concept of money is even more complicated. Similarly meanings of predicates are similarly context dependant: run, run for a president, run there, a good run is an example of how the meaning of concepts is made only in the context they are used. These kinds of difficulties do not usually rise when working with small concept maps, especially when the focus question helps to direct attention toward one aspect of ambiguous concept. Also many things that are easy and natural to create with language are difficult to express with concept maps: adjectives when there is a need for different outcomes for same adjective: difficult birth and difficult test would require two separate instances of concept difficult, or the implications of difficult birth and difficult test would become mixed.

3 Principles of Knowledge Building Discourse in Learning

In the same way that Novak and Cañas (2008) base the idea of concept maps on an attempt to reach meaningful learning, so do Scardamalia and Bereiter with their idea of knowledge building (2003). Knowledge building changes the focus of "learning" from merely a process that results in change of individual belief, attitude and skills to something deeper, often called meta-cognitive. The most fundamental results of knowledge building are critical thinking skills, with advantaged methodological and epistemological understanding. Knowledge building practices are claimed to guide people to "developmental trajectory leading from the natural inquisitiveness of the young child to the disciplined creativity of the mature knowledge producer" (Scardamalia, M., & Bereiter, C. 2003).

Scardamalia (2002) has defined the principles of knowledge building communities. First of all participants in a knowledge building community should focus on authentic problems and real ideas in a real world. All the ideas presented by the participants should be regarded as ideas that can be improved. The diversity of ideas and point of views are seen necessary to improve the ideas. From the variety of ideas, the participants should be able to "rise above" individual ideas and create new concepts that are higher level concepts than the original concepts and ideas presented by the participants. The participants should hold epistemic agency - their should negotiate a fit between their personal ideas and ideas of others and this way sustain knowledge advancements. The ownership of the knowledge should be shared and all the participants should have a same rights to contribute to the collective community knowledge. Participants should use variety of information sources and have a respect and understanding of authoritative knowledge sources combined with a critical stance towards them. The knowledge building discourse should be more than just sharing of knowledge - the overall explicit goal of the participants should be advancement of knowledge. Evaluation and assessment of the activity is considered as part of the effort to advantage knowledge. This way the participants should engage in its own internal assessment, that is pervasive and ongoing. A kind of side or meta products of knowledge building focusing on to advantage knowledge on some specific topic are often considered to be critical thinking, increases in literacy, information search and general productivity in knowledge intensive work.

The Fle3 Knowledge building tool (KB-tool) is a software component designed to support and enhance knowledge building discourse. The KB-tool is part of the Fle3 (http://fle3.uiah.fi), server software for computer supported collaborative learning (CSCL). Fle3 is designed for group-centered work that concentrates on creating and developing expressions of knowledge. KB-tool is group tool for having knowledge building discourse, theory building and debates in a shared database. KB-tool includes Knowledge Types to scaffold and structure the process. With the KB-tool the participants can post notes to the share database and when posting the participants are asked to use knowledge types summarizing the main thinking mode presented in the note. When selecting the knowledge type the KB-tool offers guidelines and checklists on how to write notes to the database. For instance, the Progressive Inquiry knowledge type set contains the following knowledge types: Problem; My Explanation, Scientific Explanation, Evaluation of the Process and Summary

The knowledge types guide students to think about the knowledge creation process, and helps students to write more substantial notes to the database. As an aid for users to follow the knowledge building discourse, users may take different views to the knowledge building database by sorting the notes as a discussion thread, by writer, by knowledge type, by date or on freely editable spatial map view. An advanced search engine allows searching the database of notes by title, author, course context or words used in the note. KB-tools are designed for progressive discussion, thinking, and pondering in a group as well as act as the collective memory of the process. These features of the tools are intended to help participants to identify the key centers of the collaborative activity, who is involved in the key centres of activity, who is working with whom, what new ideas are currently receiving the most attention, how one can participate in advancing the work of the collective etc. These are critical capabilities of knowledge building tools that move them beyond traditional threaded online discussions.

4 Four User Interface Prototypes

Combing concept maps and knowledge building discourse can be carried out by bringing concept maps to knowledge building or by bringing knowledge building to concept map creation. In the following we will describe four different prototypes where concept maps are integrated into knowledge building discourse.

4.1 Concept map as a media type in all knowledge building notes

With the current KB-Tool, participants may add in-line images to the knowledge building notes and links to external resources. The reasons to limit the use of media to images, and not having audio or video in the notes, are pedagogical. The process of writing notes and presenting arguments in a written form is considered to advantage the common knowledge in more easily reusable form than in a case of using time-depending media. Also formatting written notes is seen to advantage participants' thinking and argumentation skills. The concept maps inside knowledge building notes should be simple images used to explain or illustrate arguments. The concept map should be static images so that one could not change the content anymore when the note was posted to the database. One possibility is, however, that the concept map image is always just one revision of the map and one can build on it and use a new version in some other knowledge building note.

4.2 Concept map as a media type in notes that are some specific type

We may consider some pedagogical reasons to limit the use of concept maps only to some type of knowledge building notes. For instance, the concept map can be considered to be a tool to present a summary of the knowledge building discourse or as a rise above note bringing the knowledge building discourse on a new level. In one shared concept map the participants could bring together and summaries their discourses taking place in different places. The concept map could be collaboratively own by all the participants and the common map could be used as the context for a new knowledge building discourse. Based on the concept map the participants should formulate their new study problems for further discourse.

4.3 Knowledge building discourse notes inside concepts

Each concept is a concept map could also act as a discourse note, with more content and argumentation under each concept. This way the actual concept would be the subject of the note. The concepts / subjects of notes would be linked to each other in a normal concept map creation style, but inside each concept there could be more explanation and argumentation related to the content of the concepts. The concepts should not be editable, but one could start at any point a new creation of concept map / discourse that is building on some earlier concept map / knowledge building discourse. The difference to the current CMapTools feature of having a description of the concept is the aim to support discourse with the notes. This way the note attached to the concept should not be a description “hide” to inside the node, but the main content aiming to explain it and build on other notes presented in the map.

4.4 Knowledge building discourse and concept maps side by side

When writing a knowledge building note the participants could be asked to add also a single most important concept, keyword of tag related to the discourse note and relate it to other concepts presented in the discourse. This way the collective concept map would live next to the knowledge building discourse but in a close relation to the discourse. Based on the concepts, keywords or tags the system could also cluster notes that share the same concept, keyword and tags and could this way offer another alternative view to follow and keep eye on the discourse.

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CONCEPT MAPS AND THE IHMC CMAPTOOLS PROGRAM AS TOOLS TO FACILITATE CRITICAL REFLECTION

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Abstract. In the present work we will argue that both concept mapping and the IHMC CmapTools program´s search utility are invaluable tools for facilitating the critical reflection (CR) process. On the one hand, concept mapping may be a useful first step to bring to consciousness our knowledge, feelings and assumptions about a topic, as a tool for individual critical reflection. On the second hand, using the IHMC CmapTools program to consult maps done by others worldwide may allow us to add new, alternative perspectives. This, together with exchanging concept maps with other stakeholders, would allow for communal critical reflection at a local and worldwide level. The end result of this CR process would be a new concept map which integrates fresh perspectives and reflects newly gained meaningful learning. By way of example, we present the design and the a glimpse at the first steps of an on-going pilot study of CR facilitation in the proposed fashion, in which participants were asked to construct and exchange maps on the topic of *classroom management or discipline*.

1 Introduction

In the preface of their book "Learning How to Learn", Novak and Gowin (1984) pose an interesting question: "How can we help individuals to reflect upon their experience and to construct new, more powerful meanings?" In the following pages, the authors propose concept mapping as a process than can help educators to achieve this ambitious goal. Thus, concept maps are presented precisely as a tool to aid the reflection process, considered a crucial step in learning; i.e., in changing the meaning of experience. Elaborating on this idea, in the present work we will explore the value of both concept mapping and the IHMC CmapTools software[1] (Cañas et al, 2004) in facilitating the critical reflection (CR) process.

In order to be able to explore the possibilities of the process suggested, we are currently conducting a pilot study on facilitating CR about a topic that we regard as a dilemma for educators: discipline. Twenty-five administrators, educators, students and family members from an urban elementary school in Allen, Río Negro, Argentina, are participating in the study. This intentional sampling was supported by the fact that each group represents different stakeholders in the issue at hand, who will add fresh perspectives to the reflective process.

We are at the first stage in our study; that is, we have collected the first participants´ concept maps. As a second step, the participants will engage in local communal CR. Then, they will use the IHMC CmapTools program's search tool to look for maps on discipline, so as to consider these maps in their further communal reflection. In the final phase, participants will construct a new map that reflects how this reflection process has enriched their meaning making as regards the topic. To round off the data gathering procedure, we will conduct semi-structured interviews, to learn about their opinion about this process for facilitating CR. Given the fact that we do not have definitive results, we will discuss some of the possibilities for CR that we foresee regarding the concept maps presented, as a way to illustrate the potential of the process suggested.

2 Critical Reflection

There is no clear cut definition of what exactly is entailed in the CR process (Brookfield, 2000; Mezirow, 1990). For the purposes of this work, we will adhere to the following definition of CR, which was suggested as the result of synthesizing an important number of works that focus on this process: ¨**a *commitment* to consider any proposition, assumption or practice, the reasons that support it and the further consequences to which it tends, in the light *of multiple theoretical and personal lenses*.**¨ (Chrobak-Muñoz, 2001)

This definition emphasizes a key element which most authors would agree is essential in the critical reflection process: considering multiple lenses or perspectives. In other words, it highlights the importance of being able to take into account numerous viewpoints in order to more fully appreciate the object of reflection. These myriad of possible perspectives includes theoretical productions (such as humanism, feminism, gender studies, etc.), feelings, intuition (Greene, 1973), experiential knowledge (Dewey, 1938; Kolb, 1984) and the points of view of experts and of all stakeholders.

[1] This software program was downloaded from http://cmap.ihmc.us/ .

If we come to a renewed interpretation of reality, then meaningful learning (Ausubel, Novak & Hanesian, 1968) has taken place. It's important that this questioning process occurs in a supportive and respectful atmosphere; as Novak (1998) points out, the role of affect is of upmost importance. He explicates that "the complex interaction that takes place between stored info about knowledge, feelings and actions is very important." Moreover, he suggests that integrating these three aspects of learning is an empowering experience: "Knowledge that we have learned meaningfully, that we have constructed from a union of our actions, feelings and conscious thought, is knowledge we control […] and with which you feel a sense of ownership and power."

3 Concept Mapping and Critical Reflection

The process of constructing a map about a given topic, as Novak and Gowin (1984) have shown, implies an individual reflection process that allows us to depict the concepts that we deem important as regards that subject and the links that we see among these concepts. When we construct the map, our conceptions, misconceptions and assumptions come clearly into play and are reflected in the fashion in which we decide to show the relationships among the different concepts. This is why constructing a map is proposed as the first step, which should be followed by an instance of communal reflection.

As a second step, communal CR may be achieved by exchanging and discussing maps with other stakeholders, who can help us question our interpretations and assumptions. Each participant should explicate why they believe certain concepts should or should not be included; where a concept should be placed in the map´s hierarchy or how conceptualizations should be linked to others. This collective process has the potential of facilitating CR upon the philosophical matters or differing interpretations regarding the object of reflection.

Let's refer to our study to illustrate this point. In analyzing the concept maps constructed by an Elementary School Teacher (Fig. 1) and the Principal of the same school (fig. 2), we can see how each of them included different concepts in the map, which reflects the fact that they represent different perspectives to the issue. We can only speculate (as we invite the reader to) about the communal reflection process that may occur when they are both asked to consider each other´s map, but we believe they will both modify their map to some extent, to reflect the new perspective gained. For instance, we may expect some fruitful discussion around the fact that the teacher has included concepts like *society, violence* and *injustice* while the principal has introduced ideas such as *the family´s responsibility* as regards the students´ behavior, *behavior management strategies* and *consensus.* Both of them, however, have considered *values* to be a central concept, which may mean that, upon CR, this will become a yet more meaningful concept for both.

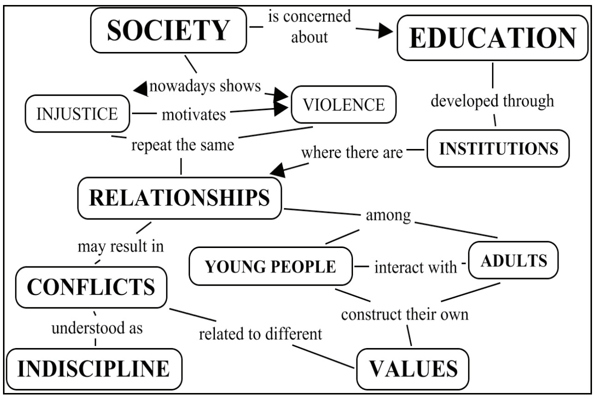

Figure 1. C-map on Discipline by Elementary School Teacher

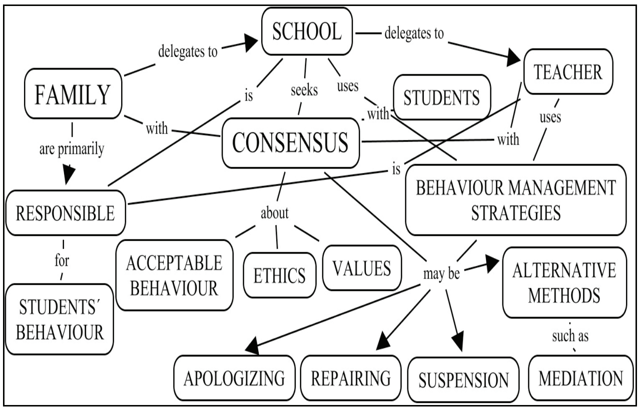

Figure 2. C-map on Discipline by Elementary School Principal

4 The IHMC CmapTools Program and Critical Reflection

The IHMC CmapTools program enables users to construct, navigate, share and criticize knowledge models represented as concept maps, at a worldwide level. Accessing maps constructed by such a diverse group has the potential to help users surface and question their assumptions, since homogeneous groups may actually reinforce shared bias, prejudices or assumptions (Zeichner & Liston, 1996). Analyzing maps that have been done by people from other theoretical backgrounds, beliefs, contexts -or otherwise different from ourselves- is priceless. If, as Dewey (1938) suggests is required, we engage in CR with an open mind, consulting maps through this on-line tool has the potential of becoming a meaningful and transforming experience.

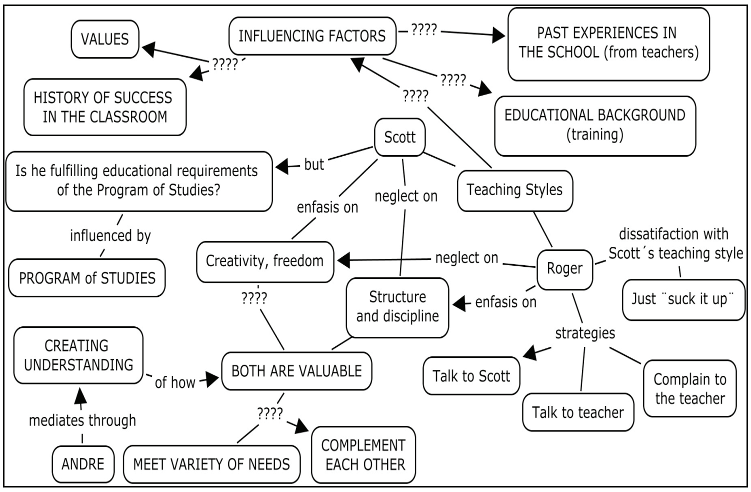

Figure 3. Concept map found on the IHMC Public Cmaps Server

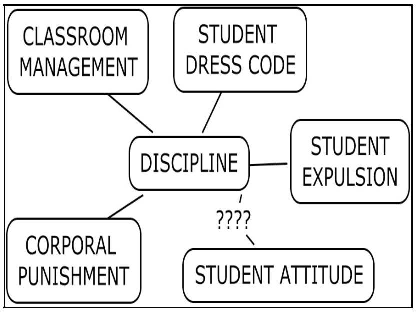

Figure 4. Concept map found on the IHMC Public Cmaps Server, Entitled: ¨Steve – Boston Public 6-9¨

Let us examine one of the maps found through the CmapTools software (figure 3). There are several new perspectives which are introduced by this map. One of them is reflecting upon one´s biography as a learner -introduced by concepts like *past experiences in school* and *educational background*- which has been suggested to have a substantial impact in our teaching practices (Brookfield, 1993). It also invites us to reflect about our biography as teachers, since the concept *history of success in classroom* is included. It also introduces concepts like *structure, creativity and freedom*, which might open up fresh perspectives for CR.

It is important to point out that this communal CR process does not necessarily result in our altering our conceptualizations, practices, beliefs or assumptions. Upon reflection, we may confirm with renewed assurance some or all of the concepts in the map we started with. This might perhaps be the case if the participants consider the map on figure 4, which includes a concept like *corporal punishment*. This is a new perspective for the school principal and the teacher who constructed the maps shown above, but they may not find this as a worthwhile perspective. Moreover, they may arrive to the conclusion that building *consensus* and resorting to other *behavior management strategies* are more acceptable or in harmony with their values and ethics. These are some of the possible reflections that may be triggered by the maps found in the IHMC Public Cmaps Server.

5 Final words

We have explored different options offered by concept mapping and the IHMC CmapTools program as tools for facilitating critical reflection. We have presented the design of a pilot study aimed at shedding more light into this potential use for these tools. In addition, we have briefly analyzed two of the maps collected in the fist stage of this study and anticipated some of their potential for reflection. We have argued that this coming together of concept mapping and critical reflection may result in a rich learning process that allows all stakeholders to negotiate meanings, as they gain multiple novel perspectives as regards the object of reflection. We would like to round off by resorting once again to Joseph Novak's inspiring words when he suggests this type of educational experiences "lead to a constructive change in a person's ability to cope with experience… and become more autonomous and in charge of [their] destiny."

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CONCEPT MAPS AS TOOLS TO AID IN THE UNDERSTANDING AND STRUCTURING OF RESEARCH PROJECTS AND AS A SUPPORT TO TEACH RESEARCH METHODOLOGY IN SOCIAL SCIENCES

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Abstract. This paper reflects on the usefulness of concept maps as an aid in teaching research methodology in social sciences in Mexico, based on our extensive experience. The paper discusses the need for methodological instrumentation to support the body of research based on reality and its reconstruction through specific problems. It claims that in this way, reality can reclaim the central role it must have in the scientific development of sociology. We argue that to describe and characterise a phenomenon it is useful to have methodological processes that simplify it. In this sense, concept maps show the nature of the relationships between processes showing how scientific knowledge is developed. A concept map is a technique used to make a graphic representation of knowledge, showing the webs of interrelated concepts and explaining their nature. If we understand a concept as an abstraction of a process, then a concept map is a schematisation and representation of it, generating and organizing the methodological processes of social research.

1 Introduction

When we were studying sociology at university we learned how to do research under the assumption that research is a continuous process. We learned that the methodological processes are sequential and are interrelated, at least accumulatively.

We learned that we had to:

a) Define an appropriate research topic by creating a statement and justifying it
b) Develop a conceptual framework
c) Design a fieldwork guide, to gather information
d) Carry out fieldwork, through fieldwork practice, where students carried out interviews and registered data
e) Systematise the information gathered in a fieldwork report
f) With help of direct information, theory and our research problem we would differentiate a hypothesis system. We would reduce our hypothesis into variables, indicators and items, and as a result would come up with a questionnaire to be implemented in the field
g) Process the quantitative information and present results in a quantitative research report
h) Gather all our material to try to arrive to conclusions in a final research report

These experiences were interesting because they taught us that:

1) Formal research is a process made up of stages
2) These research stages were serial and cumulative
3) Each step was always dependent on the previous one
4) Research is a process, whose parts are related in a lineal sequential and cumulative way

As sociologists we found that the only way to describe social reality was through direct research. In our experience, fieldwork is in essence a set of processes geared towards selection, recollection, registry and elaboration of a direct research report, aided by social research techniques and methodological processes that are carried out through qualitative and quantitative instruments.

Through years of experience we formed a general, sequential and cumulative idea of research and the interrelationships between its parts. This came with the help of concept maps.

2 Concept maps

Concept maps show the constitutive nature of the different parts of a process as well as a view of the entire process altogether. Maps show the nature of things in a simple way and the interconnection between them. This is due to the way in which the human brain recognizes the characteristics of the objects that surround it in its initial perceptions and representation in the process of learning (Novak, 1998). Novak (1998) defines a concept map as a graphic resource that helps us represent a group of conceptual meanings included in a structure of propositions that work as a tool to organize and represent knowledge.

Concept maps show the nature of relationships between processes and hence how scientific knowledge is developed. This means looking for new relationships between objects and processes through establishing problems and questions or thinking about the relationships of another group of processes or phenomena.

The researcher states, establishes, elucidates and/or explains the relationships of two or more phenomena and its direct or indirect connections with other processes. The relationships between things are not always evident or observable at first glance. In fact, the relationships between things are frequently imperceptible or unimaginable.

Concept maps become a mental tool to simplify the thinking process required by any methodological approach to science. The importance of the concept map for research is essential because a) it provides a general and specific vision of processes; b) it provides a clear view of the relationships between processes and; c) it clarifies the connections between processes.

3 Concept maps as a tool to help students learn

We have realised that with the help of concept maps students can integrate and structure a research process (Ausubel, 2002). This is because of the relationship between maps and their impact in the instrumentation of the whole process and the different types and ways of acquiring information needed in research.

In recent times, as researchers and lecturers we have looked for ways of applying concept maps to research methodology as a tool to comprehend and structure research projects as well as an auxiliary tool for courses on methodology in social sciences (Arellano, 2005). We think that the methodology of social research can be represented with conceptual schemata and/or maps making its learning more accessible to students.

Concept maps can be useful to the teaching-learning methodology because they show the nature of the relationships of the processes being studied. Furthermore, concept maps are a technique used for graphic representation of knowledge that form networks of concepts where relationships are implicitly presented (Dutra, Fagundes, et al, 2004: 217).

Describing the pedagogic experience by using concept maps in the everyday context enables students and teachers to arrive at conclusions regarding the educational practice of teaching how to conduct research. In the Faculty of Social and Political Sciences of the National University of Mexico (UNAM), where we have lectured for more than 30 years, written texts are still the main way to transfer knowledge. The essay has been prioritised as an ideal way to put together acquired knowledge and to clarify the foundations of an individual's opinions and/or perspectives about a matter or event. The result is that every time a student writes an essay, their thinking becomes abstract. This conceptual form is appreciated by the academic community that sees the use and implementation of concepts as a means of understanding the theoretical propositions in social sciences. When we encourage students to use concept maps the aim is not to abandon texts (Aguilar, 2002), but to make them interact with a graphic representation of knowledge.

In our courses, concept maps have a double use. On one side, they are used as a methodology for teaching and learning. On the other side, they are used as a methodology for social research. We use concept maps so that students learn schemata. Students are therefore able to create the concept maps of their own research and its implementation.

Each student has to develop maps of their a) research problem, b) literature review, c) research concepts, d) qualitative instruments, and f) strategy of analysis. We ask students to think in terms of schemata, not in terms of texts.

Students also design three maps to show the problem formulation, the statement and its justification (Arellano, 2005). In class, students elaborate each of these maps from the methodological perspective, both of their contents and of the relationship between the elements of the process. On the other side, they elaborate maps regarding their specific research, applied to a particular and concrete reality, which in this case would be their dissertation.

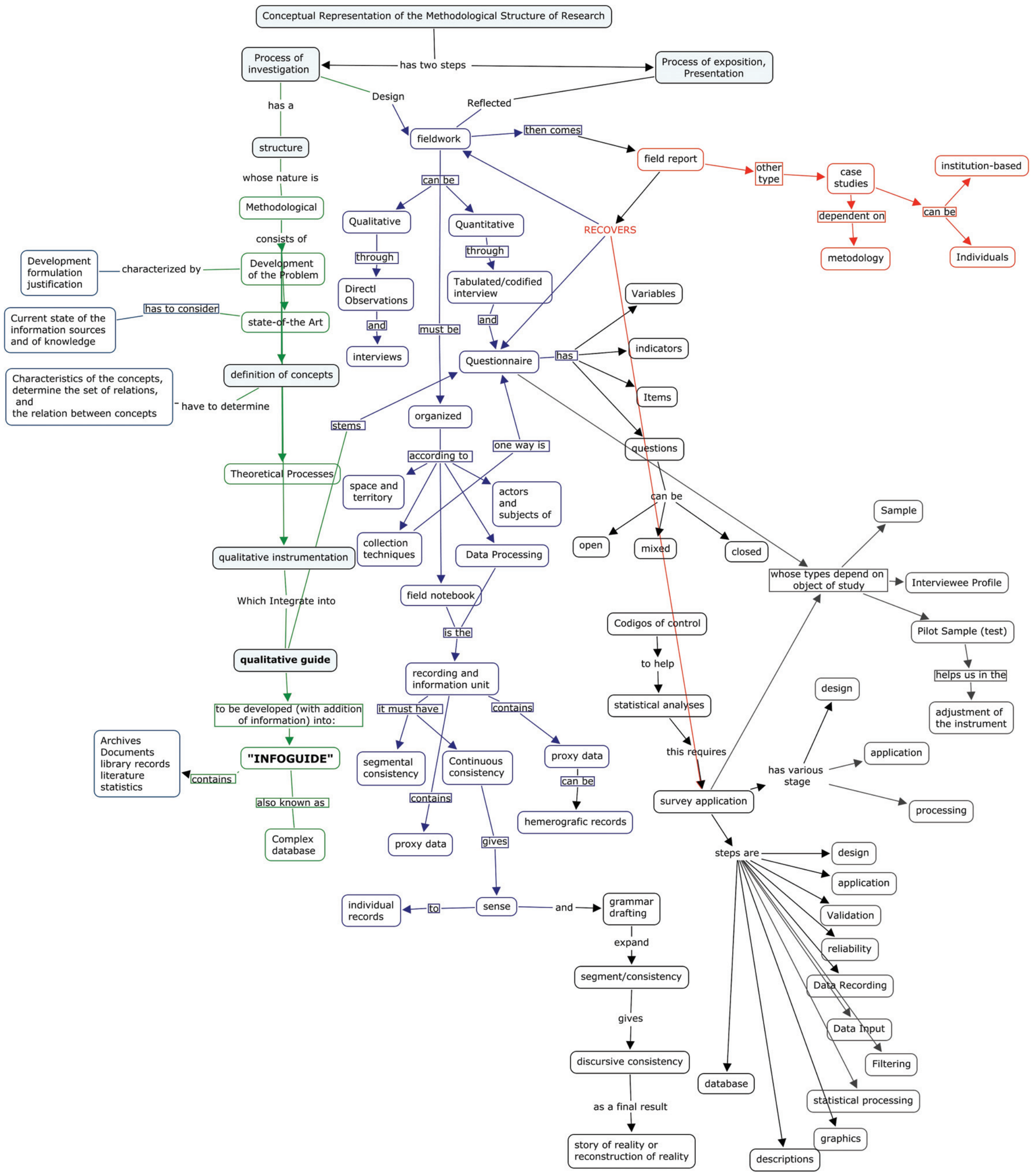

Figure 1. In the Conceptual Representation of the Methodological Structure we can distinguish each of the methodological steps independently, as well as understanding each of the phases and parts that integrate the methodology both individually and together in the research process. Concept map designed by José Arellano Sánchez and mapped by Fernando Luna using CmapTools.

Our work with students is focused on going through implied relationships in the methodological processes. From a global perspective, the work carried out with students aspires to achieve a total vision of the methodological relationships. However, this is complemented with the specificity in the concept maps of each and every part of the methodological process. Their concept maps show the sequence of relations and interconnections within their research, demonstrating both simplicity and complexity. They also allow both student and teacher to see the entire research problem and its interrelated processes in one graphic representation.

Synthesising the characteristics of reduction processes and their relationships with characteristics of the observed reality into databases are processes that require rigorous systematisation. This is especially important when such processes are confronted with reality to be then reinserted in the conceptual world. The mental maps of the qualitative and quantitative instruments, and the subsequent gathering, selection and systematisation of data are interesting and are illustrative of the relations of these methodological processes.

To move from the written text to a concept map and vice versa, as a dialectical process, is an effective way to carry out scientific work. Methodologically, using maps is an excellent resource to elaborate objects under study.

Concept maps help us to achieve clarity in our research and allow us to find new relationships between concepts and processes, which make it easier to understand the new contributions to science.

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CONCEPT MAPS FOR QUALITATIVE ANALYSIS - THE ¨TRACES¨ OF HIGH SCHOOL IN GRADUATES FROM PATAGONIA

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Abstract. This paper is part of the production of our research team, directed by Mg. Carmen Palou de Mate[1], located at the College of Education, in the National Comahue University, in Patagonia, Argentina. Our current project is entitled: "What does High School teach? A study of its traces through the voices of its graduates." We have interviewed more than 40 high school graduates from Patagonia using a semi-structured interview format. We will present an experience in which, as the first step in the qualitative analysis process, we used concept maps as a tool that allowed us to structure and systematize the interviews and to facilitate our communal reflection process, as researchers. We worked with eight of the interviews to construct concept maps from the bottom up, i.e. from the most specific (the sayings of a high school graduate) to a more general level in which we looked for the concepts that each of the quotes suggested as significant. This allowed us to have a clear visual representation of each interview, which was in turn integrated into a larger concept map that reflected all eight interviews. Then, at the most general level, we were able to find theoretical work that may explicate or reflect the essence of the concepts found in the interviews. We will illustrate this process as we present some of the preliminary findings of the interpretation process we have conducted so far.

1 Introductory Words

This paper is part of the production of our research team, directed by Mg. Carmen Palou de Mate[1] located at the College of Education, in the National Comahue University, in the Patagonia, Argentina. It is our team´s aim to make a contribution to the active literature on best practices in Education. In the last years, several lines of inquiry have been constructed that address these practices. These productions are based on educational reforms and on social transformations (Diaz Barriga 1995; Gimeno Sacristán & Perez Gomez, 1985), and all point to the need for a renewed understanding and more current interpretations of the teaching practice.

We have developed our research work from a General Didactics perspective (Contreras 1990), considering also the critical and socio-cognitive literature (Camilloni, Barco & Litwin, 1996; Camilloni, 2007). For more than a decade, our research team has focused on understanding teachers` actions and their links with the craft of teaching (Tom, 1984). All of our inquiry projects (Litwin et al, 2003; Litwin et al, 2006) have specifically focused on identifying best practices (Chaiklin & Lave, 2001). Our current project is entitled: "What does High School[2] teach? A study of its "traces"[3] through the voices of its graduates." It is our goal, then, to learn about what former high school students refer to when they are asked about the traces that the high school experience has imprinted in them (Bruner, 2003).

More than 40 graduates from the High School Level of the Alto Valle de Río Negro, in Patagonia, Argentina have been interviewed. The intentional sample consisted of public day school graduates who had graduated at least 5 (five) and not more than 10 (ten) years before the interview was conducted. The graduates that were interviewed constituted a socially and culturally heterogeneous group, which adds richness and depth to our study. We are currently starting the qualitative analysis of the data collected on the field, by means of semi-structured interviews. The final report is expected two years from now.

In these pages, we present an experience in which, as the first step in the qualitative analysis process, we resorted to concept mapping as a tool to synthesize and organize the interviews and to understand and discover the relationship among the concepts that emerge from the interviews. We also realized that the process of constructing the maps facilitated our engaging in a communal reflection process as researchers both as regards how to reflect the qualitative data on the map and as regards the theoretical framework used to attempt to

[1] Director: Mg. Carmen Palou de Mate; Co – Director: Prof. Mónica Calvet; Members: Mg. Erika Chrobak; Mg. Marta Herrera; Mg. Liliana Pastor; Mg. Mónica Sobrino; Grantee: Lic. Elena Ponzoni; External Member: Patricia Barraza.

[2] The Argentinean educational system is structured by law1420 (passed in 1882), which determines that there must be three levels of compulsory education: Kindergarten, Primary and High School (or Secondary). At the High School level, students receive the knowledge and certification required for them to attend the university or superior level. High school in Argentina comprises 5 years of instruction. Students start High School at an average age of 12 or 13 and generally graduate when they are 17 or 18.

[3] The word ¨traces¨ is used as a metaphor for the impact or influence of the High School experience that still remains in its graduates. For further discussion of this concept, see Calvet, Chrobak, Pastor and Sobrino (2008).

explicate our findings. We will illustrate this process as we present some of the preliminary findings resulting from the interpretation process we have conducted so far.

2 Our Experience

In our search for methodological tools for the interpretation and analysis of the data gathered by means of semi-structured interviews, our team decided to conduct a pilot experience with the use of concept maps, in order to assess their value in assisting the task at hand. According to Novak and Gowin, ¨a concept map is a schematic device for representing a set of concept meanings embedded in a framework of propositions" (1984). Thus, they are a useful tool for one of the challenges of qualitative research "tak[ing] voluminous amounts of textbased data and reduce that data to a manageable form without loosing the embedded meaning" (Daley, 2004).

Daley goes on to suggest that ¨the maps help researchers to maintain the meaning of the interview within the data analysis. Often when looking at an interview transcript, the richness of the participants meaning can be lost. Because of the interconnections displayed on a concept map, this meaning can be maintained. Transcripts tend to represent the spoken language in a linear fashion, whereas the maps represent the interview data in an interconnected and hierarchical fashion. This representation is more analogous to the way we think and to the way we actually discuss concepts in an interview format.

The starting point of our experience was, then, the interviews themselves. Therefore, we decided to construct concept maps from the bottom up, i.e. from the most specific (the sayings of a high school graduate) to a more general level. We selected eight interviews at random and read them a number of times, selecting those quotes that we deemed central and meaningful towards shedding some light onto the ¨traces¨ of high school in its graduates. We focused on the interviewees' answer to the question: "What did High School teach you?" We looked for the concepts that each of the quotes suggested as important and meaningful, in terms of synthesizing the essence of the citation (please see fig. 1 for a sample concept map). This allowed us, as we had expected, to have a clear and rich visual representation of each interview.

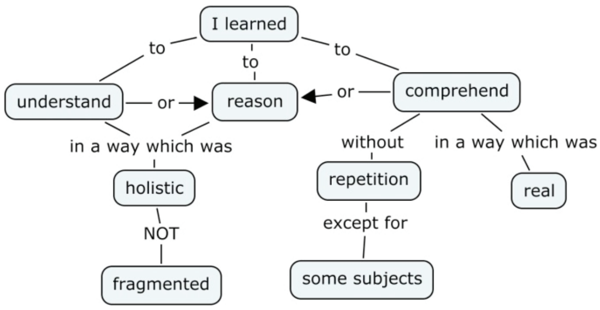

Figure 1. Map of one of the interviewee´s answer to the question: ¨What did High School teach you? ¨

When all the interviews were mapped, we constructed a new concept map that integrated the most important concepts in each of the eight maps. A rich debate was generated when we had to decide which the most significant quotations or concepts were. Thus, this collaborative concept mapping process helped us to engage in communal reflection about the reasons and, often, the unquestioned assumptions behind our construction of the map. It became clear to us, then, that the maps represented not only the sayings of our interviewees, but also the group´s reflection process both as regards the gathered data and the theoretical framework of our research work. Some of the fundamental issues that were debated at length as a result of the concept mapping process were "what do graduates refer to when they speak about the 'traces' left by High School?" or "which concept or key word best reflected a particular quotation".

These first steps in the analysis allowed us to construct a map which encompasses an important number of concepts, reflecting the richness of all eight interviews. In addition, this map helped us to see which concepts were central for our work, since we were able to see that some concepts were linked to several examples, which meant that they were mentioned by several graduates.

We then passed on to constructing the most general level of this new map. We were able to find theoretical work that may explicate or shed light onto the essence of the concepts found in the interviews. This stage was one of collaborative reflection and analysis of our theoretical framework, as reflected by the concepts in the map. For instance, we noticed that the graduates interviewed constantly referred to aspects of *metacognition*

(Mateos, 2001) when talking about the learning capitalized in the High School level. The interviewees used words such as *reflection, relating, understanding*, which led us to resort to Ausebel's work (1968) as a useful perspective to illuminate the sayings of our interviewees. This pointed to the hypothesis that perhaps the ¨trace¨ of High School could be explicated in terms of *meaningful learning.* We decided to construct a map (figure 2) to explore this possibility and test the potential of this theory for our research project.

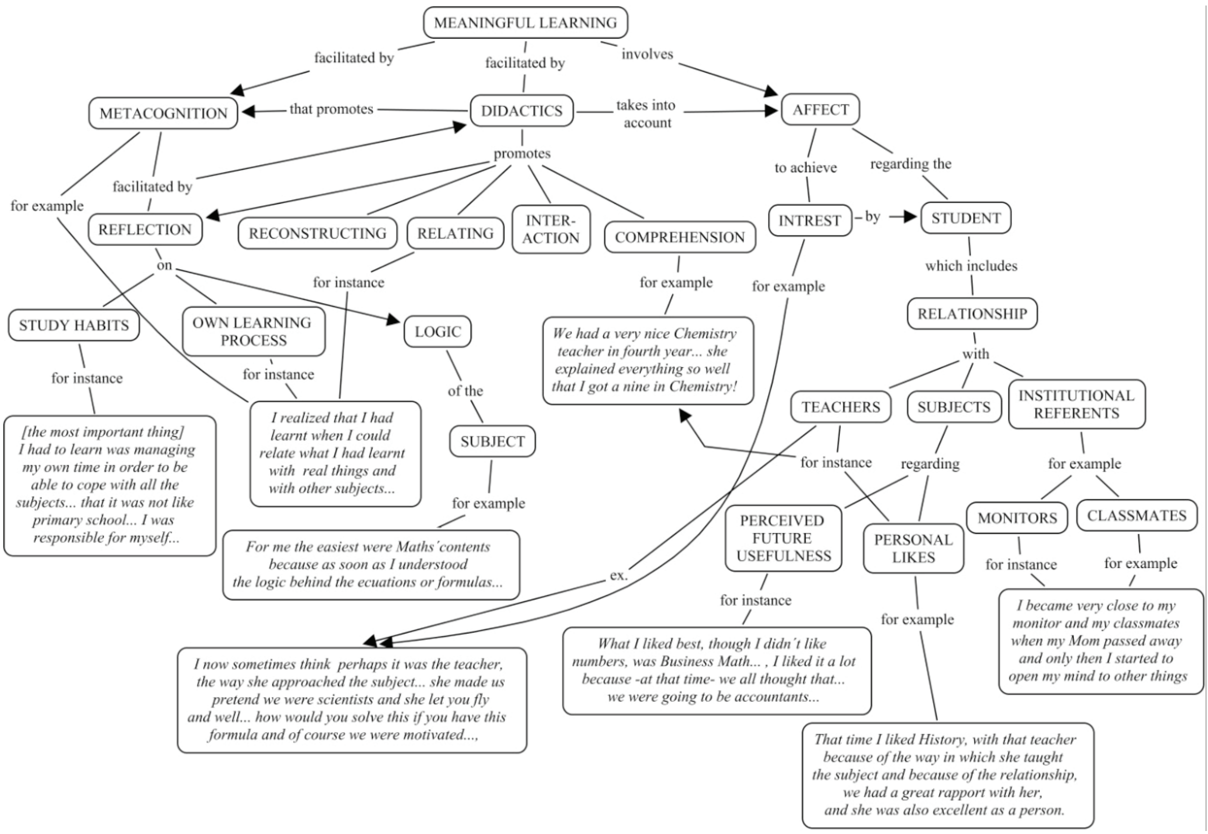

Figure 2. Concept map that reflects the integration of all eight interviews

As the reader may appreciate, Ausubel's did prove to be a potent theory, in that it comprises several concepts that are significant for the learners. Notice, as an example, that the map emerged as divided –visually- into three important areas, reflected by the concepts: *metacognition, affect* and *didactics*, two of which reflect the fundamentals of the author´s work. Naturally, the learners also referred to concepts like didactics, which are more directly illuminated by other theoretical works in Education. This concept mapping process, then, facilitated our revisiting of the theoretical framework used for the study and allowed us to see the potential of some of these concepts to interpret the narrative by high school graduates about the traces left by high schools.

This methodology allowed us to recognize teaching practices -such as responding to students' interests, having a close relationship with the learners, helping them see relate the topics learned to their own experience and explicating the logic of a discipline- that enhance the educational process and result in meaningful learning. The learning the participant graduates describe was meaningful to such an extent that it is present as a trace of high school in them even as long as ten years after graduation. Our findings, then, point to good teaching practices that may not necessarily reflect novel actions or ideas. However, they are valuable not because of their novelty but because of their power to transcend and have such a powerful and lasting impact on the students.

3 Conclusion

We have presented an experience in which, as the first step in the qualitative analysis process, we used concept maps as a tool to structure and systematize the sayings of high school graduates as regards the educational traces imprinted in them by high school. We constructed concept maps starting from the most specific level; i.e. the interviews done in the field, working up to a more general level; i.e. the concepts that each of the quotes indicated as central. We then integrated the maps constructed into a new concept map, which provided us with a clear visual representation of the most significant concepts in each of the eight interviews. Finally, the most general level in the map consists of theoretical work that illuminates the concepts found in the interviews.

The described experience led us to understand that using concept mapping for qualitative analysis allows for both a process of inquiry and a process of communal reflection not only upon the gathered data but also upon the theoretical framework used. This proved to be a fruitful methodology in that it provided a clear visual representation of the data, through which we were able to discover the most central concepts. At a later stage in our research work, we believe that we may be able to propose new theoretical constructs, by means of further analysis and integration of the concept maps.

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CONCEPT MAPS IN A COOPERATIVE LEARNING CONTEXT

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Abstract This article is about a concept map experience realized in a cooperative context which was carried on in a little infant school in Giugliano, a country in the surrounding of Naples, Italy. It's part of a research project that started last year by the PRODEST group of Naples, that belongs to a national net of schools that share same ideas on teaching. It regards mainly teaching science by means of concept maps and key-words. The research, still in progress, involves teachers and students from infant to secondary schools which work in order to find methodologies and good practices for meaningful teaching/learning process. Concept map in cooperative learning groups is the core of the research.

1 Introduction

At the beginning of this school year the PRODEST group of Naples planned a long term research based on 3 hypothesis. Each teacher, then, involved set a personal planning in his own school. These are the 3 hypothesis:

- In each level of school there is "minimum linguistic luggage" that let students to carry on their studies. A distinguished scholar, T. De Mauro, says that to have a satisfactory school experience, a pupil in the first year of primary school (in Italy: a 6 years old boy) must have a luggage at least 2000 words. Therefore, it is vital that school, especially on deprived areas gives effective linguistic models and lot of reasons to speak in class. For this motive, learning in cooperative groups is very successful methodology: it increases the number of linguistic interactions students can have in class at the same time;
- In our global society the amount and fragmentation of information on one hand and the lack of family and social structures to support children and youngsters in their personal and emotional growth on the other hand, lead to a negative attitude towards school education and formal teaching. In this situation schools-for many pupils the only place to meet culture, people and learn new skills- could have yet a really important role if they teach cognitive skills useful to live in this world and social skills to interact whit others. Teaching concept maps through cooperative learning is the right strategy to reach these goals. It enables children to acquire at the same time skills like listening, comparing, cooperating and give them chances to use meta-cognitive abilities like analysing, generalising, selecting, summing up.
- Because the importance of the "implicit curriculum"- routines, times, spaces, relationships (between children/adults, adults/adults, children/children..) external environment, parents' role – it is necessary schools take it into consideration when plan their activities.

2 The educational project in the infant school: description of the teaching planning

In September the rubbish collection in Naples and surrounding was really bad and everybody was talking about the problem. People began to realise that ignorance and negligence of local authorities and citizens could cause serious economic, environmental and social damage and menaced the public health. It was inevitable that schools were feeling the need to contribute to change wrong ideas and behaviours towards environment and the citizens' relations whit the government. This strong social feeling found answer, in our school, in an educational long-term project involving teachers, pupils, parents, local authorities and private associations. In the following, we describe only on the cognitive and social skills of the school planning. During this first year, the attention of children was focused on the differential collection of the rubbish and the recycling. To introduce these topics teachers started from two concepts: object (in PRODEST Project it means: what you can know through senses) and material (what an object is made of). These are core concepts in science teaching from the PRODEST point of view. The school project started with a plenary led by each teacher in class to let ideas come out in a brainstorm activity.

2.1 Initial conversation

Focus – question : What are rubbish?

Anna: What we don't like and throw away.
Marco: What is old and throw away.

Andrea : Old things we don't use or empty bottles
Luca : I don't know.
Giovanni: Everything we throw in the bin because if we leave in the grass we don't love nature.

After the conversation, children and teacher set a legend and worked on the first group map where rubbish were considered broken, useless, rotten or old objects (fig. 2).

Fig. 1 The big problem in the city: the rubbish

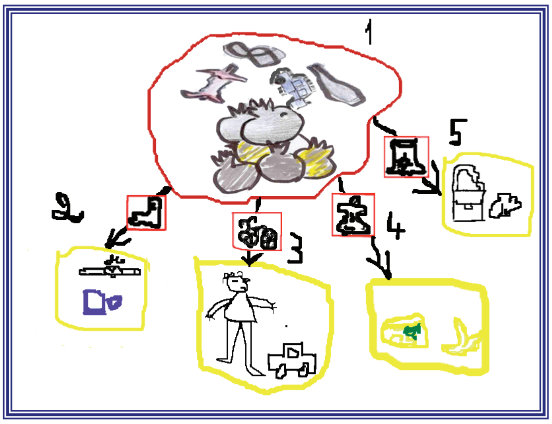

Fig 2. : Classification of rubbish: map of group
Legend
Number 1: rubbish;
Number 2: broken object;
Number 3: useless objects;
Number 4: rotten objects;
Number 5: old objects

Analysing the conversation, teachers realized children didn't know anything about rubbish collection and recycling process. So, they built together containers for recycling waste using carton boxes and painted them with different colours (fig. 3). At the same time the concept of materials was introduced through games and sensorial experiences and children produced conceptual maps (fig. 4). To evaluate this first step, children worked on a group map on differentiated waste disposal (fig.5)

Fig. 1. pupils sat next to the carton boxes for recycling painted by them

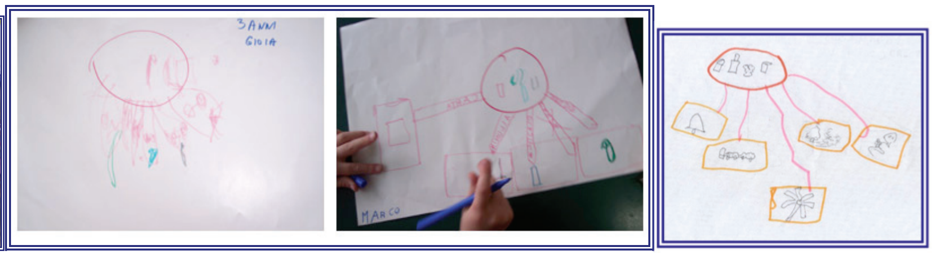

Fig. 4 :Individual map drawing: a) Gioia, 3 years old; b) Marco, 5 years old; c) Sara, 5 years old

Fig. 5: Concept map of group on differentiated waste disposal

On that occasion, teachers gave to children 4 yellow circles representing the concept of materials (plastic, paper, aluminium and organic), same arrows named with linking word "is made of.." and a red circle representing the general concept of waste. Older children put circles in the room: the big red circle at the top and the yellow ones at the bottom linked by the arrows. Then, in turn, each child put one object from the red circle to a yellow one. Children were very active during the game participating with comments and advices. For these reasons, when the local authority put the recycling containers in the school garden, children found very easy to use them. (fig. 6).

Fig. 6

Bins of different colours for separate rubbish collection

At this point, pupils had to understand the concept of recycling. So they went to visit a recycling factory (fig. 7); took part whit their parents in a creative laboratory using recycled materials (fig. 8); prepared with local environmental associations the containers to fertilize the vegetable garden (fig 9).

Fig. 7 Visit a plastic recycling factory

Fig. 8 Finding a creative way to use recycling waste: the laboratories

Fig. 9 Black bin for organic waste that become compost to fertilize our vegetable garden

At the end of May the school organized a big event. There was an exhibition with the objects made by the children and everybody could taste the vegetable from the garden.

3 Teaching concept maps in cooperative learning context

In our school concept maps are made first by groups and then by individuals. This because we think in the strength of the cooperation: it represents the only way to solve practical, social, personal or interpersonal problems in the global society. In fact, nowadays problems are usually complex and many-sided: it is not enough people has correct information to solve them. Everybody needs to be able to listen, work and interact whit the others. Taking this into consideration, school education can't suggest individuality and competition but has to create learning contexts where social skills are as important as conceptual ones. Regarding social abilities, we trained pupils starting with games in pairs that facilitate the promotional interaction "face to face"; then they played in small groups of 3 -5 children (fig. 10), and only later they worked with a group made up of the whole class. After these experiences pupils were meeting in cooperative learning groups were the success of the activity depends on everybody involved working with the others. In fig. 10 you can see children involved in small group games to improve social abilities; in fig. 11 children are working on concept maps. Cooperative groups have to rethink, check, generalize and formalize their experiences and concepts to create concept maps. These are realized using semi-structured materials given by the teachers to each child of the group. Groups are different according to the activity: in fig. 5 the group was the whole class, in fig. 11 there are five-six pupils per group.

Fig. 10 Games of social interaction

Fig.11 The cooperative groups working on concept maps

Conclusion

During this first year, we have put to the test the usefulness to link cooperative learning method and concept maps. Even we still don't have final results and scientific evidence we could say that this methodology has improved our pupils' vocabulary and their cognitive and social skills a part from a notable reduction of social conflicts in class**.**

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CONCEPT MAPS IN TEACHING AND LEARNING PROCESS OF RATE OF CHANGE CONCEPT

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Abstract. The implementation of concept maps in the classroom allows both the teacher and the student discovering and describing meaningful relations among the concepts object matter of the study (Novak & Gowin. 1988), making it possible to create connections between them and the context in which activities are developed. That is the reason why teaching and learning process are related to the rate of change, in order to provide students with a tool which allows them evidencing in an organized way several relations of the concept to events of the environment, such as a plant's growth in relation to time, a country's currency price variation with respect to other country's currency, water temperature variation when submitted to a burner in relation to time, etc.

1. Reference Framework

During the first years of education, mathematics faces students with situations in which they can use algorithms such as those from addition, subtraction, multiplication, division, among others, in order to relate two magnitudes which do not vary, from which an answer having the same characteristics is obtained. At the end of the basic education cycle, algebra studies begin; it introduces "variables" which can have several meanings according to the context from which stated problems have been extracted. From a mathematical point of view, this school pathway is characterized by going from arithmetical studies to algebraic studies. This brings new challenges to students, as operation alternatives are wider, new and different meanings are given to the answers, which require a maturity period of these new concepts to be understood.

When basic school cycle ends, the concept which synthesizes studied change processes is the *rate of change* which can be modeled, in situations where variation is continuous, from straight line equation $y = mx + b$, where m is the value representing variation relation among observed phenomena. Understanding this concept represents new challenges for students from different points of view: from language point of view, handling new mathematical expressions; the meaning of each one of the equation terms according to the context from which variables object matter of this study have been extracted; graphic representation, among others. Concept maps are a good tool which allows teachers realize the assimilation of the rate of change concept.

1.1. Rate on change in High School Education

Calculus is considered as one of the most important areas within mathematics, as it makes it possible to understand several nature phenomena from equations which model them. If students want to reach success in this field, they need to be provided with a training which is consistent with the *variation thinking*,[1] as it has been called in their school program "to presuppose overcome teaching of fragmented and divided mathematical contents in order to place us in the domain of a conceptual field involving inter-structured and linked concepts and procedures which allow mathematically analyzing, organizing, and modeling situations and problems from both man's practical activity and sciences and mathematics, where *variation* is found as their substrate." (Ministerio de Educación Nacional de Colombia, 1998).

Rate of change involves *variation* of magnitudes which should be measured and compared. These activities are performed by students as natural processes related to different knowledge situations or areas, such as geometry, administration, natural sciences, etc., which make teaching of change concept a useful tool "to prepare students for studying calculus, which has been a basic goal of school mathematics; to state and resolve calculus equations is a vital element of traditional engineering-focused mathematics" (Stewart, 1998).

The teacher is responsible for involving methodological intervention strategies in the classroom to promote exploration, discovery, and construction of mathematical ideas in teaching and learning process. Specifically speaking on the rate of change concept, this makes easier to understand proportionality relation between two variables, thus providing learning with meaning.

1.1 Concept Maps in Mathematical Teaching

Stated teaching strategies which are executed by mathematics teachers to present mathematical concepts throughout an academic period are an important factor for students to learn them. As a concept map "is a visual representation of the hierarchy and relations among concepts within an individual's mind" (González & Novak, 1993), it is a resource which evaluates relations made during a process to learn the concepts under study. This fact is particularly important for teaching mathematics, which objective is to make individuals learn several hierarchical structures which make sense in applications carried out in other knowledge fields.

The use of concept maps in *rate of change* teaching was intended to make students discover by themselves, from the very first exploration stages of the concept, different manifestations in their environment and relate them from both differences and similarities. The following are the way by which they were taken to the classroom and results obtained.

2 Classroom Intervention Integrating Concept Maps in Teaching-Learning Process of the Rate of change

The experience was carried out in 2007 during three months at Institución Educativa Pedro Luis Álvarez Correa located in Caldas (Antioquia, Colombia). Exercises to construct concept maps about previously studied mathematical topics were carried out with the students. At the beginning, the group was informed about the objectives of the work to be performed and results expected from each student at the end. This is the way how concept maps were used in the classroom intervention.

2.1 As a Learning Pathway

According to Novak's own words: "a concept map can also act as a 'roads map' where some routes are shown to be followed for connecting concepts meanings in such a way that propositions can be achieved" (Novak & Gowin. 1988). This implies an "academic program planning" for teachers, which is reflected on their activities, allowing students making questions such as: What am I going to learn? What can I use this learning for? What applications does this topic have in the context? Among other aspects.

After the discussion, students posed questions such as: What does a change stand for? How do we realize a change has occurred? In which daily life situations changes or variations occur? Which is the importance of the change? How do changes are measured? Etc. In order to give answers to such questions, interviews to people from different professions and occupations were proposed to be performed.

Answers provided by interviewees showed two kinds of change: A qualitative change considered as a transformation from one state to another, as a change of color and a change of mood, which were referred to by people performing social activities such as priests, policemen, nurses, etc. A quantitative change related to different measures, as the income and expense of money come from sales of purchases made in a store, time spent by different cars to go over a certain distance, reported by people performing activities in which accounts are managed or measures are taken. Answers provided made it possible to create a glossary which allowed making differences among the kinds of change found, and clearly defining that during the experience the interest was focused on the quantitative change, as it can be expressed in numerical terms and, based on observations, constructing tables and graphs which account for its characterization.

2.2 To Extract Meanings and to Synthesize

After students collected information from several sources (interviews, consultations, etc.), in relation to the studied concept, they were asked to construct concept maps to synthesize the process (Figure 1).

Socialization and analysis of these maps made it possible to create hierarchies among several terms which make reference to the change and which were found during the interviews. In this work stage, achievements reached were disclosed in relation to processes involving the change, as propositions and argumentations provided were constructed from language, which are a step prior to understanding the concept from a mathematical point of view.

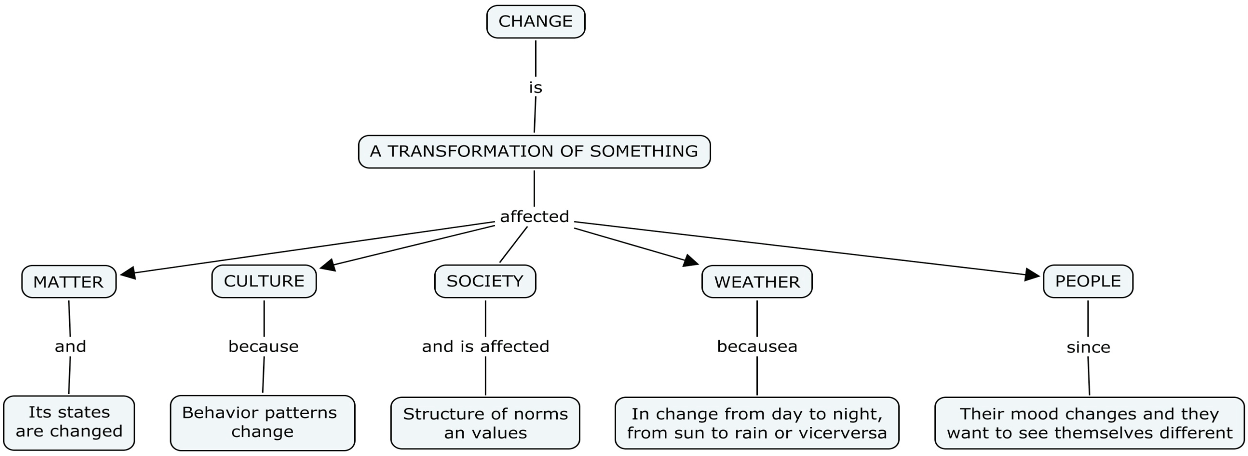

Figure 1. Concept Map Created by Students to Present Socialization Activities.

Construction of concept maps by students helped evidence differences between a qualitative change and a quantitative change, observed in different activities performed, such as. Growth of an animal, temperature records of a liter of water under fire, among others. Due to the activities nature during this part of the process, tabulation records, graphic records, and the approach to the algebraic representation (situation modeling), are basic aspects when making rate of change. Step-by-step development of aspects involved allows a conceptualization of other change manifestations such as: direct proportionality, proportionality constants, variation of magnitudes, graphic and algebraic representation of the straight line.

2.3 *Evaluative Purposes*

To get deeper into the rate of change concept, other statements in which they should involve change situations were proposed. In these situations, measures should be taken to construct a tabulation record divided into similar time intervals. Three-student groups were formed with the purpose of interacting and getting to an agreement about the way how a rate of change is produced in the experiment under execution and the meaning that could be given according to the used context. As a synthesis process, they should prepare a concept map on which they should support a presentation before their classmates. The final concept map should include the rate of change as its main concept.

Concept maps constructed accounts for understanding acquired by students. Also, they are very useful for teachers as an evidence of the way as each one of the parties involved in the process assumes his/her own learning. From their follow-up and analysis, experiences can be designed to help their students overcome weaknesses or to reinforce strengths acquired in learning process. it was intended that students include in the map, formalizations of algorithmic procedures or processes which allow them having correct answers from concepts and propositions explaining the phenomenon (Figure 2).

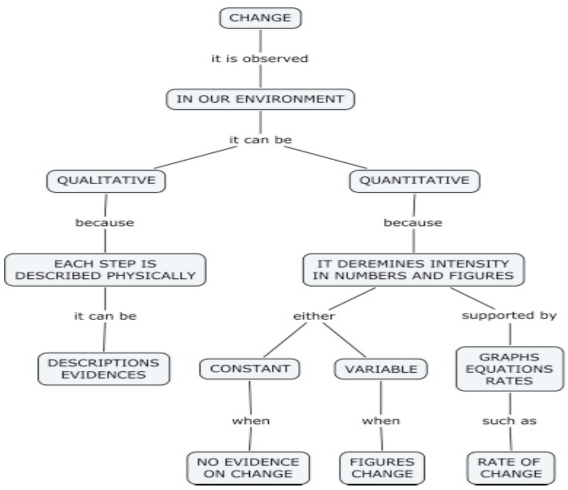

Figure 2. Concept Map Created by Students at the end of the process.

3 Conclusions

If teaching-learning educational process is considered as a goal through which students can get a meaningful learning of stated concepts, which extend and articulate their network of relations and can apply them in different contexts, it is necessary that teachers include tools to speed up act performance of agents involved in the construction of the new knowledge. In our case, applying a concept map tool in the classroom allowed students being themselves more motivated to carry out proposed activities and to participate in the construction of their own knowledge.

During the experience, we based on students' previous knowledge, in such a way that they could develop mathematical competences separated from algorithms, strengthening creative and argumentative skills which were supplemented with the design of models to let them creatively express their ideas, thus making associations of rate of change concept with surrounding phenomena which change quantitatively.

Solutions provided by students for several problems stated by them and by the teacher as well, concept maps developed as a final synthesis process, allow identifying that students, throughout the experience, reached (according to their academic level) an appropriate conceptualization of the rate of change, as they recognize it as the quotient of two magnitudes and can create tabulation records from proportional calculations, associating answers obtained with a straight line slope.

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CONCEPT MAPS IN THE REGION LEARNING

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Abstract: The present work displays an investigation focused on the understanding of sociology institutionalization in Mexico, and if it is possible to be spoken of an academic crisis of sociology, as it is handled nowadays, besides an investigation that takes care of specific values of the sociological knowledge in the reality of each region in Mexico. This approach starts, firstly, in a study of the sociology regionalization in Mexico, with a methodological tool based on concept maps. Secondly, it tries a deeper analysis of this regionalization, to understand and to observe the processes of sociology institutionalization in Mexico. It is worth mention that the construction of concept maps was supported by a computational program called "CmapTools", which allows an efficient and a faster construction of concept maps. By making used of concept maps, we had a quick access to the information that was generated and organized in this project. The information organized in this way, allowed us to develop examples from the main concepts so as to present the important aspects of sociology regionalization, and in this way to know the dimensions that Sociology in Mexico has taken, as well as the research being made in the country and with this, get to know the types of sociologists universities are being formed and the social investigation they are making nowadays.

1 Introduction

In the last years an academic crisis of Sociology in Mexico has been established, but if Sociology is called to play a role of contribution to social reflexivity, does it really exist such crisis in Mexico? Why if its methodology and its theory turn Sociology into a social science with sufficient potentiality for orienting the processes of regional and/or local development reflectively? And why does it seem that this reach in different Mexican regional contexts expressed in sociological investigations cannot be observed? People could say that we have an academic crisis of the sociology. (Figure 1 shows the pose of the problem).

We found that, at the present time, the social thing has become more complex, and it is observed in the debate on modernity and postmodernity. The changes are just being discussed. Thus, Sociology formed from its first passages like a plural company, and there are more and more authors, who defend pluralism like something inherent to Sociology, but how have this configuration been occurring in Mexico? And how are the sociologists and the institutions in Mexico being inserted to these changes?

We can say that the methodological construction, in which sociology moves, is given in certain processes and when we spoke of the "Analysis and synthesis; abstraction and concretion; reduction and application are daily processes in the scientists ´chores." (Arellano, 2005:11). To this daily form of the scientific task, Novak proposes the concept maps like a methodological tool to organize this type of processes made by the scientist. Ausubel (1963) mentions that the singular factor which influences more in the learning is everything that the student has already known, and sees in its theory the new development of the meaning like a building of relevance of the concepts and proposals, also observes the structure of knowledge like a hierarchic organization from the most general and inclusive to the most specific and less inclusive concepts under the most general. For Arellano, an investigation design constitutes a planning of the investigating process. If we know what and how we are going to make an investigation process, the complex of this activity becomes simple and accessible (Arellano, 2005:143). Thus, the importance of the schemes for the investigation is essential because it gives a global and particular vision of the processes; it allows us to see the manifest relations between the same processes. And it contributes to the clarity of the processes connection. (Arellano, 2005:149).

2 Approach to the reality by observing the relations with the use of concept maps

From Novak's proposal in the introduction of the concept maps to organize information generated in an investigation, we found a tool that gave the possibility of organizing all the captured information in the investigation that seemed to be a range of data without sense. The problem was based on the form in which relations between data were observed and organized. When the first approach was made to the expositions of Novak and his group of investigators, we obtained an investigation that allowed ordering the information in a hierarchic way and creating a relation of the data base obtained (Novak, 1977). Thus, a concept map shows the specific label of a concept in a node or box, with lines showing connection words that create an affirmation or a significant proposal.

The concept maps allow the significant learning acquisition. Because, as it leaves from the own creation of the student, this person is shaping what he/she understood of the central problem, and similarly allowing the creativity in the construction and relation of the concepts. In the case of the investigation, to observe the roundtrip between the theory, methodology and what the reality itself expresses.

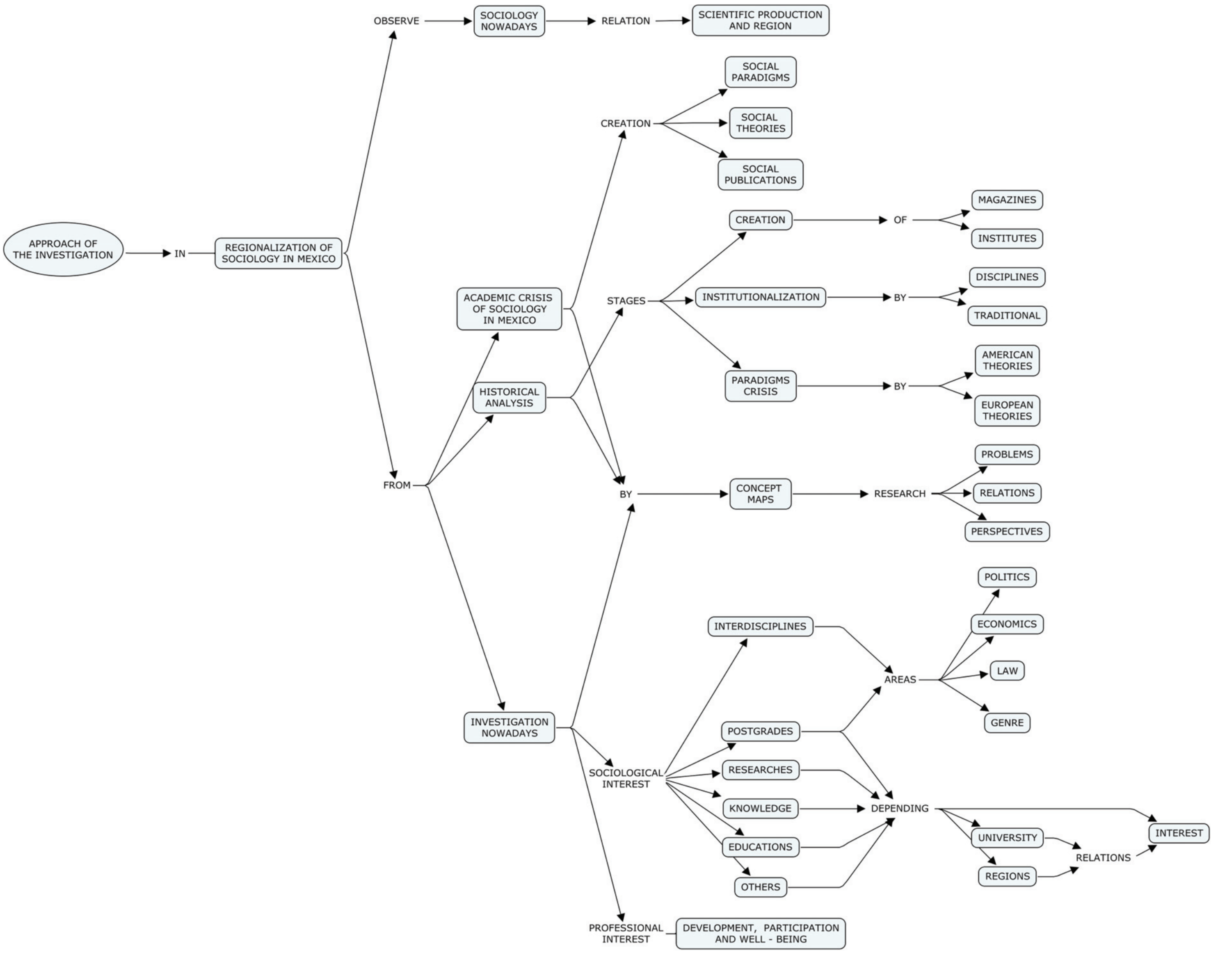

Figure 1. Exposition of the problem with the use of a concept map.

The construction of the concept maps occurs, in first place, with the interest question, that is to say, the question specifying the problem or problems that the concept map must solved. Later, a list of key concepts related to the interest question is made; these must be ordered in sequence of greater to smaller importance. With this, the construction of a preliminary map is made so as to facilitate the creation of a good order in hierarchical of concepts. In this way, a concept map cannot be finished, because it has the possibility to introduce new concepts if it is necessary. Finally, it must make the creation of liaison communications lines that help to know how concepts are related to others.

Novak and his group of investigators created the program CmapTools allowing the accomplishment of the concept maps in a simpler and practical form. With the use of software, the creation of own conceptual maps is easier, and we can manipulate the concepts and connections as we want. Also the software allows the incorporation of images, tables, formulas, allowing a better bond with the construction of the concepts facilitating the significant learning.

The usage of conceptual maps in the sociology regionalization permits to create complete maps of the information, a global field of which it was going to be investigated was created from maps, and by creating these concept maps they allowed us to organize, to analyze and to understand the relations that were occurred in the investigation; as well as to make a synthesis of the obtained data; and secondly, to permit having access to this organized information so that it was possible to be understood from a simple and fast way without the necessity to return to all the information consulted in gross, facilitating the organization in all the study of sociology regionalization, including all its relations and imagining possible worlds.

CmapTools was used as a tool to create concept maps like reinforcement for the learning subjects, it facilitates the construction of them. And we could created Web connection using the software, allowing to have accessible information to consult at any time, in addition the insertion images, in this case of geographic maps that showed the relations of the territory with the position of the universities in Mexico.

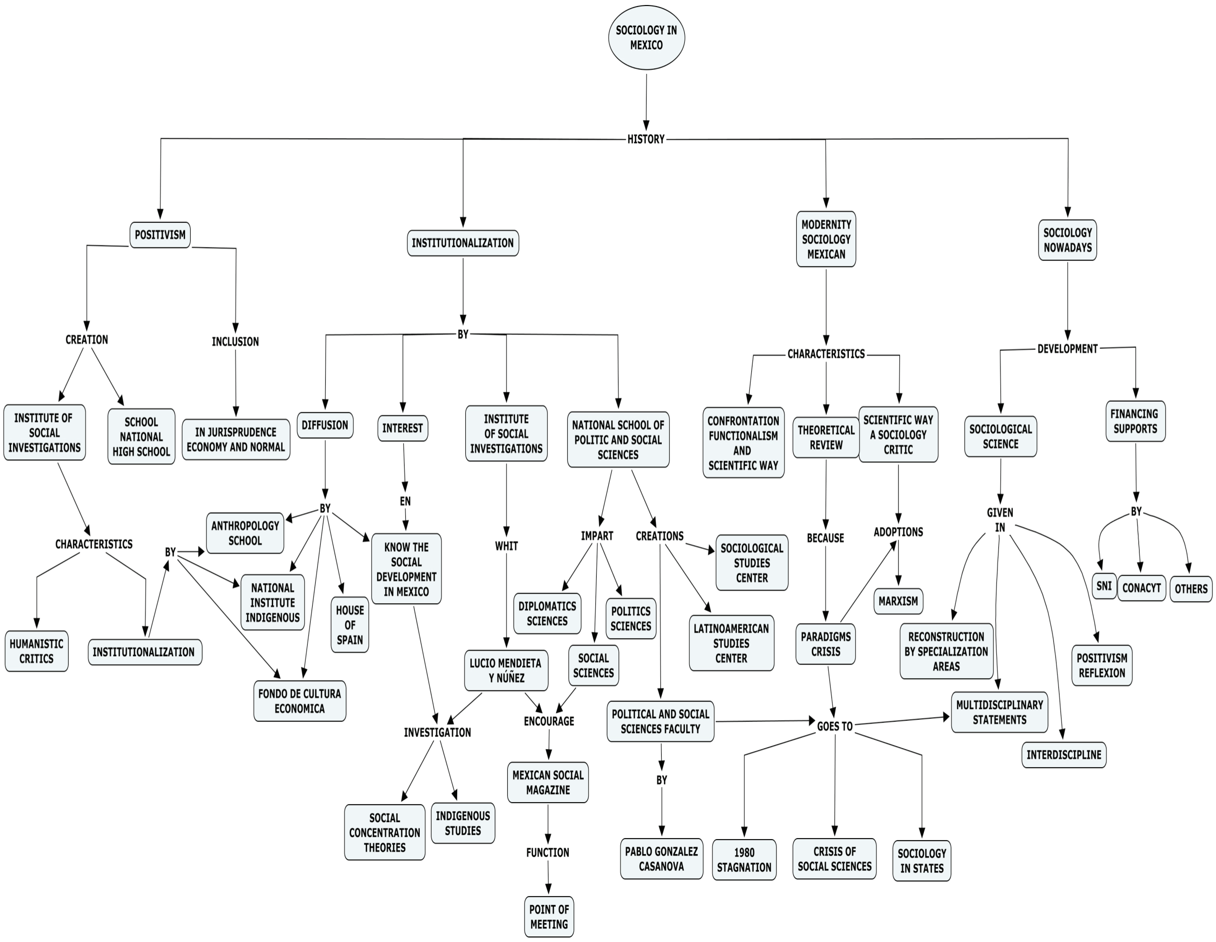

Figure 2. Historical process of sociology in Mexico

3 Regionalization of Sociology

As one considered, an academic crisis of Sociology in Mexico has been established, the interest on this topic, is focused on understanding the situation of the development of sociology in Mexico since the research of a regionalization of the sociology, starting the investigation with an historical and analytical revision of the discipline, and the relation that keeps with the certain regions in Mexico, observing if the conditions of each region determinate the institutionalization of sociology, thus to arrive at the exposition if really such crisis of the discipline exists as certain authors said (Castañeda, 2004), and if this crisis exists to know in which dimensions it is, therefore, to know the extent on what is spoken on this crisis in relation to the academic scope with the relation that exists between the sociological production in the country on one hand, and by the other in the absence of consensuses generalized on the fundamental questions of the discipline in a heterogeneous community of sociologists.

Therefore a regionalization study is made in universities that teach sociology in Mexico. In this way, a regionalization considers, cradle in the creation of nodal's regions; that is to say, starting with the centered universities of the country and then to the surrounding ones, this regionalization is based on the historical construction process, being the capital of the country where the sociology was institutionalized, and it was from this region where it began the sociological studies.

In this first concept map that I made is a general exposition (figure 1) of the approach questions related with the topic, and the first question which we start was: how is organized sociology in Mexico?, which took me to the historical interest of sociology from its beginnings to the present time (figure 2). But also it took us to pose how sociology in Mexico is organized, and why is necessary to know the perspective of the investigation in relation to the region in the universities in which is distributed and investigated, and to know what kind of sociologists are being created within these universities.

3.1 History of sociology in Mexico

As it is shown in the concept map (figure 2), the historical development of sociology in Mexico can be seen in a simple, practical and completed way. When we set the information in the concept map, it allows us to a fast access of the historical information, to see the basic processes that occurred in the institutionalization of the sociology, the characters of the different institutions that gave a contribution in the institutionalization of it and the changes determinating historical contexts in which sociology was developed. Once, having organized the information in concept maps, relations were easier to see on each of the stages of sociology, and this permit to observe the most important aspects in the development of sociology in Mexico, or if it is necessary to incorporate new scenes to the reconfiguration of sociology, and therefore new problems were generated through history of sociology. Also in the concept map it was observed clearly the shifts of paradigms in the processes of the institutionalization and modernity of sociology, and the change to multidisciplinary and interdisciplinary studies accompanied by the few or null governmental supports in the social studies in Mexico nowadays.

3.2 Regionalization of the universities

Once an historical knowledge of sociology in Mexico was acquired, it was consulted by Internet all the universities of Mexico, with the purpose to know where people can study sociology. First we search the sociologist profile; this was made to know if in all the universities the same vision of a sociologist was handled. Secondly the structure of the curricula of the discipline in each of the universities, to observe the approach that was occurring to the preparation of the sociologist, who although, was related to the profile of this one, they went finding relations between specific studies of the region in where the university was located. In general, we are speaking about Sociology in Mexico that has shown a permanent interest to understand the situation of crisis of the region and, in general by the characteristics of the contemporary society.

4 Conclusions

The use of the concept maps in the learning regions, the case of the regionalization of sociology in Mexico, was very useful since they facilitated the exposition of the investigation in first place; and secondly, it helped to create the relations between the concepts developed with respect to the exposition of the problem: its organization and hierarchical structuring. Maps were supported by a computational program called "Cmap Tools", which allows an efficient and a faster construction of concept map, allowing modifying them, when a revision was made. And mainly the annexation of Web sites, that permitted a faster access to the sources in a direct and efficient way. Another utility that left the use of concept maps was the knowledge acquisition. It is possible to be said that creativity woke up to look for more suitable forms in the relation of the concepts that described the exposition of the problem.

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CONCEPT MAPS: TOOLS FOR UNDERSTANDING COMPLEX PROBLEMS

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Abstract. One of the major obstacles to effectively informing the public about complex problems is the lack of means to make such problems comprehensible. Global warming and nanotechnology are extraordinarily complex issues because they involve a great deal of highly specialised knowledge and also because it is difficult to perceive how they impact our daily lives. It is extremely challenging to create an adequate cognitive representation of these questions because of the tremendously large scale of one (global warming) and the exceedingly tiny scale (nanotechnology) of the other. In this work we propose using concept maps as a tool to communicate knowledge and facilitate understanding of these important subjects.

1 Introduction

Complexity is a broad concept that touches upon different aspects of how issues or problems are perceived. To begin with, we can accept that complexity arises from different sources. First of all, there is epistemological complexity linked to: being unaware of information that allows a problem to be understood; the seemingly random fluctuation of the real world caused by total or partial ignorance of the conditions that determine a result; situations that emerge when events that are not causally related interact with each other, and finally, the total or partial inability to evaluate effects provoked by all of the above. Secondly, there is a cognitive complexity involved in mentally representing problems.

The methods employed to disseminate information to the public about complex problems should provide scientifically valid information represented in a way that reduces epistemological complexity. At the same time these methods should be able to render the cognitive complexity of problems comprehensible. To accomplish this, links between scientific knowledge and common knowledge should be represented.

When modelling our examples we considered the sources of epistemological complexity mentioned above, as well the cognitive complexity arising from the inability to create a mental representation of knowledge objects that are either too large (global warming) or too small (nanotechnological products) to be perceived on a normal human scale.

2 Global Warming: the complexity of the very large.

Climate change is a process that involves variables related to nature. The interaction of these variables and the value that they adopt in each space-time moment determine the dynamics of the climate system. Anthropogenic activities have created disturbing trends in the dynamics of the current global climate. Consequently, in order to understand global warming we must consider not only natural variables, but also how they interact with variables related to human activity. From this perspective, the methods used to inform the public about global warming must be capable of managing a large amount of information related to different categories of variables and rendering the interactions between them comprehensible. This will allow cause-effect relationships to be established between variables that initially were far beyond common knowledge.

All concept maps are based on a theory. In our case we feel that natural and social systems are interdependent and that a great part of the complexity involved in global warming arises from this interdependence.

2.1 Representing the complexity of global warming

A map outlining the problem of global warming must tackle various sources of complexity. Complexity [1] caused by the magnitude of the problem; global warming overwhelms a subject’s cognitive expectations because it involves a reality of extraordinary size. Complexity [2] related to the large number of variables interacting, which allow us to understand the cause-effect relationships and the different phenomena related to global climate change. Complexity [3] is also derived from the fragility of the system which is vulnerable to the fluctuating values of variables as they interact (values which determine the seemingly random behaviour of the system). Finally, [4] the specialised scientific knowledge about global climate change creates further complexity.

Because there are so many different sources of complexity interacting, this subject and knowledge system is difficult for the general public to understand. Our example presents a graphic visualisation of the basic expert knowledge related to global warming. By indicating the functional relationships, the concept map helps close the gap between how this subject is understood and how it is mentally represented.

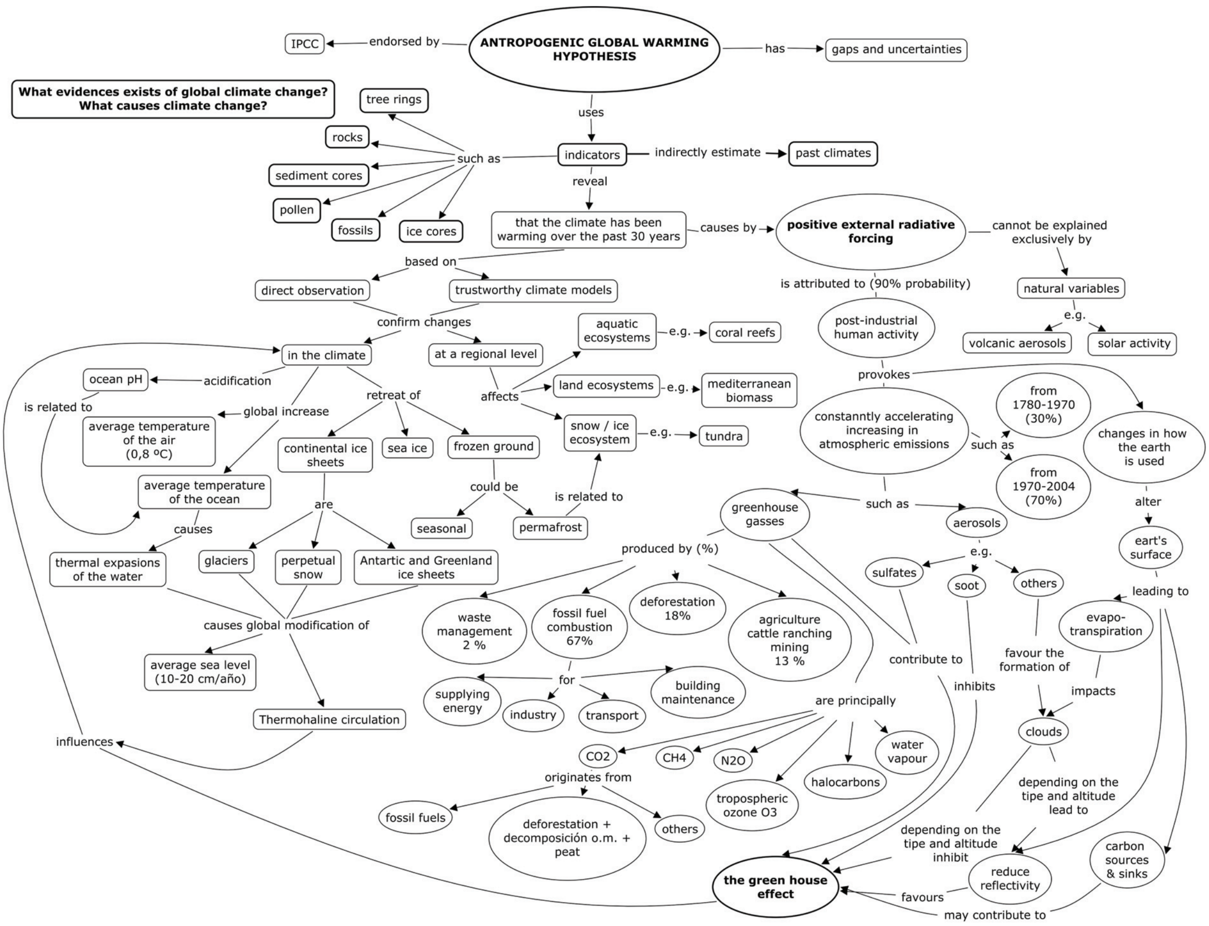

Figure 1. This is an example of the basic expert knowledge related to global warming.

3 Nanotechnology: complexity in an emerging world

Nanotechnology can be defined as applications derived from specialised knowledge of Materials Chemistry, Materials Physics and Molecular Biology. By applying this knowledge, nanotechnology can produce artificial objects that are so tiny that they are imperceptible to humans. These artificial nanoscale objects produce effects which can be perceived at the macroscopic scale through items we use in our daily lives.

Because nanotechnology is based on highly specialised knowledge that is not understood by the majority of the public, information about nanotechnological products and processes should be aimed at clarifying the fundamental concepts of the technology and facilitating a cognitive representation of the nanotechnological world.

3.1 Representing complexity through ordinary examples

Nanotechnology shares complexity sources [1] and [4] with the global warming problem and incorporates a new source of complexity: technologies that manipulate the physical world to create objects that do not occur naturally are always risky. The fact that current scientific literature does not completely describe how these newly developed objects will interact with those that already exist introduces uncertainty into our knowledge systems. This uncertainty makes it difficult to evaluate nanotechnology and, therefore, to decide whether to accept or reject it. Hence, in order to comprehend the complexity of the problem the benefits and risks involved must be understood.

To achieve this understanding, the specialised knowledge at the heart of nanotechnology must be linked to objects and processes that operate in environments that cannot be manipulated at the human scale, yet whose existence modifies the perceivable world. With this in mind our example represents nanotechnology from the point of view of familiar applications in the hope of evoking mental images of the technology and its relationship with specialised scientific knowledge that can be understood by the general public.

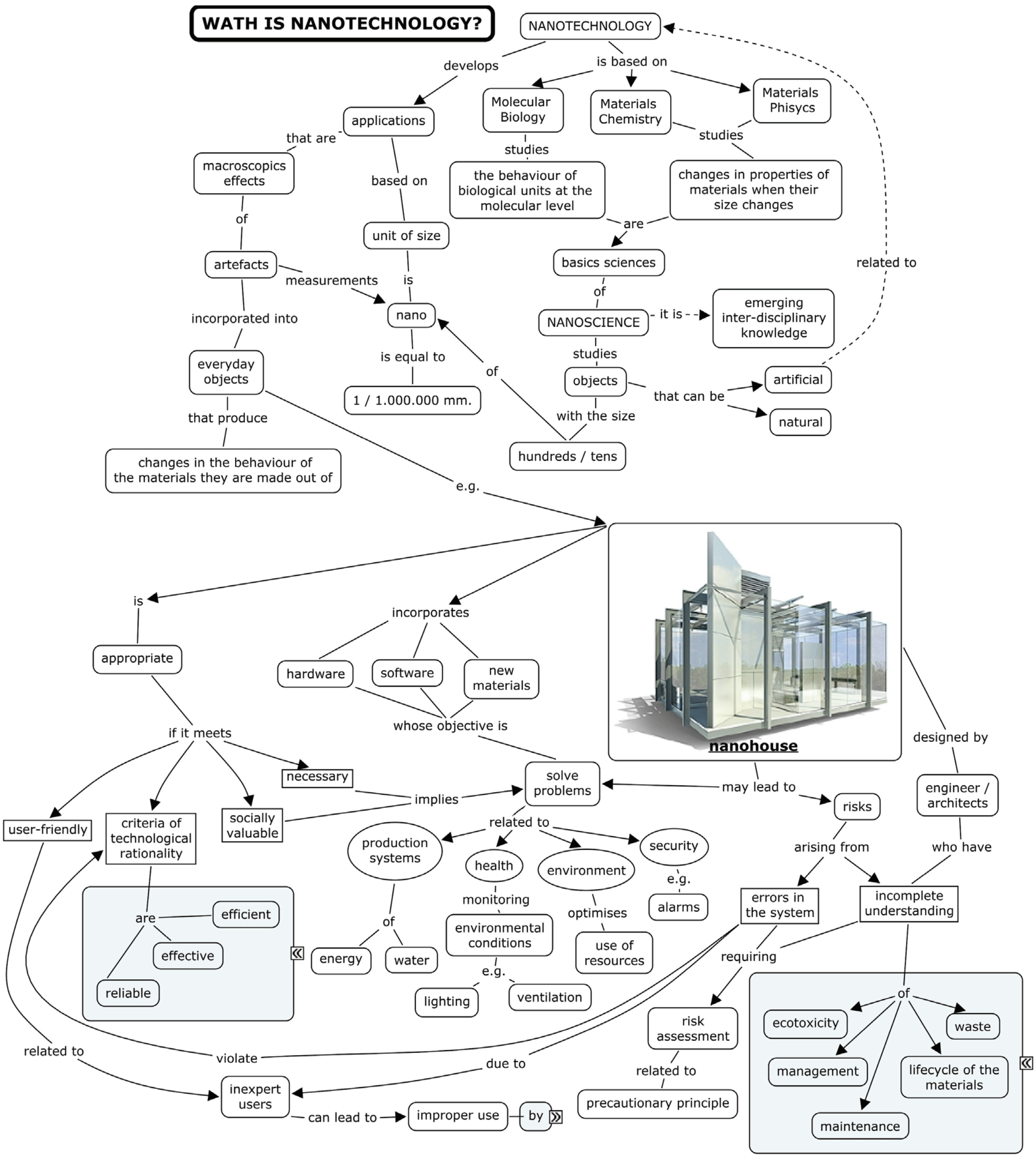

Figure 2. This is an example of the basic expert knowledge linked to everyday objects and processes.

4 Summary

We propose to involve concept maps in the public dissemination of scientific knowledge and technology. We have linked the use of concept maps to both the communication and comprehension of information by using iconic representation of specialised knowledge and evoking relationships between this knowledge and everyday life. Our initial hypothesis is that concept maps can be useful tools for communicating information to the general public about complex issues, as long as fundamental expert knowledge is represented and the sources of cognitive complexity related to the issues are minimised.

The examples that have been described are part of two projects designed to disseminate information. In the case of global warming, work is being carried out in secondary education to develop concept maps that allow students to acquire specialised knowledge by understanding the global dimensions of the problem.

The Project is currently in the experimental phase, with two groups of 16 year old students: a) a control group that, with little instruction, receives information by watching part of Al Gore's documentary "An inconvenient truth", which focuses on part of the problem by presenting information that is medium-highly difficult to understand. b) an experimental group which takes part in activities designed to contextualize the problem before (a conceptual questionnaire) and after (group discussion of a complex expert conceptual map which is divided into a group of simpler, interconnected maps) viewing the documentary. In order to minimize the possible "map shock" suggested by the TCU group, Gestalt principles are employed when organizing the complex information. In addition, using different iconic codes the students' preconceptions, the concepts in the video and concepts from other sources, some of which contain hyperlinks, are emphasized. Finally, both groups are given an evaluation questionnaire, which focuses on the comprehension of the new information, the acquisition of scientific knowledge and the application of this information to real situations that affect the students.

The nanotechnology example was borrowed from a project to disseminate scientific knowledge; this project seeks to facilitate understanding of this issue by constructing a conceptual framework, which gives meaning to the relationships between basic disciplines and everyday applications, within a more general framework of the Science, Technology and Society Programme.

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CONCEPTUAL CHARACTERIZACIÓN IN CALCULUS WITH TECHNOLOGICAL MEDIATION USING CONCEPT MAPS AS FOLLOW-UP STRATEGY

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Abstract. Calculus is the language to express basic concepts of various scientific fields. A solid understanding of Calculus by students should be a key process in the learning process of students of diverse fields, it allows for a better performance in various knowledge areas. The use of specialized mathematical software empowers the student to visualize and integrate the concepts at hand and allows for the simulation and modeling of phenomena that the student finds in his/her environment. This way, concepts gain a particular importance for each student, furthermore, its integration the integration and understanding are reflected by the construction of concept maps both inside and outside the classroom.

1 Introduction

The learning process is the result of interation and intervention activities, where the learning subects get support from other subjects and from technology in order to build conections with their environments. These connections become the place for the projects the subjects undertake as social individuals.

Starting in 2005, Eafit University (Medellín, Colombia) has undertaken a long-term research project aiming at observing the learning process that takes place when ITCs are introduced to the classroom.

The integration between technology and the learning process made us think of an "Ecology for Cognition". We built indicators to measure the impact of the use of technology on the didactical practices in the university, both in the short and in the long term. In the project we have observed the communication between students and instructors, as well as the intaractions among (i) students (ii) contents and (iii) context.

The transmission process was analized from the point of view of the transmitted values, cognitive strategies and the context (Debray, 2000). Concept maps were one of the used tools in order to discover the structure of the concepts at hand.

2 Elements for the intervention and development of strategies inside the classroom

In the traditional teaching and learning of calculus, very few collaborative spaces are created by the instructor or by the curriculum. These spaces should allow students to collaborate among them and use their insights in order to solve practical problems. Georg Cantor (cited by Davis & Hersh, 1998), states that "The essence of Mathematics is their freedom. Freedom to build, freedom to propose hypothesis". Based on this statement, we proposed to develop a mathematical thinking on the students based on their environments, as well as practical problems related to their professional lives.

During the experience, students had to undertake activities in which they could develop collective and multidisciplinary projects related to multi-variate calculus. In parallel, they had to formalize and sinthesize mathematical explanations of real-life objects. This process allowed them to exchange questions and answers, compare ideas, regulate and validate the knowledge, all of this guided by the instructor. The process, in turn, allows students to understand how to create and validate mathematical statements.

Students were introduced to specifical situations by the use of Pocket PCs running 3D-Universal[1]. The software allows students and the instructor to visualize and manipulate surfaces and their corresponding equations. The instructor led the students in the process of detecting real-life objects that looked like the mathematical surfaces. They recognized external information from a process involving analysis, processing, deduction, building of feasible solutions; thereby allowing them to understand multi-variate calculus as a powerful language to create (or re-create).

Formulation of questions allowed students to reach conclusions or open new paths to explore (Elder & Richard, 2002). Some questions were used to emphasize concepts. Other questions were used to lead students to

[1] A sofware we designed for the project.

a cognitive "conflict", allowing them to build their own arguments and connect the new concepts with older ones in a non-straightforward manner. A two-way communication was established between the instructor and the students. The process of formulation of questions, proposition of hypothesis and possible solutions, improved the understaning of the various processes. The use of technology fostered the creation of meaningful concepts on the subject at hand.

2.1 Use of collaborative tools in the construction of solutions to calculus problems

Collaborative work for problem solving is important to collect information from the participants during the experience. The analysis of the anwers is important for the student to expand their networks of concepts. During the Multi-Variate Calculus course, the *Forum* allowed students to collaborate in an asynchronous manner for solving typical problems.

Students had access to the following resources: The text book, a computer with Internet Connection, Eafit Interactiva[2], links to applets related to the subject at hand, Pocket PCs running 3D-Universal, Cmap Tools, basic Office software and math software, such as Derive and MatLab. They could also get support from the instructor.

Students were asked to share ideas, formulas, graphs with their peers using Eafit-Interactiva. We observed three aspects when reviewing the use of the *Forum*: (i) It is not easy to communicate, with words, what students think, therefore, (ii) students use graphs, equations, sketches, etc. to communicate, which, in turn, allows them to (iii) reach a collective agreement on the various forms to approach the problem. This shows a process of meta-learning (or learning to learn). Students identify the ways to construct hypothesis and how these are accepted or rejected according to the problem (meta-thinking).

The analysis of problem-solving by the students allows them to approach knowledge from a personal-meaning point of view. This allows them to start cognitive and meta-cognitive processes based on perception, understanding and modelling (Chavez, 2006). The first step is perception, induction and valuation. Connections are created. The second step is understanding (explanations), where thought is re-accommodated and he mind searches concepts in familiar stimula. The last step involves the creation of a representation (modelling), semantics and language. This is where the student enjoys generating ideas, understanding and abstract reasoning, thereby improving autonomous learning.

In the learning process, spaces have to be created to allow students to freely express their ideas and to explore different forms to solve problems. Students should also be given a number of tools to build their solutions.

2.2 Concept maps in the synthesis process of calculus concepts

Concept maps are a tool to explore and evaluate the relations that a subject has in relation to a concept, subject or topic in his/her mental structure (Novak, 1999), and are a powerful tool to observe the relations that a student or group of students create in relation to a concept or subject.

With the use of concept maps to represent Multi-Variate Calculus concepts, the following cognitive processes are fostered: (a) Ability for induction, deduction and abduction, considered as competences for logical reasoning (Pérez Flores, 2006). (b) Ability for structuring, in a graphical manner, information. This ability is a competence of spacial orientation (Barra, Ramírez y Díaz, 2006).

During the process of research, the experimental group was asked to use concept maps in order to characterized the concepts, integrate and evaluate the processes. The students did use concept maps in order to synthesize a unit of study and at the end of the course, they were asked to use concept maps to summarize their experience. The following questions were proposed:

- What basic concepts of Calculus have I studied?
- How to these concepts relate to each-other?
- What real-life applications does Calculus have?
- How can I connect the concepts to the applications?

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[2] http://isis.eafit.edu.co/ei/

One of our objectives was to observe the relations and contrasts of students in the control and in the experimental group. (Students in the control group did not had technological support and did not use concept maps during the course). In order to compare, the control group was taken to the computer room, and were asked to create concept maps to answer the same questions as the experimetal group. There were clear differences between the maps build by students in the exerimental and the control groups.

Students in the experimental group, quickly created connections between the concepts they have previously learned and the applications. The concept map in Figure 1 is a representative example. There is an outstanding number of cross-links, and the language is used in an appropriate way. On the other hand, a student in the control group created the concept map described in Figure 2, with few concepts and limited connections. At the end, we talked openly to each group.

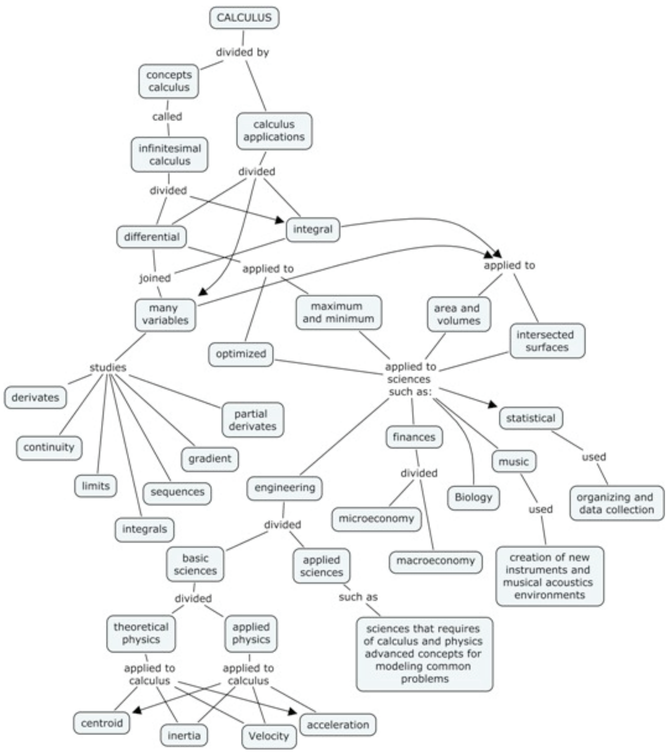

Figure 1. Concept map designed by a student in the experimental group.

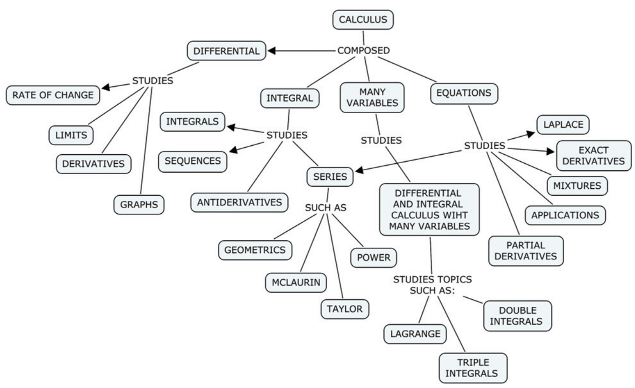

Figure 2. Concept map designed by a student in the control group.

The construction of concept maps allows both the student and the instructor to evaluate the regulate the understanding of the concepts that students have been exposed to during the semester. The observed difference between the concept maps elaborated by the two groups (differences in conceptualization, assimilation, appropriation and use of the course topics) was basically due to the use of technology mediators by the experimental group.

3 Conclusions and future work

An active relationship of the instructor with technology is fundamental for the transmission of concepts in the process of building mathematical knowledge by the students, both on an individual and collective manner. In our experience, technology mediators were were used to foster conversations in which students expressed their reasonings freely, both about their own solutions as well as their peers', thereby creating a process of mutual respect and confidence. This framework was described th the instructor as follows: "This type of course forsters participation of the students with the contents, the quality of formation and processes of interaction. It added a new dynamism to various processes, among them the exchange of ideas. At the same time, it allowed for the evaluation of the individual and group evolution, through the implementation of individual and group assignments."

Based on the supplementary activities proposed by the instructor (real-life objects, virtual forums, concept maps and identification of objects in their environment), students had the opportunity to approach learning from different perspectives. Each activity had different technological support. Since students were comfortable with technology, they could easily use the PocketPCs, even for the first time in their academic contexts.

The instructor considers that the use of technology allowed him to approach learning from the processes of induction, deduction and abduction reasoning. The graphical support of the technological tools also allowed students to understand several concepts easily. Concept maps fostered the creation of connections among the concepts. Technology also allowed students to foster the understanding of relations between the mathematical concepts and real-life applications.

The use of technology in various activities in the classroom, allowed students to recognize other communication and evaluation strategies, permitting the construction of knowledge and self-regulation of learining. The use of technology also motivated students to the use of other information sources and created new ways of student-instructor, student-student and student-context interation, starting from a collaborative work methodology.

Thanks.

The group would like to express gratitude to Eafit University and the support for the project "Desarrollo e implementación de servicios y contenidos en el uso de tecnologías móviles en el trabajo colaborativo universitario" (project code 13-000058).

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CONFUSION AND UNKNOWN ABOUT CONCEPT MAPS IN ESIME-CULHUACAN IPN MEXICO

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Abstract. Today there are different models of teaching - learning for college and everyone agrees that the student has a higher level participatory. Sometimes the models are taken very fast by educational institutions and the teachers have a slow response, to resist change and in many cases confused by ignoring pedagogical techniques. Stay as single transmitter of knowledge instead of facilitator. This happens in the Computer Engineering career in ESIME-Culhuacan in the National Polytechnic Institute, Mexico. Six years ago changed the educational model traditional by one learner-centered in which concepts such as *learning how to learn*, *learning how to do,* new teaching tools and techniques, meaningful learning, concept maps and constructivism, generate a lot of confusion among teachers and they need to make a training plan to learn and employ such theories to obtain good results to use. In special mentions the interest in knowing concept maps it was commented that they are an extraordinary tool and simple, complete and proper, for teaching - learning process. As a result of the foregoing propose a plan of instruction that will serve as a solution to the current state where we are, introducing teachers in the study of meaningful learning and concept maps.

1 Introduction

In the various psychological approaches to learning, the ambit of meaningful learning by David Ausubel (Ausubel 1978) is the most widespread by psychologists and educators and within its theoretical framework their best exponent is concept map that elaborated in an appropriate way leaves clear the internal assignment of conceptualization (Ballester 2002). It is based on cognitive theory of meaningful learning and is a technique developed and proposed by Joseph Novak and collaborators at Cornell University. The concept maps are powerful tools that make using labels or slogans, concepts systematized of events and objects that surround us, including links that connect concepts, to form meaningful propositions for those who attribute this relationship construction.

In National Polytechnic Institute (IPN) Mexico, is located ESIME - Culhuacan that forms undergraduates of engineering career area and from six years ago adopted a new educational model (NEM) enabling it to provide graduates they can integrate the current globalized society. This model is focused on students and incorporates the constructivism as educational paradigm.

Despite that has begun to train their teachers more than 15 thousands teachers, so that, is very complicated and an enormous effort of the institution, we still lack much to learn and test. In this sense the knowledge and training about meaningful learning and in particular concept maps is still very poor.

In this work presents the errors and lack of knowledge about concept maps in our school, obtained through interviews and questionnaires and is intended to serve as a state of the art of our position on this issue, which in turn, serve to establish lines of research, training and is a representative sample of the state of our institution.

2 Confusion in concept maps at ESIME - Culhuacan

Being questioned and interviewed 35 of the 79 teachers who are part of engineering in computer career in ESIME - Culhuacan because those with more hours of discharge, time of seniority and status, as well as degree of doctorate and master showed the following results listed in table 1.

Questions	Answers				
	Yes	No	Regular	a little	Don´t care
Are you concerned that their students learn?	32	0	0	0	3
Do you use any method to assess their teaching- learning process?	7	10	9	5	4
Do you know the theory of meaningful learning?	4	0	5	20	6
Do you know the theory of concept maps?	4	6	2	18	5

Do you know the new educational model of IPN?	**4**	**2**	**9**	**19**	**1**
Do you know teaching techniques?	**24**	0	8	3	0
Are used to teach in class?	**17**	0	**15**	3	0
Have you recently trained as a teacher?	**26**	3	6	0	0
Do you feel motivated to pursue teaching?	**15**	7	10	3	0
Are you motivated in your workplace?	**7**	15	7	6	0

Table 1: Questionnaire – interview to teachers from ESIME Culhuacan.

3 Test

The interviews were conducted between pairs scholars who have knowledge and experience in the subject of meaningful learning, and concept map of the area that corresponds interviewed, conducting queries displayed in Table 1 and deepened through chat informal according to their response for additional information on the origin of data and sort it by time, support, economics or need for any reason according to the answers.

As shown in the table most of the teachers concerned that their students learn what seems quite obvious, however, to deepen the interview we note that there is no clear idea about how to evaluate the process of teaching - learning? Who are making. Thus, by introducing them into the study of meaningful learning several aspects related to the acquisition of knowledge emerge as reflection.

They commented on their availability participation in a plan for training and if they want to get involved in the preparation, likewise, at the suggestion of the first review of this paper they showed that is a concept map for the preparation of a questionnaire and the organization and construction of knowledge related to the initial questionnaire and most were surprised how useful and practical it is a concept map and showed more interest.

As we look at the number of teachers interviewed represents approximately 44% and the other party does not suppose that makes a significant planning nor are trained to teach it only attends class in front of his group, so that, is unknown information that may be provided by these

Lastly were showed examples at random from diagrams of hierarchy, flow diagrams, concept maps and other graphics, to identify the type of representation that this was in addition to questions about the rules of construction, including those who said they were aware showed confusion and shyness to be used as teaching material.

4 Evaluation

As we noted there is ignorance and lack of learning about meaningful learning and in the case of concept maps there is much confusion, for this reason, deem it necessary induction course allowing train and raise awareness of the teacher of new tools proved and recognized to pursue teaching as part of an initial exercise.

For a future we believe that it will also be necessary establish a more comprehensive training program in the remaining areas including development and research in the field of concept maps and meaningful learning techniques for teaching, information technology and educational innovation among others if we want to be part of the globalized society and train high-level engineers and humans learn by themselves.

As for the numbers reflected in the table 1, 5% know the theory of meaningful learning, 25% know little and 7.5% not interested. In the case of concept maps, practically and the results are similar with respect to the NME, IPN almost identical. For education tools 24% and 21% know applies them in his class and 18% know them on a regular basis and 10% applies them regularly. The training is 32% in the teaching area and nearly 19% feel motivated to do their jobs. With regard to the identification of the rules of charts, only 10% managed to respond satisfactorily such representations and indicated possible uses in the exercise teacher

5 Argument

As a proposal we submitted a plan of action to follow through a concept map shown in Figure 1 below, which will serve as introductory and will exercise regimen to begin the subject by observing, studying and implementing the management process. Which will serve as introductory and will exercise regimen to begin the subject by observing, studying and implementing the management process with the participation of all teachers together to form the floor of the teaching career and that in turn can contemplate the inclusion or expansion as the case may be, towards the other areas of ESIME – Culhuacan.

For the resulting numbers reflect an ignorance very big if we consider that the percentage interviewed is half the existing taking into account the fact that teachers give class and just do not know its capabilities in the area and didactic and pedagogic only has supported by expertise in specialty topics of study for Teachers.

Likewise there is little academic staff it employs teaching techniques because of deficiencies and the effort that went into putting out. Ignorance and confusion about the rules, representations and implementation of concept maps demonstrated and leads us to reflect on the urgent training on these and other techniques as soon as possible to be incorporated into the background of teacher and keep it improve its performance professional.

Moreover tool to show the computational CmapTools were more concerned that relates to the area of engineering and several of them want to know more about meaningful learning and other models for teaching process.

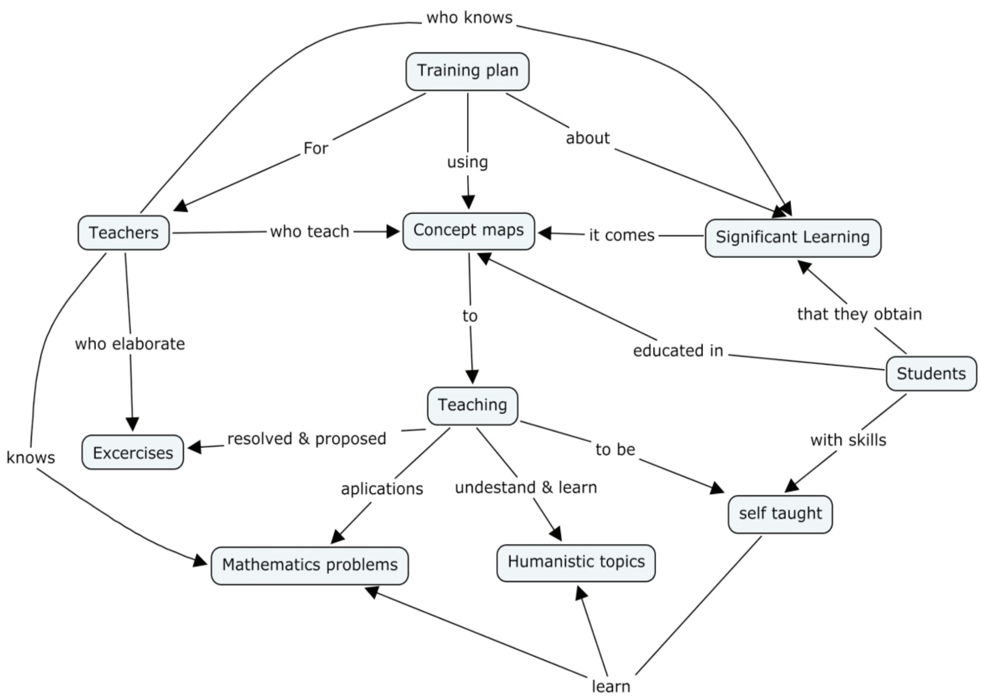

Figure 1: Concept map describing the proposed training program in concept maps for ESIME - Culhuacan**.**

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CONSTRUCTING KNOWLEDGE MODELS. COOPERATIVE AUTONOMOUS LEARNING USING CONCEPT MAPS AND V DIAGRAMS

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Abstract. This paper describes an experience in the construction of knowledge models, conducted at the Public University of Navarra (Spain), during the 2006/07 academic year, with 120 student teachers. The subject area was Knowledge of the Natural, Social and Cultural Environment and the objective was to create knowledge models based on the characteristics of the different areas of the Botanical Gardens at the Public University of Navarra. It was an experiment in cooperative, autonomous learning, using concept maps, V diagrams and CmapTools software. The results clearly illustrate the effectiveness of the teamwork, the high degree to which the students were able to master the targeted instructional techniques, and the importance of these techniques in creative knowledge construction and the acquisition of key basic skills for their future careers. The positive attitude shown by all the students at every stage of the experience added value to the final outcome.

1 Introduction

Cooperative learning is a movement based on a set of theoretical principles and a mode of group organisation, according to which a group of students must collaborate to achieve a more meaningful learning outcome for all members. The research, first undertaken by the Geneva School, suggests that peer interaction is more effective than student-teacher interaction when it comes to achieving a more balanced exchange and promoting knowledge construction. In this vein, Vigotsky (1979) established the notion of the Close Development Zone to refer to the difference in the level of tasks that pupils are able to undertake with the help of their peers and the level of tasks they are able to undertake independently. Due to the assimilation process it involves, social interaction is the origin and driver of learning and intellectual development. Other research works (Johnson, 1981) have demonstrated that pupil-to-pupil relationships play a key role in achieving the educational goals proposed by the teacher (Lobato, 1998).

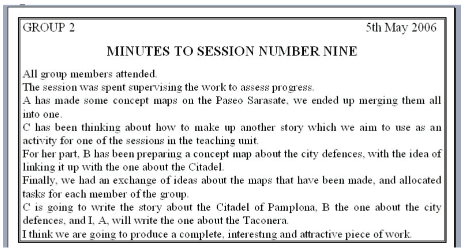
Bearing in mind that these theoretical assumptions can be operationalised with the help of CmapTools, a computer program designed to support collaboration in cooperative knowledge construction and knowledge sharing and thereby facilitate meaningful learning (Albisu, San Marín, González, 2006: Novak & Cañas, 2003, Cañas et al., 2004), this paper presents an experience inspired by the principles described above, in which student teachers at the Public University of Navarra will be set the task of constructing knowledge models based on the characteristics of different areas of the university's botanical gardens, using methodology based on cooperative, autonomous learning.

2 Methodology

The experience was conducted during the 2006/07 academic year with 120 student teachers, specialising in infant, musical and foreign language education, as part of the subject area of Knowledge of the Environment during their teacher-training course at the Public University of Navarra. It comprised the following stages:

2.1 Stage one

The experience began with an awareness-raising session in which the students were presented with the learning task and divided into groups. The learning topic and objectives were also explained during this stage. The various groups were asked to create a Knowledge Model on the subject of the botanical gardens on the university campus. The students had received prior instruction in the use of CmapTools Software and the construction of "V" diagrams (González, 2008).



GROUP 2 5th May 2006

MINUTES TO SESSION NUMBER NINE

All group members attended.
The session was spent supervising the work to assess progress.
A has made some concept maps on the Paseo Sarasate, we ended up merging them all into one.
C has been thinking about how to make up another story which we aim to use as an activity for one of the sessions in the teaching unit.
For her part, B has been preparing a concept map about the city defences, with the idea of linking it up with the one about the Citadel.
Finally, we had an exchange of ideas about the maps that have been made, and allocated tasks for each member of the group.
C is going to write the story about the Citadel of Pamplona, B the one about the city defences, and I, A, will write the one about the Taconera.
I think we are going to produce a complete, interesting and attractive piece of work.

Figure 1

The students were divided into groups of 4-6, and two members of each group were assigned as group leaders, one to take charge of the material and write fortnightly reports on the group's progress, and the other to supervise all the assignments to be completed using CmapTools. Figure 1 shows an example of one of these reports.

2.2 Stage two

This was when the students began the teamwork, (Figure 2) which was supervised at all times by the teacher-educators. It was while preparing the theoretical basis for their assignment that the first discussions, debates and problems arose, requiring the students to work towards a consensus, share meanings and interpretations, and establish agreements accordingly. The fortnightly reports, written up in class, helped to put the importance of these dynamics into perspective.

Figure 2

To find the information they required, the students used the University library to consult the bibliographic sources indicated by the teacher-educators. All group members also made frequent visits to the gardens to observe the trees, bushes and flowers throughout the changing seasons. This enabled them to take note of the characteristics of the different plants on observation cards specifically designed for the purpose. Other data sources were photographs, videos and semi-structured interviews with the gardeners.

All this work was reflected in the knowledge models created by the various groups.

Figure3 is the map of the basic knowledge model constructed by one of the groups with the link to the corresponding V diagram partially opened, and figure 4 offers a partial view of the knowledge model created by the same group with some of the links opened. The HTML versions and CD-ROM recordings of the knowledge models created by the various groups were handed in to the teacher-educators.

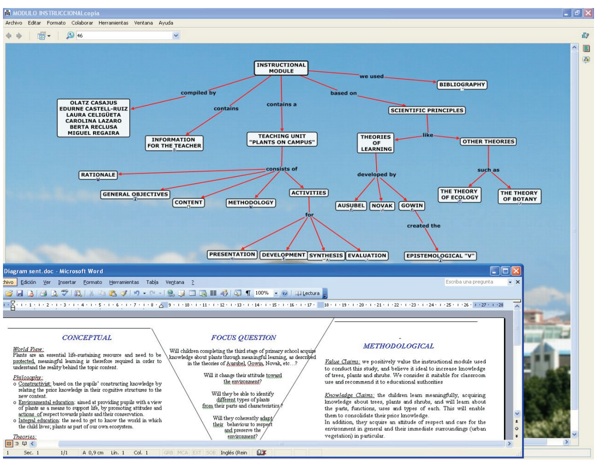


Figure 3

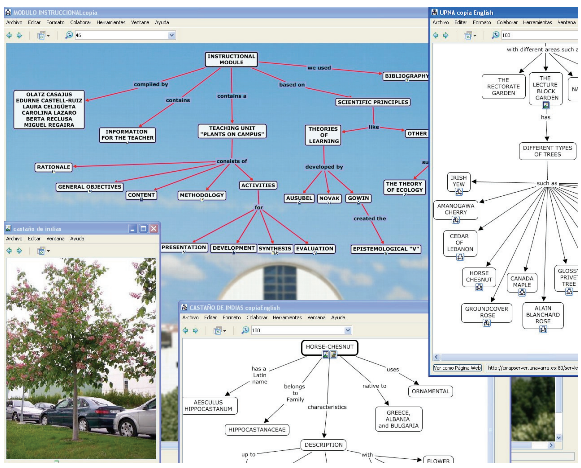


Figure 4

2.3 Stage three

Each group presented its work to the others using ICT resources (computer and video projector), in 20- minute presentations.

Figure 5 shows one of the groups during their presentation.

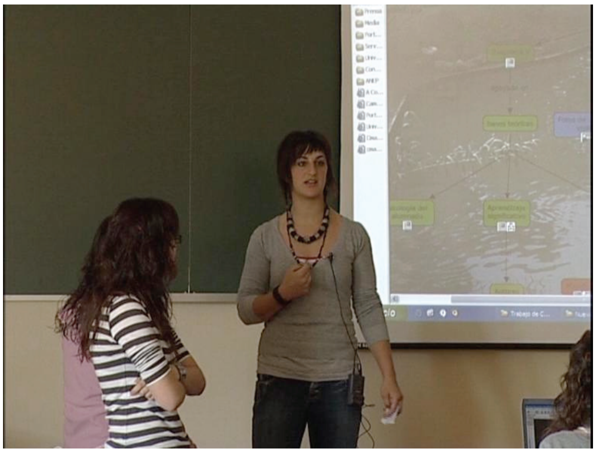


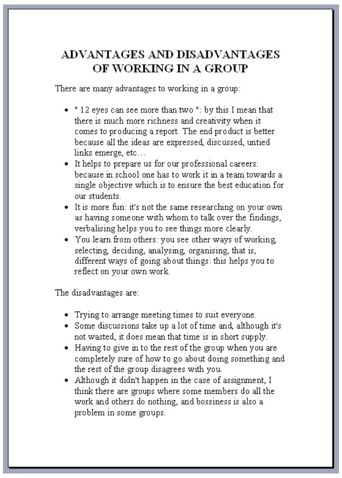
Figure 5

3 Results and discussion

Analysis of the knowledge models created by the various groups of students revealed a logical correlation between the theoretical and practical domains of the different Vs, and also the remarkable precision of the epistemological elements contained in each of them. The scores on the indicators established by Guruceaga & González (2004) also showed the high quality of the concept maps created by the various groups. The richness, variety and creativity that went into selecting the resources associated with the concepts in all the maps were also clearly apparent.

The fortnightly reports and the analysis of the replies to the final questionnaire put to the students, (Figure 6) allowed us to verify the theoretical rigour with which the students had undertaken their task. This was particularly apparent in the positive interdependence achieved in their teamwork, and the facility with which the students, who belonged to similar levels of the Close Development Zone, were able to achieve social knowledge construction. It was also obvious that they had acquired some of the key competencies contributing to their future careers, such as the development of skills in oral and written communication, analysis and synthesis, meaningful learning and creative knowledge construction, and that the synergy and empathy between group-members had increased. Figures 3 and 4 offer excellent examples of the rigour with which the students created their knowledge models. The map shown in figure 3 shows the hierarchical ordering and transparency of the concepts and the clarity of the processes and outcomes. It is also worth noting the rigorousness of the V constructed by this group. Figure 4 shows a partial view of the knowledge model constructed. It also reveals the high-quality of the resulting concept maps and the selection of resources.

The oral presentation was a further manifestation of the high degree of coordination between the various group members, the ease and expertise with which they used the technological aids, and their remarkable verbal fluency, all of which revealed the seriousness and strict adherence to the instructor's guidelines with which they had undertaken the assignment. The experience clearly showed that the information collected by the students in the initial stages of the process had, by the final stage, been transformed into useful knowledge (Meichembaum & Biemiller, 2000). From the emotional point of view, the group members displayed from the start a highly favourable attitude towards the task, thus adding value to the outcome and strongly promoting the achievement of meaningful learning.



ADVANTAGES AND DISADVANTAGES OF WORKING IN A GROUP

There are many advantages to working in a group:

- " 12 eyes can see more than two ": by this I mean that there is much more richness and creativity when it comes to producing a report. The end product is better because all the ideas are expressed, discussed, untied links emerge, etc…
- It helps to prepare us for our professional careers: because in school one has to work it in a team towards a single objective which is to ensure the best education for our students.
- It is more fun: it's not the same researching on your own as having someone with whom to talk over the findings, verbalising helps you to see things more clearly.
- You learn from others: you see other ways of working, selecting, deciding, analysing, organising, that is, different ways of going about things: this helps you to reflect on your own work.

The disadvantages are:

- Trying to arrange meeting times to suit everyone.
- Some discussions take up a lot of time and, although it's not wasted, it does mean that time is in short supply.
- Having to give in to the rest of the group when you are completely sure of how to go about doing something and the rest of the group disagrees with you.
- Although it didn't happen in the case of assignment, I think there are groups where some members do all the work and others do nothing, and bossiness is also a problem in some groups.

Figure 6

4 Conclusions

This research demonstrated the advantages gained in the creation of a Knowledge Model through the use of Concept Maps, Gowin's V and CmapTools computer software, by teams working in a cooperative and highly autonomous environment.

The knowledge models analysed revealed the high level of expertise in the use of concept maps and V diagrams achieved by the students and key role that this plays in processes involving creative knowledge construction, meaningful learning and the transformation of mere information into useful knowledge.
This experience in teamwork has enabled the students to acquire a series of basic skills that will be of great use to them in their future careers. These include the ability to work in a group, to generate synergy and empathy between group members and to communicate orally and in writing. All aspects of both the process and the outcome were optimised by the level of attitudinal and emotional involvement among the students, which gradually increased throughout the experience.

5 Acknowledgements

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DESIGNING DATABASES WITH CONCEPT MAPS

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Abstract. We propose the traditional approach to data modeling (using the Entity Relationship model) be augmented with concept maps. A data model can begin as a concept map and if the concept mapper chooses linking phrases carefully the transformation of a concept map to an ER model is facilitated. We propose a set of linking phrases to accommodate many aspects of ER modeling. Students benefit, in general, from using concept maps in any area of study, and so as concept mapping can be integrated into ER modeling the student gains additional benefit from studying ER modeling.

1 Introduction

Concept maps were developed in 1972 (Novak & Musonda 1991); they are graphical tools for organizing and representing knowledge that include concepts, and relationships between concepts indicated by lines connecting (linking) pertinent concepts. The links between concepts are propositions that comprise two or more concepts connected using linking words or phrases that form meaningful statements (Novak & Cañas 2008).

The developer of a concept map has total freedom in choosing concepts and linking phrases which is useful when creating a representation of knowledge. However, discipline is necessary when choosing linking phrases to avoid ambiguity, and when a novice is becoming an expert, the same domain knowledge gets represented by more accurate linking words (Kharatmal & Nagarjuna 2006).

Entity-relationship (ER) models are used in the traditional approach to database design. ER modeling abstractions include entity types, relationship types, attributes, specialization, composite attributes, key attributes, partial key attributes, derived attributes, domains, categories, n-ary relationships, xor relationships (Elmasri & Navathe 2007, Hay 1995, Silverston 2001). (Xiao 2007, Sien & Carrington 2007) showed that concept maps can be used to develop a first domain model from user requirements and that concept maps are useful for helping students develop abstraction skills needed in data modeling. If pertinent link phrases are applied, these concept maps can be transformed into more traditional data models. If an ER model is to be generated, concepts in the map become entity types or attributes according to the link phrases used. Link phrases are also used to determine the type of relationship that exists between entity types. (Xiao 2007) used three classifications of link phrases: (1) to associate attributes to entity types, (2) to accommodate aggregation/ composition relationships and (3) to accommodate generalization/ specialization relationships.

In section 2 we discuss concept maps and ER models and give examples to illustrate the additional link phrases we propose. In section 3 we give our conclusion and suggestions for future work.

2 ER Modeling and Linking Phrases

When a business analyst begins to design a database the analyst starts with rough sketches, jotting down tentative entity types (concepts), and joining them with relationships (linking phrases). A database design often begins as a concept map and at some time is expressed in a more formal manner such as an ER model. The symbols that appear in ER models have precise meanings that reflect business rules in the problem domain. Each rule can be expressed in a natural language statement or as concepts and linking phrases in a concept map. Table 1 summarizes the linking phrases that a concept mapper can use to facilitate the transition to an ER model. Our table extends previous work (Xiao 2007, Sien & Carrington 2007), and proposes additional phrases: “identified by”, “calculation provides”, “subdivided into”, “based on”, “union of”, “e.g.” and “either or” as further refinements for linking phrases related to data modeling.

ER construct	Linking phrase
Entity type - attribute	Described by #
Specialization	Is-a
Aggregation/Composition *	Includes
Entity type - key attribute	Identified by
Entity type - derived attribute	Calculation provides
Entity type - composite attribute	Subdivided into
Attribute – domain +	Based on
Category	Union of
Relationship type	*Phrase comes from problem domain*
Example +	e.g.
XOR Relationships *	"either or" *with phrase from problem domain*
# We choose to use "described by" rather than "knows" as done in (Xiao 2007, Sien & Carrington 2007). Anthropomorphism is a natural aspect of object modeling, but in the traditional approach we think of an entity and attributes that *describe* the entity.	
* Strictly speaking, these are not part of the EER model in *Fundamentals of Database Systems* but they can be accommodated with simple extensions.	
+ Understanding the domains and providing examples are important to ER modeling but they are not included in ER diagrams.	

Table 1: Link Phrases for ER Modeling

Next, we discuss cases to illustrate our proposed linking phrases for ER modeling.

2.1 *Entity Types, Attributes, Domains, Examples*

An entity type is a definition of a grouping of entities that have common characteristics in terms of attributes and relationships. Consider a Student entity type with attributes student number, gender, phone number, name (first and last), birth date, and age where student number is a key. The concept map in Figure 1 uses linking phrases "based on" and "e.g.", "identified by", "subdivided into", "calculation provides", and "described by". Note that "based on" and "e.g." linking phrases identify information that is not shown in the ER diagram. "identified by" informs us of keys and "subdivided into", "calculation provides", and "described by" inform us of composite, derived, and regular attributes respectively.

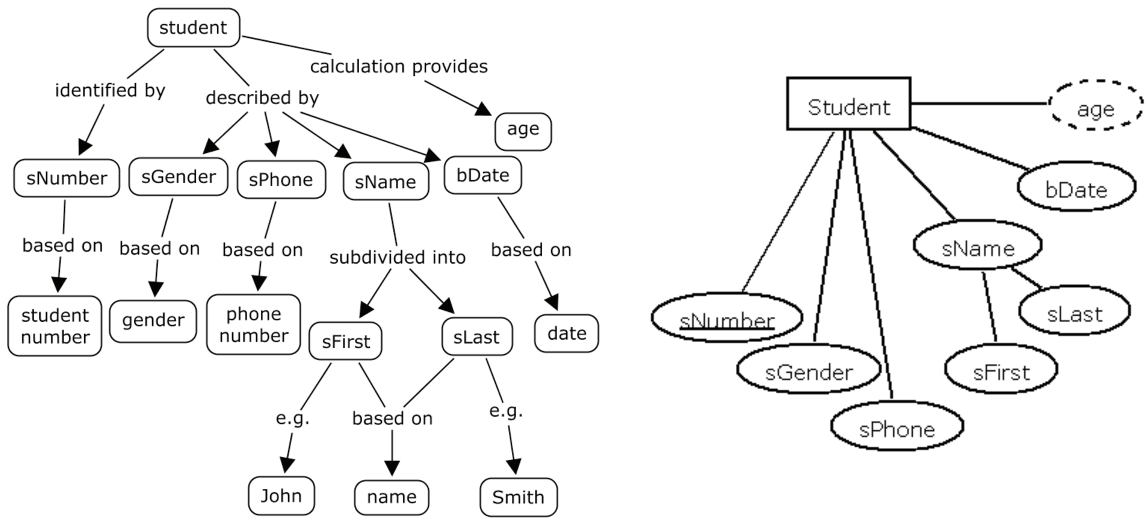

Figure 1. Concept map with attribute-related link phrases and the corresponding ER model

2.2 *Weak Entities and Identifying Relationships*

Our next example deals with courses and departments at a university. Consider that a department is identified by a department number and that a department offers courses that are identified by both department number and course number. Figure 2 shows the concept map and the ER model it transforms into.

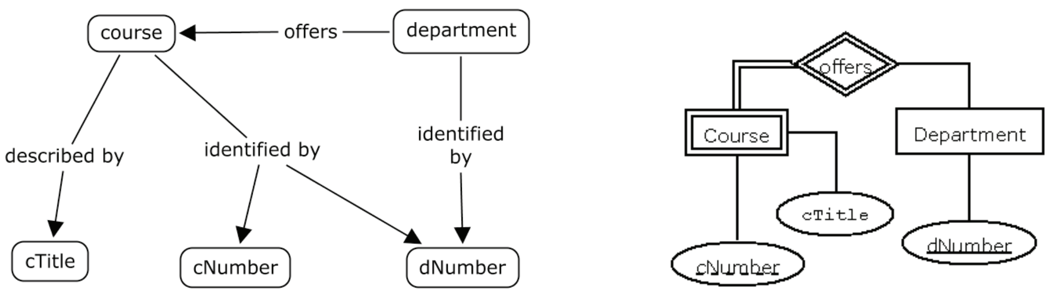

Figure 2. Weak entities and identifying relationships

Due to the representation for identifying relationships, weak entities and mandatory participation in a relationship, the corresponding ER model is complex. In the ER model the relationship is considered *identifying*, Course is a *weak* entity type and Department is a *strong* entity type. This has several implications that can be problematic for a student new to ER modeling: a) the department attribute is not shown as an attribute for Course, b) Course is shown as a rectangle with a double-lined border, c) Course's participation in the Offers relationship is mandatory and so there is a double-lined connector from Course to Offers, and d) Offers is identifying and so it is shown with a double-lined border.

2.3 n-ary Relationships

Previous work (Xiao 2007, Sien & Carrington 2007) considered binary relationships. n-ary relationships, where n>2, involve one relationship type and 3 or more entity types. For example, the ternary relationship "a student may enroll in a course offered during a term" involves the "Enrolls In" relationship and entity types Student, Course, And Term. The concept map and the ER model it transforms into are given in Figure 3.

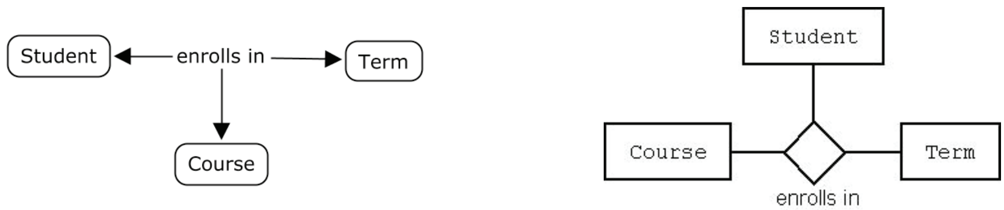

Figure 3. n-ary relationships

2.4 Categories

A category in ER modeling denotes an entity type that represents the union of two or more disjoint sets. For example, consider that a library patron is either a student or a staff, and that a patron borrows books. Note that a student is not necessarily a patron and a staff is not required to be a patron either; this is in contrast to specialization where students and staff would always be considered patrons. See Figure 4.

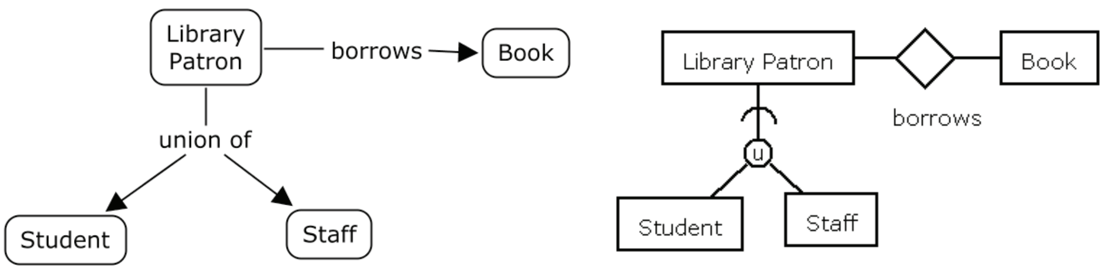

Figure 4. Categories

The category construct appears under-utilized in ER practice (Hay 1995, Silverston 2001) and instead we see models illustrating mutually exclusive relationships. In contrast to Figure 4, the business rules for library patrons are shown in Figure 5 but with mutually exclusive relationships.

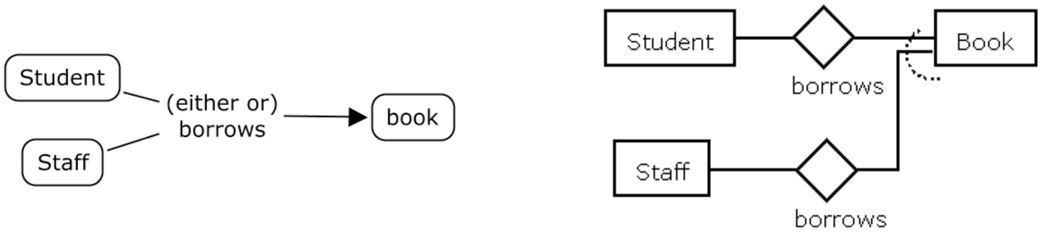

Figure 5. xor relationships

3 Conclusion and Future Work

The procedure for designing a data model begins with creating a concept map. An analyst begins by jotting down ideas/concepts and connecting them with links/relationships. The analyst does not need to be concerned with distinctions between entity types, attributes, domains, and examples in a concept map; they are just concepts which can evolve to attributes, etc., according to the linking phrases used. In one sense, concept mapping is much simpler than ER modeling because there are only two constructs to work with. Thus, concept mapping is the better tool for the novice to start with. Advanced modeling concepts can be introduced to the student as refinements that make our thinking more accurate and consistent. Once the refinements are understood, instruction can introduce ER modeling notation as a further refinement.

In future work we would like to integrate concept mapping and ER modeling in one tool and experiment with this in an educational setting. We would like to investigate the possibilities and issues of moving from a concept map to an ER model and, in the opposite direction, from an ER model to a concept map at any stage of development. It appears attractive to us to be able to view an ER model from different perspectives (layers) in a concept map; for example, some layers could present attribute information, others relationship information. Another area that, in our opinion, gives database students some difficulty is normalization. The topic of normalization includes a discussion of functional dependencies where graphs are used to illustrate dependencies between attributes. We would like to explore the connection between the concept maps as presented here for database design and attribute functional dependency graphs.

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DEVELOPMENT OF A KNOWLEDGE MODEL ABOUT PLASTICULTURE USING CONCEPT MAPS

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Abstract. We can find, actually, a great interest in the Latin-American countries on the application of the intensive agriculture techniques based in the used of plastics, because the requirements in increasing production in order to accomplish food security. Last news about food availability and prices of basic products confirm this point. Use of these technologies presents some risk, environmental, social and economical. A key point in a correct application of these techniques and material requires of a adequate knowledge that as in all natural and social environment conditioned systems, must be adapted to specific conditions of each location in order to obtain good results. In this sense in 2004, a set of 27 research groups and companies of 12 countries decided to collaborate in order to assemble a knowledge model of the plasticulture techniques, that has been assembled using mainly concept maps. Information was classified in 11 main areas and maps: agro-packing, climatic control, plant conduction, phytosanitary control, agronomic management, plant nutrition, soil preparation, crop protection, characteristics of plastics in agriculture, and a general one of plastics in agriculture. The use of the concept maps in general and of IHMC CmapTools has been a key point in ordering all the information and assembling the knowledge model.

1 Introduction

In the Latin-American countries of Portuguese and Spanish language, we can find actually a great interest in the use of plastics in agriculture, mainly as greenhouse covers and irrigation elements in intensive production. This new set of technologies is called actually as Protected Agriculture or more adequately “Plasticulture” (Pacheco 2002, Plasticulture).

Using correctly these materials, technologies and methods is a complex matter. Main characteristics are:

1. Correct application of technology depends on external conditions, as the weather, local materials, markets (local and external) requirements, soil characteristics, social situation and cultural traditions as example. It is an extremely locally specific technology, as example, a good tested greenhouse from an area of North Mexico it would be not suitable to be used in an area with same weather conditions (temperatures, humidity and winds) in Ecuador because the angle of sun rays is different and this conditions the optimum angle of roofs.
2. Actual knowledge about this technology has been developed in cold or template areas in North-America (USA), Europe (Holland and Spain) and the Mediterranean Basic (Israel), and East-Asia (Japan). Real conditions of Lain-American countries are extremely different at all levels from those of the actual technology leaders in Plasticulture. Direct translation of technology as the construction of a Israel greenhouse in a place like Venezuela Central Valley gave as result an installation absolutely inadequate, it reached inside 50 ºC.
3. Protected agriculture requires a higher investment than open-air one; bigger expenses and investments means greater risks. If there is not a good harvest (in quantity, quality and value), the farmer can go easily to ruin.
4. When correctly applied, if offers higher results, as bigger income, workload, and even environmental protection (as a reduced land area can sustain a higher population, more land areas can be reserved for ecological and environmental purposes). A correct application of these technologies offers good economic (income), social (work) and environmental (best use of lands) results, all these after assuring the availability of food to the population.

In order to improve the specific knowledge about the plasticulture technology in our area, the Latinamerican countries of Portuguese and Spanish language, a wide group of research groups and companies in our area decided to constitute a working group and propose to the CYTED Organization (the branch for Science and Technology for Development of the Ibero-American Organization of States), a project named CIACAP (“Comunidad Ibero-Americana de Conocimientos en Agro-Plasticultura”, Ibero-American Community of Knowledge in Agro-Plasticulture), which main objective was cumulate and order the knowledge about these plasticulture technologies in our countries, developing a shared knowledge model and an index of active agents. The project lasted 5 years from 2004 to 2007.

2 Methodology

Main objectives of the project were:

1. Creation of a repository of the knowledge (Schreiber et al. 2000) about plasticulture in our area, supporting dynamic retrieval of information. It would use a taxonomy of the field and would include a catalogue of resources. Main difficulty reaching this objective was ordering the available knowledge.
2. Developing a virtual work system supporting the work of multiple groups in an extremely disperse area. We should require a CSCW systems adaptable to different technological conditions. This system would be capable of been used by other projects in the same organization.
3. Compiling, classifying and systematizing the accessible knowledge about plasticulture in our area, previously disperse between several groups and working areas, in order to share it easily. We would wish to find all the possible synergies between the participant groups.

One key point in our work, was classifying and ordering information, and even after several meetings we found it was required the definition of the different concepts that constituted the nucleus of the plasticulture as a new field. A second point was the fact that most of the participants were specialist in non computing areas as agronomy, plastics, environmental issues, development, and so on, with not great experience in modelling knowledge. In this sense, we analyzed several methodologies, techniques and tools for knowledge modelling, selecting finally the concept maps as representation technique and CmapTools as tool, for knowledge extraction, modelling, sharing and presentation (Novak 1998, Cañas et al. 2000). Main advantages of using CmapTools were:

- It required no previous knowledge of computing tools.
- Easy management of the tools, quite intuitive, easy learning.
- No cost for research.
- Great autonomy. After a learning session all the participants could use the tool with autonomy.

Main problem, in our case, has been the lack of a system for management of synonyms, which could be used in our case as a way of managing different languages.

Main steps related with the use of concept maps, during the project were:

1. Developing a Computer Supported Work Systems, in order to reduce real meetings.
2. Forming the different participants in the use of Concept Maps and CmapTools (2002).
3. Configuring the main areas or work, selecting finally 11 areas, that generated the 11 concept maps included in the system (2002). Each area was assigned to a manager and a developing team was in charge of their assembling. Main working language was Spanish, a special mention must be done to the Brazilian teams in charge not only of developing their parts but in charge of translating the biggest part of the information.
4. Definition of the catalogue of concepts and agents (2002).
5. Developing the different maps, starting with a personal meeting (2003), followed by on-line work, a second pre-consolidation meeting (2005) plus more on-line work, and finally a final definition meeting (2006).
6. Selecting the areas for development of the GIS related to the project (2002-2003).

3 Results

Main results of the project were:

1. A project web with several functions, presenting the results of the project, offering a Collective Work Support System, including file interchange and management, internal e-mail, chat, forums and work repository and storage of project files (as concept maps).
2. A set of concept maps where actual knowledge about the plasticulture in our countries was concentrated. These maps were structured as pointed in previous section in 11 areas: plastics in agriculture (a general one), agro-packing, agronomic management, characteristics of plastics in agriculture, climatic control, crop protection, plant conduction, plant nutrition, phytosanitary control and soil preparation. Concept maps have been developed in Spanish and Portuguese, as all the documentation of the project. Figure 1 shows the translation to English of the map about "Crop protection". Figures 2 and 3 shows some detailed information about anti-insect nets.

3. A list of resources on plasticulture agents for the different areas and/or territorial areas of interest.

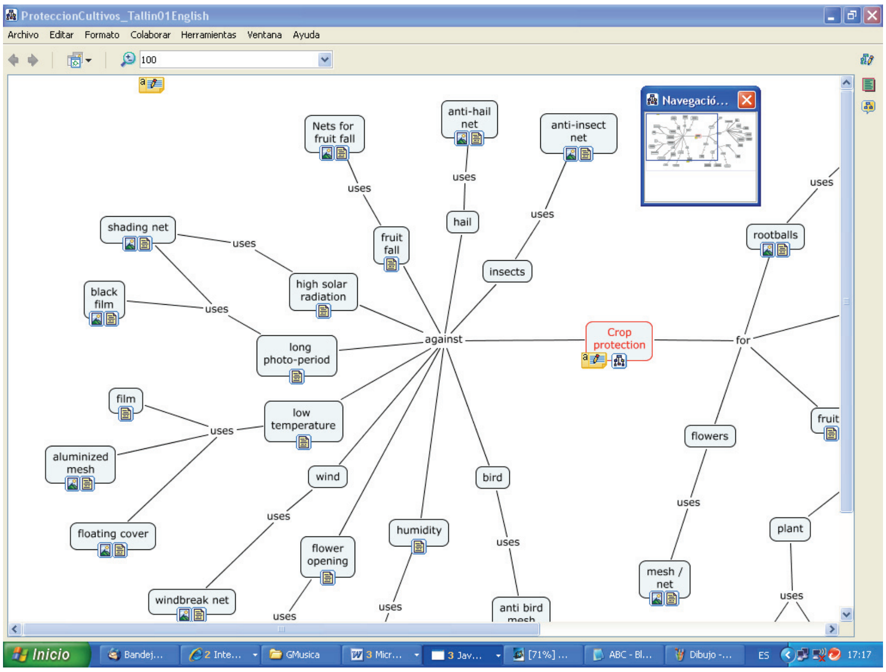

Figure 1. Concept Map about "Crop Protection", English version.

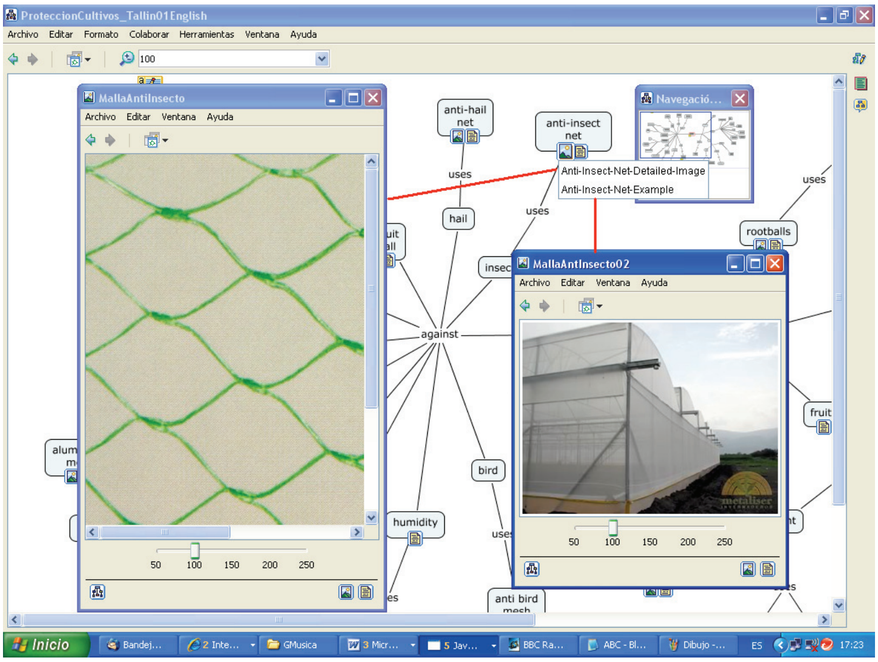

Figure 2. Images linked with the "Anti-insect nets" concept in "Crop protection" concept map.

4 Conclusions and further works

CIACAP project has been a complex project because it was highly interdisciplinary, with a great dispersion of participants, complex field of work (a new area with changing knowledge), use of different languages and argots, adaptation to specific areas requirements and novelty. One key point in the development of the project was the requirement of extracting, structuring and storing knowledge about plasticulture from different agents of diverse work fields disperse in a wide area, in this case, the use of concept maps was a good solution for this challenge.

Using of CmapTools has satisfied the requirements of our work; the only limitation has been the use of different languages, requiring the development of alternative maps instead of activating the alternative presentation of the same maps. Easily learning of the tools and their adaptability can be checked by the actual use of them in diverse fields by the participants of the project (as pest management or climatic control in greenhouses). Team members that have not used them previously have interiorized their use; they are utilizing them in other fields.

Next works include, translating the whole system to English (and probably French), transferring the system to a public ad-hoc web page, and preparing a system for public addition of references and knowledge.

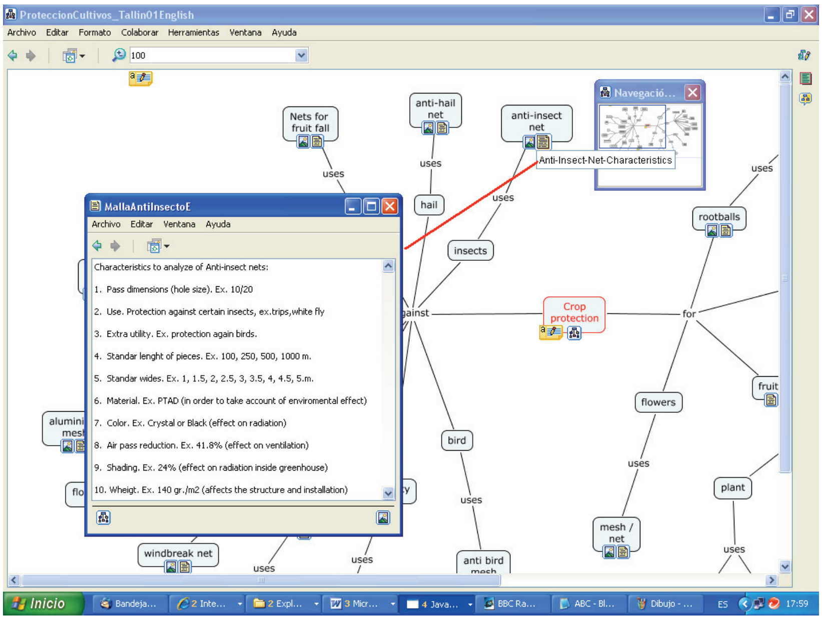

Figure 4. Characteristics to be taken in account for use of "Anti-insect nets", found in "Crop protection" concept map.

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DYSLEXIA AND CONCEPT MAPS: AN INDISPENSABLE TOOL FOR LEARNING

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Abstract This paper describes the experience of the Modena Section of the Associazione Italiana Dislessia in using concept maps with dyslexic students. An evaluation is made of the characteristics of concept maps that highlight the strengths and minimize the weaknesses of young dyslexics while promoting their success at school at all ages. The fundamental difference between normal student readers and dyslexic students lies in the difficulty dyslexics have in reading a text and then create a map autonomously. The help of a tutor or supporter is necessary. The map represents a substitute for the text and allows access to knowledge, favours learning and memorization, and encourages autonomy in study and revision so much that it becomes an indispensable tool for learning at school.

1 Introduction

Dyslexia is defined as a specific learning disability that is neurological in origin. (Lyon, Shaywitz & Shaywitz, 2003). It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.

It tends to be resistant to conventional teaching methods, but its effects can be mitigated by appropriately specific intervention, including the application of information technology and supportive counselling. Those involved with dyslexic learners (teachers, parents, associations) have a great interest in identifying study methods that are compatible with the typical learning difficulties that dyslexia causes, thus facilitating learning for many intelligent students who would often otherwise be forced to abandon school and allowing them to achieve academic success.

2 The relationship between concept maps and the learning styles of dyslexic students

People with dyslexia

1. Have normal I.Q.
2. Read slowly
3. Easily get tired
4. Comprehension difficulties in reading texts

In most cases the last three points limit the dyslexic student's ability to acquire methods that allows him or her to study autonomously and to effectively complete a normal school career (Stella, 2004). Indeed, while in most cases dyslexia improves with age due to its developmental nature, the reading effectiveness of the dyslexic student at high school decreases because of the greatly increased demands of the school and the number of pages to be read, which in Italian high schools average more than 20 pages per day.

Learning using auditory input by means of a human reader or speech technology is often insufficient because it lacks the supporting visual text that every normal reader makes use of. It should also be taken into account that people with dyslexia usually have a "visual" intelligence and think in "images" so that it seems logical to utilise this learning style. This does not happen with teaching strategies which use only aural means as when you listen to the voice of someone reading, with e-books and with school books in digital format. It should also be remembered that the aural memory is weaker than the visual memory and that speech synthesis is not particularly pleasant.

Concept maps are also an important tool because their characteristics complement the learning difficulties caused by dyslexia and can enhance the dyslexic's particular points of strength as listed below (Abi James, 2003)

- They provide non-linear information in the visual domain.
- Concepts are emphasized by "nodes" together with the labelled relationships in a meaningful net.
- Concepts are represented by key words and relationships by verbs or essential linkers.

- The organization of a map is independent of the rigorous grammatical and syntactical structure of sentences.
- Images and colour can trigger ideas, categories or subjects to facilitate memorisation.
- The maps allow large amounts of information to be stored graphically.

Compared to a normal reader, the problem that the dyslexic learner meets when constructing concept maps on his/her own consists in the difficulty of identifying key words and the relationships connecting them because their reading problem. This process is greatly limited by a slow reading speed, by frequent spelling errors and by comprehension difficulties especially when the text is long and complex.

3 Case report and methods

Since 2001 the Modena section of the Associazione Italiana Dislessia (Italian Dyslexia Association – A.I.D.) promotes the use of graphic organizers by tutors and parents when helping dyslexic students during their homework, especially during high school years. Both mind maps and concept maps have been used and are chosen according to the kind of homework and the student's preference. Concept maps were made both by hand and by using different software such as: CmapTools, Inspiration, Knowledge Master.

Compared to other kinds of graphic organizers (Hall & Strangman, 2003), concept maps have been shown to be the most useful way of representing knowledge, especially when dealing with complex subjects. The representation of the relationships that connect the concepts is a particularly important tool (Novak & Gowin, 1995), and is useful in the learning process and in facilitating the recovery of information during revision. Compared to studies of the creation of maps by normal readers, concept maps prove to be particularly difficult for dyslexic students to build on their own.

The experience acquired in the Modena A.I.D. Section suggests some possible ways of using concept maps with dyslexic students which vary depending on the individual characteristics of the student and on the quantity and complexity of the subject to be studied:

- The making of a map can be guided by an expert tutor who supplies "the skeleton" of the map and who then reads the text in such a way that the student can trace the missing concepts and add therefore "the pulp" to the skeleton.
- The tutor reads the text, underlines the key words and writes them on the "nodes" if the student prefers to see all ideas on the screen at once before connecting them up manually to form a conceptual network.
- The tutor makes the map: this constitutes the textual support and is a substitute for the book, one that has a strong visual impact, and which the student uses as a guide while listening to the reading.

The finished map can then be used by the student for revision or as a guide during oral presentation. If the map is made using software it can easily be personalized by the student, with consequent advantages for learning.
The text can be read by a tutor or by speech synthesis software.

It is important to remember that dyslexia often goes along with dysorthography and dysgraphy. In this case, as well as being slow reader, a student will also be dysorthographic and have problems in dealing with space. This further complicates autonomous creation of concept maps and makes them less usable in the study of foreign languages due to frequent spelling errors. In resolving this problem, a tool contained in the "Knowledge Master" software has proved to be very useful. It allows you to import text in .txt or .rtf format, copy the key words and include them in nodes by simply clicking on them without having to type them in. This tool is extremely easy to use and rapid even for normal readers.

4 Discussion

Dyslexic learners often do not make full use of the potential offered by the construction of maps because of the difficulty they have in working autonomously with the written text. However, concept maps offer these learners the great advantage of a textual support that can represent knowledge in a way that is more suited to them and to visual thinking compared to the traditional linear type of text which is generally not sufficiently accessible. The advantage of a concept map is that it is the equivalent of a simplified text that, because it represents knowledge by using short phrases, does not require good literacy skills. It appears to be a very effective tool for improving vocabulary knowledge and allows for greater comprehension, stimulates memorisation, and facilitates recall of acquired information. It also favours autonomy in at least some of the stages of learning and by means of the visual approach develops the reader's auditory understanding of the text, which is not the case with e-books and digital texts.

The use of mapping software, such as Cmap, which can be read by speech synthesis, allows access to unknown or foreign words which represent the equivalent of the "non-words" that are particularly difficult for dyslexics to read as they require phonological processing, which is usually lacking.

5 Conclusion

From several years' experience of working with dyslexic learners, it has become clear that concept maps are an advantageous learning strategy at the upper elementary and upper level grades. They develop the strong points of dyslexic students while minimising their weak points. One drawback is that they cannot generally be created autonomously and they need the aid of a supporter. While the autonomous creation of maps adds to their worth, it might be useful to make ready-made maps on different school subjects available as a study tool for those who do not have the aid of a supporter or individual tutor.

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E-LEARNING USES OF CONCEPT MAPS

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Abstract: Concept maps can be considered as a multi-resource in e-learning environments. Concept maps present a strong power of integration, navigable and meaningful representation. Under this point of view, a student centred framework can be approached, as the European Higher Education Area (EHEA) requires. In the present work, we show five types of different significant uses of concept maps for learning purposes: a) as a guide for navigation inside the virtual environment; b) as a learning activity; c) as an expert model of knowledge representation; d) as an evaluation tool; and e) as facilitators of the construction of collaborative work.

1 Theoretical framework

Concept maps are potent tools of knowledge representation that allow to transmit complex conceptual messages in an understandable way. They facilitate both teaching and learning. Novak & Cañas (2006) define concept maps as graphical tools for organizing and representing knowledge. This representation includes concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line. Words on the line referred to as linking words or linking phrases, specify the relationship between the two concepts. These authors define concept as a perceived regularity in events or objects, or records of events or objects, designated by a word. Propositions are "statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected with other words to form a meaningful statement"

On the other hand, e-learning is a general term covering a wide range of approaches and it may combine a mixture of different elements such as: information and communication technology, interaction, learning resources, collaborative and individual learning, formal and informal learning and support (Clarke, 2004). On May 2000, the European Community Commission adopted the initiative "E-learning: designing tomorrow's education". This initiative is defined as the use of new multimedia technologies and the Internet, to improve the quality of learning and facilitate access to resources and services, such as exchanges and distance collaboration (European Community Commission, 2001).

The emergence of learning technologies is fundamentally changing the nature of how people learn. People are more and more encouraged to learn by themselves and they do it in interactive way. To be successful in e-learning is necessary to have big doses of self regulation skills (Nagy, 2004) and technology skills (Clarke, 2004). The tools of an e-learning system (computer based learning) and content's design can help the students to manage themselves easily across the course, including a more fruitful approach to the learning activities and the online resources.

A number of studies with the broad subject of e-learning have examined the evolution of different types of systems over time. First generation e-learning systems, for example, were often seen as a substitute for classroom training, on-line courses tended to be developed as direct analogues of conventionally delivered courses (Darby, 2002). Actually, online learning must move towards a model that offers the student opportunities for individual exploration and self-learning. The student needs to build relations, discover the process from within, and feel stimulated to draw his own roadmap. Thus, he will not only learn, but will learn to learn (Pedreira, 2004; Novak, y Gowin, 1996). In agreement with Pedreira, this kind of learning can only be obtained through action strategies. Contents should be represented not as an objective but rather as necessary elements towards a series of objectives that will be discovered along the course.

The use of concept maps like instrument facilitators of meaningful learning (Ausubel, Novak and Hanesian, 1986; Novak and Cañas, 2006), turns them into a valuable resource in this new paradigm of learning, in conformity with the European Higher Education Area requirements (EHEA) which promotes student centred learning.

2 An integration proposal

In this poster we propose, and show, a meaningful utilization of concept maps as a potent multi-resource in e-learning environments: a) as a **virtual guide** inside a course, that is to say, as a facilitator of the relationship between the learner and the course structure and didactic contents and, at the same time, as a good organizer of different course resources; b) as a **learning activity**, orientated to the promotion of student's meaningful, active and deep learning of the student c) as an **expert model**, due to the fact that they are powerful tools for the presentation of complex knowledge networks; d) as an **evaluation tool** that allows the exploration of the student learning process. Having used concept maps in different phases of the learning process, to develop an approximation to a knowledge extension network is possible; e) as a **tool of production** of shared knowledge, as it facilitates collaborative processes of reflection and discussion.

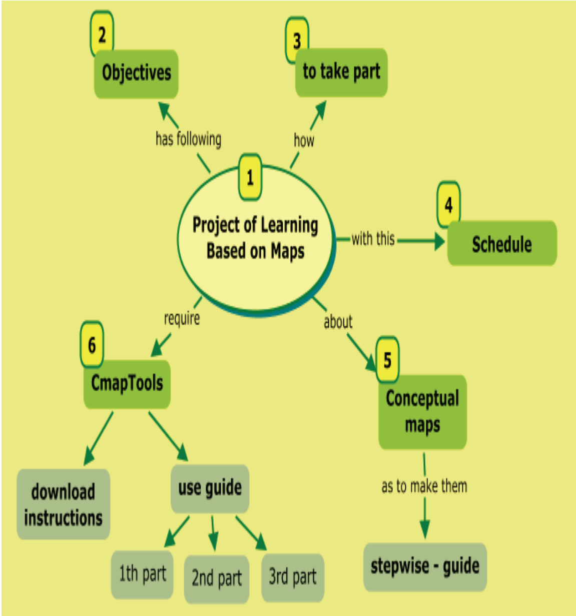


Illustration 0

- The use of concept maps as a virtual guide: this use orients learners' attention and action system. For example, as a way to present a Project: this map (see illustration 1) presents -in a hyperlinked image- the steps to develop a learning activity based on maps. The main characteristic is the organization of all the resources to be used by the participants: tutors and students. A low number of visual elements and textual contents is recommended at this level.

- The use of concept maps as learning activities: this is the most common use of concept maps. On one hand, it is important that the student approaches the learning process of a module with previous knowledge activated. In this sense, it is necessary to determine the level of understanding that students have about the topic to be studied before the topic is introduced (Novak & Cañas, 2006). Concept maps can be used during the introduction of a learning module, as a mechanism promoter of specific cognitive activity: the recovery of information. This work can be done by the tutor, in a strong directive way, or by an individual or collaborative work of students under a low directive way. When the module has been presented to the students, the central task will be the elaboration of a concept map. During this production phase, mistakes, confusions or absences of relevant information are frequent, allowing the re-elaboration through deeper analyses. If a course provides good resources about the learning unit, the maps will be extended and refined. In this phase, the cognitive activity is centred in storage information in knowledge networks, based in multiple significant associations with old and new concepts: this is a wide assimilation process. But that is not all, this cognitive process contributes to students' ability to evaluate critically and a reasonable way about evidence more generally. This is fundamental not only to their understanding of learning contents, but also to their ability to contribute to society as a critical consumer of information (Namy, 2002).

- The use of concept maps as expert models: this utilization is focused on teacher's efforts to communicate the conceptual and theoretical aspects of the didactic unit, and its relational and significant structure. This resource is mainly oriented to direct the student attention over the structured network of knowledge (see illustration 2). These maps might allow, finally, the construction of the curriculum of a degree, ¡a very attractive project based on concept maps!

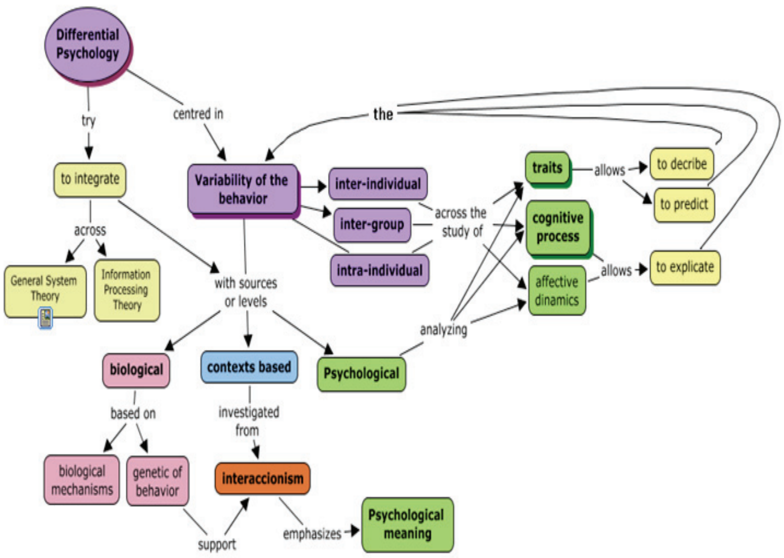
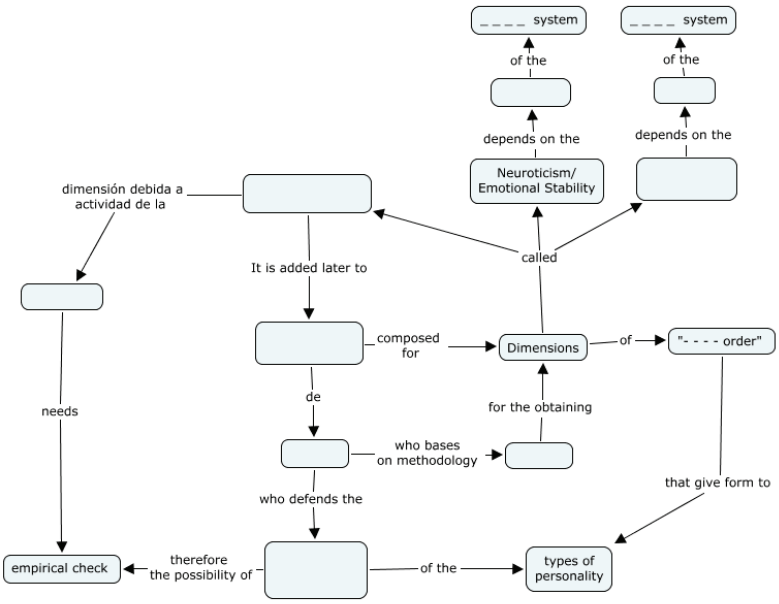


Illustration 0

- Use concept maps as

assessment tool: The process of evaluation produces effects on the process of education - learning that, according to Barberà (2003) can be described like: - of type motivational, doing that the student centres his/her attention on the evaluated, - of consolidation, from the same moment of the evaluation backing or consolidation takes place (is produced); - anticipatory, so that the evaluation shapes from the beginning of the learning process across directives, the own learning process (see illustration 3). In this respect, the elaboration of tests of selection multiple promotes the learning directed towards memorization, while the evaluation based on production and creative activities probably orientates towards the deep learning. The use of concept maps as evaluation tools facilitates a vision more nearby of the network of knowledge and of the cognitive individual process.

- The use of concept maps as facilitators of the construction of collaborative work: in the current knowledge society, new significant models of knowledge construction based upon collaborative work are a central goal of more advanced educational models, being also strongly emphasized in working environments. In this sense, the use of concept maps as a way of promoting discussion and negotiation processes through communication tools can be a powerful learning tool. Collaborative knowledge construction takes place when several participants contribute to accretion of interpretations by building, commenting on, transforming and integrating a shared information base (Suthers, 2005).



3 Summary

Concept maps represent a wide range of versatile and economic tools in e-learning environments. They show organizing capacities in two senses: knowledge and learning resources organization. Concept maps can be widely used in virtual environments, being able to be presented as learning tools in all phases of the learning process. According to this point of view, we agree with a Novak and Gowin (1996) comprehensive and original definition. They define concepts as “a perceived regularity in events or objects, or records of events or objects, designated by a label”. In this sense, we consider this definition includes also “action”, because in an e-learning context, the movement around the contents, across the resources and different sources of information can be guided in a significant way using concept maps.

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EFFICACY OF COMPUTATIONAL MAPPING TOOLS FOR IMPLEMENTING NEW STANDARDS AND INNOVATIONS IN TEACHING CHEMISTRY AT SCHOOL

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Abstract. German students showed only a mediocre performance in national and international scholastic tests. As a consequence of the subsequent discussion the school administration initiated educational standards which were supposed to cause an educational change in German classroom teaching and school staff collaboration. Knowledge management research proposes to use 'synergy maps' as a focusing tool in the communication of innovation. The goal of this study is to develop and optimize a set of computational maps, produced with CmapTools, which can facilitate and support these change processes.

1 Introduction

The mediocre results of German students in national and international scholastic tests, like PISA or TIMSS, were succeeded by a wide and open discussion in the German society and educational research. The political consequences of this discussion led to fundamentally different requests from German teachers. The 'Munich Knowledge Management Model' (MKMM) (Reinmann-Rothmeier, 2000) and the 'Concerns Based Adoption Model' (CBAM) (Hord, 2006) sketch an approach how this educational change in classroom teaching can be managed. Eppler (Eppler, 2004) proposes to use structured visualizations as 'synergy maps' in knowledge management and change processes. This study is to investigate in how far structured visualization and networking can facilitate and support the process of implementing curricular changes.

2 Political background: Recent developments in secondary education

With chemistry teaching in Lower Saxon[1] grammar schools being in the focus of this research project, the new Lower Saxon chemistry core curriculum (CCC) (Kultusministerium Niedersachsen (KM), 2007) is quite different to all the directives, chemistry teachers had to fulfill before. Former curricula were input-detailed by drawing a timescale of themes, whereas the new core curriculum only presents a rather abstract schedule of goals to be reached in two year terms, that is after 6th, 8th, 10th and 12th grade (with the last being in development). The way to reach the goals of the CCC is left to the chemistry staff of each school. Furthermore the Lower Saxon school administration developed a quality management including an 'orientation schedule' giving advice to schools which aspects are important for quality management and controlling (KM, 2006). It consists of several aspects of school with one being important within the scope of this study: 'professionalization of teachers'. The core of the teacher's professionalization is to facilitate collaboration within a school's staff, being unfortunately quite uncommon among German grammar school teachers (Graesel, 2007). Thus, requests and prerequisites on the chemistry teachers have changed very much within a short period of time.

Statewide teacher training courses for the CCC were initiated by the Lower Saxon school administration. The author is one of the trainers, and his subjective qualitative impressions of the training program can be summarized as follows:

- Motivation and attitudes towards this 'top down'-innovation varies from 'negative' to 'curious'.
- Many teachers are frustrated because of the lack of material and because of the demand to complete what they call 'the job of the administration'.
- The CCC is quite abstract and in its text structure rather unclear and hard to be transferred to a practical use.

These impressions clarified the need of "*bridges*" between the abstract goals of the CCC and the daily practice of classroom teaching. Visualization and mapping tools like CmapTools (Novak & Cañas, 2008) may serve promisingly to be such kind of support. However, open questionnaires with chemical education students and beginning teachers have indicated that there is little to no experience with mapping and computational mapping tools yet. Both the students and the beginning teachers commented a disadvantage of mapping lying in the reduced and abstract content of information. On the other hand both groups mentioned text-based chunking by writing summaries as an important aspect of successful preparation of major exams. This indicates the lack of

1 Lower Saxony is a federal state of Germany, and school administration is a state matter.

knowledge, routine and appropriate use of general as well as computational mapping methodologies. Therefore, there is an essential need for teacher training programs in visualization tools, like CmapTools.

3 Theoretical background

The main focus of this research project is the educational change process of a chemistry staff of a school. Therefore, the theoretical models were chosen in order to be able to describe, structure and analyze this kind of developmental processes.

3.1 The Munich Knowledge Management Model

The MKMM is an educational-psychologically grounded theory of knowledge management usually used to administer knowledge in corporations. The theoretical and the practical approach of the model is held general enough to be promising for the demands of the school system as well. The model intends to lead a system into a vivid and lifelong 'learning organization' with a dynamical culture of knowledge and learning. It defines a constructivistic understanding of knowledge based on the widely accepted 'knowledge of information' (KoI) and 'the knowledge of action' (KoA). These are represented in four different aspects of knowledge management, each of which is accompanied by corresponding psychological aspects to be kept in mind (Reinmann-Rothmeier, 2000).

The *communication of knowledge* is necessary to interchange, share and network the concepts and the knowledge of individuals. Communication processes can be disturbed heavily by antipathies and a lack of trust between individuals. The communication can induce a *representation of* knowledge being a materialized, transparent and technically applicable knowledge which is desirably achieved in a consensual process. The psychological problem of representation of knowledge is that the individual has to express his (lack of) knowledge. This can cause distress of incompetence and loss of power. Synergetical effects can cause a *generation of knowledge* with new, innovative ideas. Curiosity, creativity and the ability to question routine are supportive conditions of a successful generation process. At last, the *use of knowledge* has to transfer the KoI to an applicable KoA that supports daily problem solution processes. An individual meta-knowledge is essential in all of the four aspects of knowledge management to overcome most of the psychological problems.

The MKMM has both an organizational and an individual component. The organization is the place, where the change has to be managed, and has to set up the general framework for the change process. The management aspect, 'top-down' vs. 'bottom up', is also very critical with 'bottom up'-management being more promising. The individual within the organizational system has to organize and accomplish his or her individual change. The MKMM lists three cumulative 'stations of an individual learning cycle' which are referred to the school system:

- *New skills* expand the patterns of thinking and handling daily classroom teaching
- The new scope of patterns leads to a *new sensibility* and a new *awareness* of teaching and useful changes
- This new sensibility causes *new attitudes and perspectives* and thus implements the change

'Communities' (Wenger, 2000) play an important role during this process. They are informal, desirably hierarchy-free and self-organized networks of individuals of the system driven by a convention of interests and/or problems. Central processes in the communities are communication, cooperation, exchange of experience, generation of knowledge and mutual learning (Parchmann, 2006).

3.2 The Concerns Based Adoption Model

The CBAM can be characterized as an innovation-focused framework for educational change describing and predicting teachers attitudes and behaviors (Anderson, 1997; Hord 2006). It is applicable to the understanding of both 'bottom up-' as well as 'top down'-change initiatives, and consists of the following components:

- *Stages of Concern (SoC):* The model describes seven possible stages of concern of teachers. Stage 0 'Awareness' means that teachers have little to no interest or information about the change whereas Stage-6-teachers ('Refocusing') reflect the entire innovation process. The model offers diagnostic tools.
- *Levels of Use (LoU):* While the SoC represent the attitudes of the teachers the LoU describe general patterns of teacher behavior as they prepare to use, begin to use, and gain experience implementing classroom changes. Level-0-teachers ('Nonuse') have no knowledge of changes and no plans for an implementation. Level-6-teachers ('Renewal') may modify the innovation or explore an alternative practice.

- *Innovation configurations (IC):* The key assumption is that teachers rarely implement an innovation in the same way and in the manner intended. The CBAM therefore offers an *Innovation Configuration Component Checklist*.

Further focuses of the model are put on the role of the change facilitator, on the intervention itself (*Intervention Taxonomy*) and on aspects concerning the innovational context.

4 Goals and design of the developmental research project

The goal of this research project is to provide CmapTools change facilitators for the implementation of the CCC. The role of these change facilitators, proposed by the CBAM, will be investigated qualitatively as part of a knowledge management process of a school's chemistry staff.

To prepare these change facilitators two groups of potential users will interviewed. University students participating in last semester's 'chemical school experiments'-course used CmapTools to develop teaching units where the experiments of the course were part of. Their practical experience will be explored through interviews. Furthermore, exemplary mapping results of the university students will be shown to teacher trainers. These practitioners used text based documentation proposed by the CCC to document their teaching units and are not qualified in using CmapTools yet. The contents of this interview will be possible benefits and problems along with further aspects to be kept in mind when developing change facilitators with CmapTools. Both interviews will be analyzed using the qualitative content analysis (QCA) according to Mayring (Mayring, 2003). The categories for the QCA will be drawn from the MKMM and the CBAM.

To show an example, the structured visualization of a chemistry teaching unit (fig. 1 (Parchmann, 2008)) was developed after the introductory CCC teacher training.

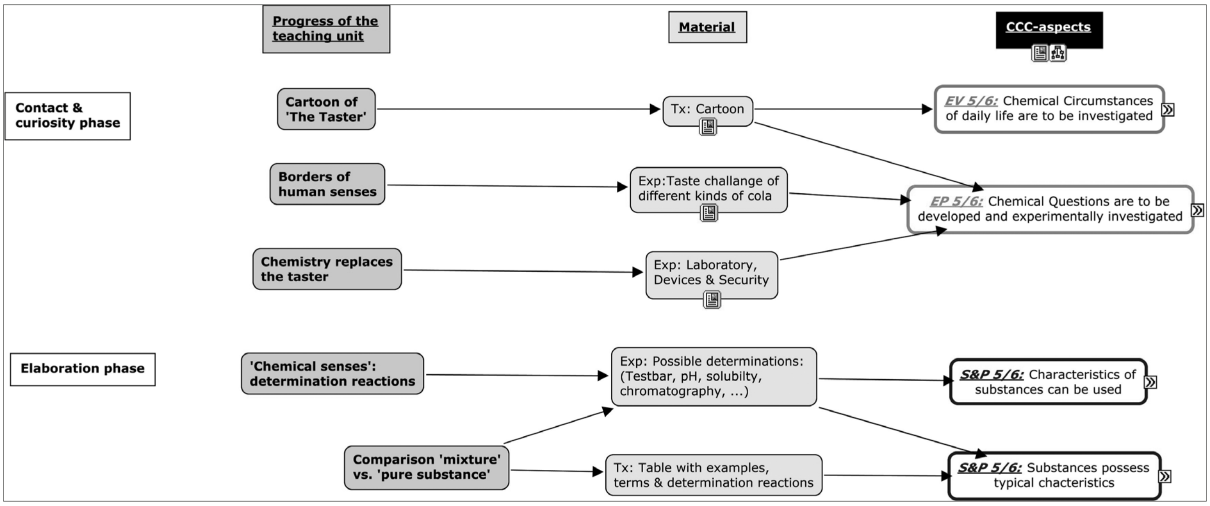

Figure 1. Flow diagram of the 'chemistry-in-context'-unit 'The Taster'.

Figure 1 contains a part of a flow diagram of the 'chemistry-in-context'-unit 'The Taster' (Nentwig, 2007) also by using CmapTools. The black-rimmed white icons on the left are the overall phases, and the dark-grey icons indicate the progress within the teaching unit. The arrows to the light-grey icon connect teaching material on the computer's hard disk or internet-URLs to the corresponding step of the unit. At last, this is connected to one or more related competencies of the CCC shown on the right side of the flow diagram.

Keeping in mind the teacher's IT-competencies, the computational mapping tool 'CmapTools' is a complex matter to many teachers. The use of this complex tool must be justified by the complex task the teachers have to succeed in as well as an effective and practical use of the results for the development of teaching units and in classroom teaching. Therefore, a CmapTools- teacher training will be developed to scope the demands described before. The teachers will be especially encouraged to use their CmapTools skills to document their teaching units. This training program will contain strategies and material, like exemplary 'synergy maps', according to the results of the QCA of the interviews.

Finally, the success of the training program along with the mapping results of the teaching units will be evaluated again by interviews with an adjacent QCA. The mapping results will be compared with text-based CCC documentation equivalently using hyperlinks to crosslink the documentation with material. The results of this QCA will finally lead to an optimization of the strategies and the material.

The presentation will contain first results of the QCA of the university students' and the teacher trainers' interviews and a sketch of the teacher training program.

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EVALUATING THE USE OF CONCEPT MAPS IN NURSE EDUCATION IN N. IRELAND TO PROMOTE THE DEVELOPMENT OF CRITICAL THINKING

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1 Introduction

Since September 2007, The University of Ulster has adapted a blended learning approach to the delivery of its Pre Registration BSc (honours) Programmes. The curriculum framework applies the concepts and values in pre registration nurse education through e-learning and face to face small group sessions.

Knowledge	**Skills**	**Applied Values and Beliefs**
Nursing and healthcare sciences underpinning practice	Objective judgement & decision-making	Innovations in practice
Theory practice relationship in theory practice	Governance and creativity	Person centred care
Global developments in care	Patient/client/colleague education and support	Applied ethical and legal principles
	Communication & clinical skills	Reflection

However, the researcher, who has bee a Registered Nurse Teacher and University lecturer for some 20 years identifies similarities between this new style of learning and the previous methods of nurse education in that students struggle to "connect" modules and consequently demonstrate limited critical ability, a requisite of higher education. Critical Thinking in Nursing is a refusal to accept the status quo, the logarithmic thinking, the routine and ritual that has ear marked much of nursing practice over many decades. Things must make sense to and for the critically thinking student nurse, they must go together; and they must connect if true erudition is taking place .In the current environment of change and flux in healthcare worldwide, critical thinking and connected knowing is essential and ways of promoting this in nurse education must be a priority in order to prepare nurses for the diversity of roles and the variety of health experiences that await them.

2 Critical Thinking

In a quest to discover what critical thinking is the researcher has come across a vastness of definition with limited consensus (Ennis 1985, Adams et al 1996 ,Facione 1990, Boxler 2002, Riddell 2007). Continuing on this journey to unravel the mystery of critical thinking, the researcher uncovered a multitude of educational strategies that purport to facilitate critical thinking and conducted focus groups within one faculty to elucidate how university colleagues facilitate critical ability within their teaching methodologies Confirming earlier findings, a wide diversity of classroom technique and a definite lack of consensus on either definition or best practice emanated from this small preliminary project. Critical Thinking (CT) as an outcome of nurse education is required in many countries but is merely implicit in the UK; yet CT is explicitly required in international nursing practice. (Mangena et al 2005). Whilst nurse educators differ on teaching and learning strategies that develop critical thinking abilities (Raymond et al 2004), it is suggested that an educational intervention is needed to bridge the gap between classroom teaching and clinical placements to develop CT nurses and CM may help in visualising the questioning and connected learning processes required in modern healthcare arenae.

2.1 Concept Maps and Nurse Education

The educational intervention for this research will be concept mapping (CM) for three main reasons:

1) Concept mapping is not widely used in nurse education on the island of Ireland or on mainland Europe although new literature is emerging from the USA on its validity and reliability (Hinck et al 2006)

2) The literature supports CM as important in higher education as it allows teachers to research students' prior knowledge and to document learning empirically whilst having little impact on overall teaching time. (KCL 2008)
3) Emerging literature suggests that concept mapping can be used to promote and evaluate critical thinking (Gul & Boman 2008)

Concept mapping is based on the constructivist theory of learning in which meaning is organised on a personal level with the teacher & CM as facilitators of this learning (ibid). Teaching strategies to improve critical thinking skills and knowledge construction are most effective when they actively engage the student (Maskey 2008).

CM is a teaching-learning strategy that can be used to evaluate a nursing student's ability to critically think in the clinical setting (Senita 2008). It has been used in disciplines other than nursing to allow the learner to visually recognise, reorganise and arrange information in a manner that promotes learning of concepts that interrelate.

It is suggested that CM is introduced into the Pre Registration Nurse Education curricula in the University as a matter of urgency, both as an educational intervention and an attempt to improve CT across the curricula. In the words of Kinchin (2008) "concept mapping makes more visible what teachers do to make learning happen" Certainly some intervention is required as Higgs and Jones (2000) remind us that within a rapidly changing health care environment and relentlessly increasing knowledge base, professional nurses need to develop critical thinking skills that will provide them with expertise in flexible, individualised, situation specific problem solving abilities.

3 Research Methodology

The research hypothesis is that there is a relationship between the use of concept maps (CM) and the development of critical thinking (CT) abilities. The aim of the study is to find out whether the use of CM to help students structure their learning will have an impact on CT.

The proposed study involves an ongoing literature review and three stages in the research process once all ethical and research governance guidelines have been approved and student participation agreed:

I. An initial pre-test of pre-existing critical thinking skills for all volunteers in the adult branch 2006 cohort of Pre Registration students will be done using the California Critical Thinking Assessment Tool (CCTST) [August 2008]
II. Introduce Concept Mapping as a teaching and learning tool to the experimental group i.e. all year 2 students on placement in peri-operative and critical care modules where the researcher is the link lecturer over the course of one academic year. Students are allocated to their clinical placements by the placement office; the link lecturer has no input into this process. Students will be taught nursing in the same way the lecturer has always taught in the clinical arena however Concept Maps will now be used as a framework to structure this learning within a holistic framework that connects all aspects of each individual patient. Students will be asked to connect their patients' symptomatic presentation within a concept maps in order to begin to understand their patients' holistic needs. All other students in the 2006 cohort who are not on placements where the researcher is the link lecturer will naturally form the control group.
III. The discussions that take place initially will be no different to what is happening now in the placement regarding planning care for their identified patients. However in the research study, after each discussion in order to test understanding and recall, the student will be asked to develop a concept map of this discussion and submit this at the beginning of the next placement meeting. They may use the introductory concept map to develop their new map listing and connecting the key concepts involved in understanding their patient's problems holistically. Students will structure their map using the rules of concept mapping and over the course of a typical 6-week placement, 3 serial concept maps will be submitted for discussion and analysis.
IV. In order to capture the students' reflections on the experience after each teaching session, each student in the experimental group will be asked to reflect on the use of concept maps in a 5-minute audiotaped interview that will be transcribed by the interviewer and validated by the student at the next meeting.
V. A post intervention CCTST will be completed at the end of one academic year for all student volunteers. [August 2009]
VI. Data Analysis

Quantitative Data:

i. The California Critical Thinking Skills Test (CCTST) will be used as both a pre and post test baseline assessment of students' critical thinking skills.
ii. Biographical Data will be collated and inferences drawn.
iii. To compare pre and post intervention differences between the two paired samples, a Wilcoxon non-parametric t-test will be used to analyse data.
iv. To compare the differences if any between the independent sample i.e. experimental and the control group, a Mann Whitney non-parametric test will be used to analyse data.

Qualitative Data:

Taped audio reflections will be transcribed by the researcher, validated by the participants and then analysed by the researcher using the Newell and Burnard (2006) six step pragmatic approach to thematic analysis

I. Timeframe:

Pilot study CM… …………………………… June 2008
.Invitation via WebCT hyperlink to join study… July 2008
Pre CCTST…………………………………….. July 2008
Continuous concept mapping for one year ……. August 2008-August2009
Post CCTST…… …………………………… September 2009
Analyze Data………………………………..… . September 2009 –January 2010
Write Up Research Findings………………….. February-August 2010
Submit Research ………………………………. (1st)January 2011 , 2nd June 2011
Present Research Findings to the 5th International Conference on Concept Mapping

II. Research Implications

This research will go some way towards addressing the need to provide evidence of effective teaching strategies that promote and nurture critical thinking ability .The development of critically thinking nurses must be an explicit goal of European Nurse Education as it is in other countries and if Concept Mapping facilitates this process as the literature suggests it should be incorporated into UK nurse education curricula as soon as possible.

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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.

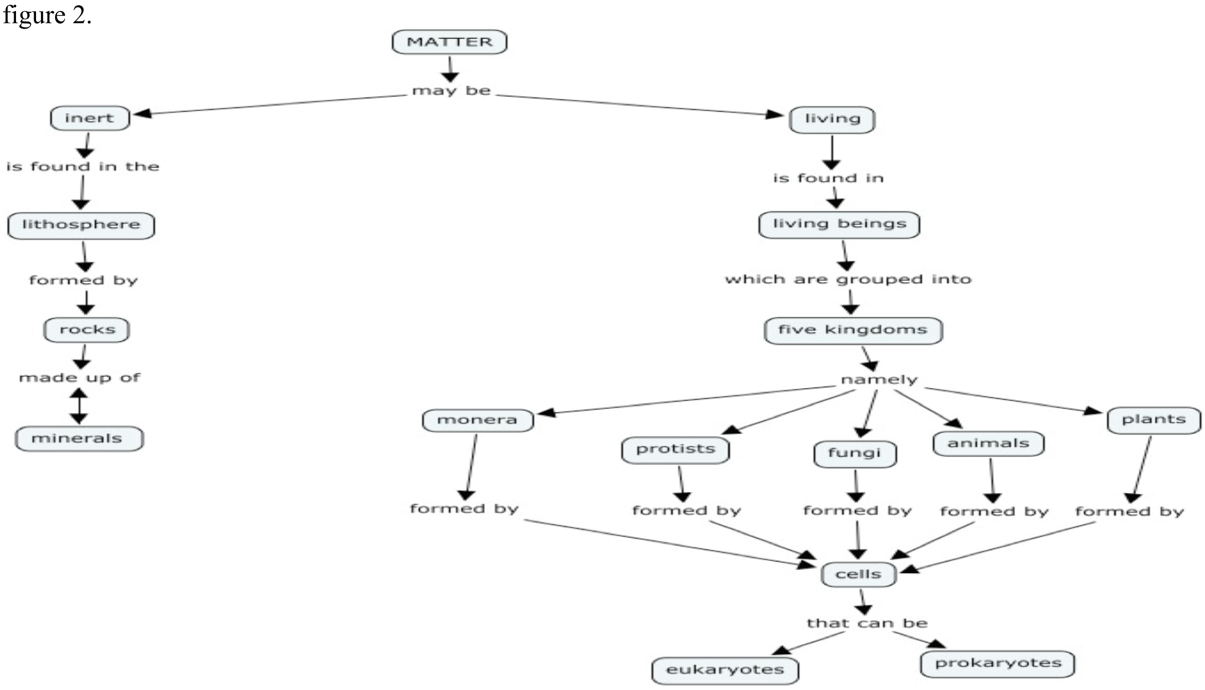

Figure 1. Concept map drawn by a novice without assistance.

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.

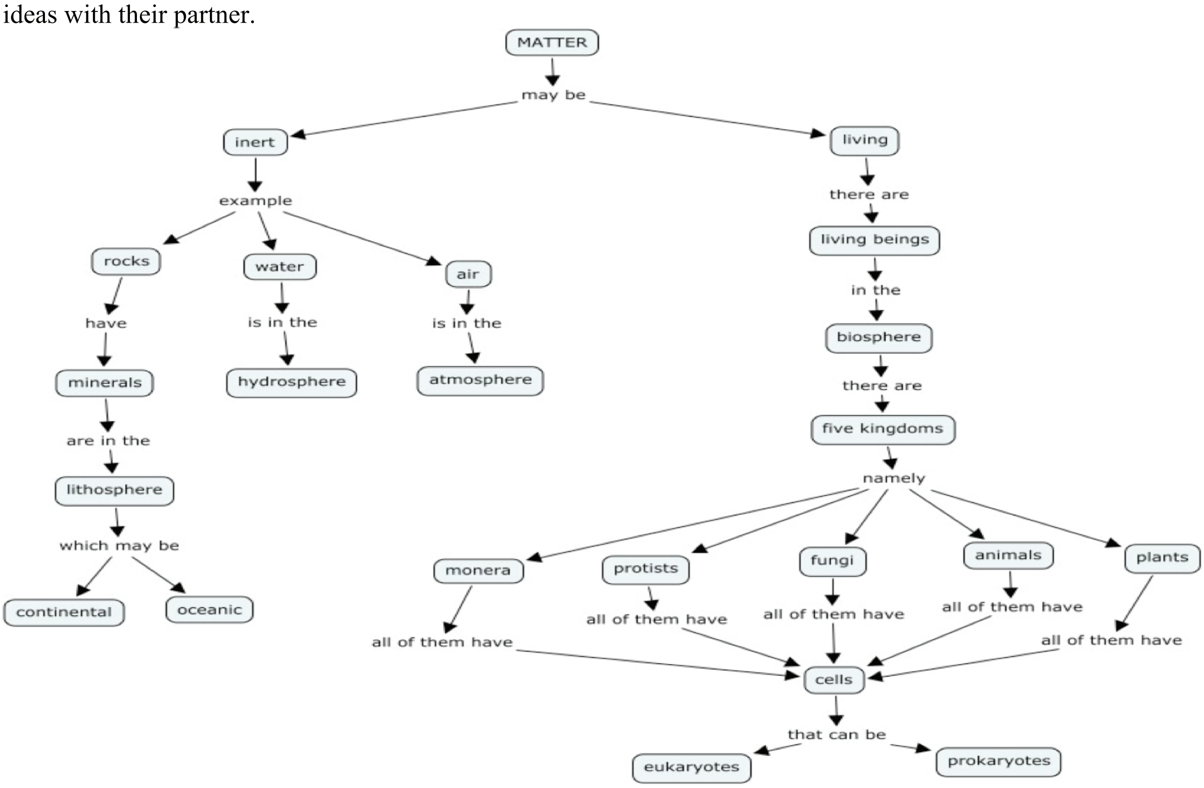

Figure 2: Concept map jointly produced by a novice and an expert (supportive pairs).

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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FOSTERING LEARNING THROUGH MUSIC IN DYNAMIC CONCEPT MAPS

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Abstract. This project aims at developing a rich environment that integrates music in order to reinforce learning. Fostering learning through music is based on the visualization of concept maps. This novelty approach relates the rhythm and melody of a song with the dynamic appearance of the concept map; this is carry out by changing some design properties of the elements that composed the concept map. We try to encourage the connection between songs and ideas, more precisely between the notes and rhythm of a melody and the concepts expressing an idea. For this purpose we build a rich concept map editor and record some songs for testing our environment.

1 Motivation

Music plays an important role in every day life. From the mass media such as publicity, video games and cinema to the music entertainment, music is used for emphasizing images, games and feelings. On the other hand, music has attracted researchers for enhancing learning in different ways. Some of them correlated music literacy with basic process like reading, writing or the process of creativity, while others works like (Weyde, 2004) creates dynamic concept maps based on the score of a musical single piece.

The fact that it is easier to remember the text included in a phrase song than a single readable or audible text is our start point for trying to reinforce the connections between melodies and the visual representation of a sentence in the form of concept map. Our project thus aims at enhancing connections between music and the visual appearance of a concept map. This is carried out by analyzing the spectrum frequency of a song with concrete mixing and mastering features, being this what mainly differs form other similar approaches.

2 Our Approach

Let's assume that we have a concept map with one main element and five surrounding elements (see Figure 1). Our first idea is to compose a song according to the elements that the user sees on the screen, thus for this case we create one melody that has a main chord (main concept) and a secondary melody that has five notes (the five surrounding concepts). Once the melody of the song is composed and the rhythm section is added, our next step is to modify the appearance of the concept map according to how the song is developed in time, namely according to rhythm and melody.

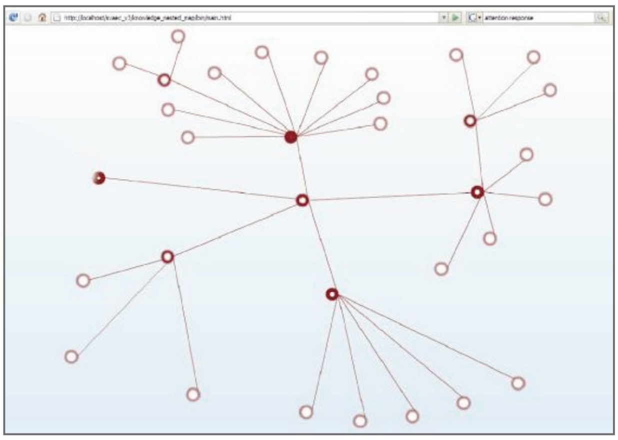

Figure 1. An example of an initial concept map with one main node and five child nodes.

For this dynamic visualization through the time the system analyses the spectrum frequency and then it modifies the appearance of nodes (concepts) according to the frequency response. Furthermore, the system speeches the node's text for improving the user's attention.

Table 1 details a prototype of the visualization in order to dynamic adapt the appearance of the nodes contained in the concept map. As we can see in the table, the dominant chord is placed at the left channel and the melody is situated at the right channel, while in case there are drums playing, they are located on both channels, thus the systems compares both channels, if the output frequency is the same in both channels, it treats the frequency data as rhythm section's signal, therefore as rhythm pattern. These mixing and mastering features allow the system to extract the dominant chord, the main melody and the rhythm pattern.

What we get as a first result is a rich piece of knowledge visualization coupled with a melody that stimulus our senses and thus we believe we stress the interaction with the concept map in order to enhance learning.

Instrument	Element in harmony	Range Frequency (Hz)	Visual element that is modified	Values/actions over the element	Audio channel
Piano (bass notes)	Dominant chord	[28, 131]	Main node	Appear on the screen	Left channel
Bass and/or Cello	Dominant chord	[33, 262]	Main node	Color, glow effect	Left channel
Piano (middle C)	Melody	[131, 1047]	Surrounding nodes	Appear on the screen	Right Channel
Guitar	Melody	[131, 1319]	Surrounding nodes	Color, glow effect	Right channel
Xylophone and Piano (high notes)	Melody	[1319, 2093]	Secondary nodes	Appearance	Right channel
Drums	Rhythm	[28,3951]	Node structure	Size effect, glow effect, transparent effect	Both channels

Table 1: Prototype of mixing and mastering features applied to our set of songs

Once we have showed the relatedness between a particular song and a concrete concept map a question arise: is it possible to input any particular song in our environment and let the system manage the concept map's layout according to the melody and rhythm as showed above?

For answering this question we should considerer that one of the main open research issues in intelligent retrieval systems based on music content information is rhythm pattern mining and sound recognizing and in spite of many advances the problem remains open (Betser et al., 2007; Bello, 2007).

Our system is being developed with *Flex Technologies* for constructing a rich environment (Sanchez-Zamora et al., 2008); this technology allows to analyze separately the two channels of a stereo recording. What this is meant is that the system analyses the spectral frequency and it returns the values of the sound frequencies that are playing in time *t*. For instance, if we input a standard song that plays drums, bass, guitars and voice, the main problem is to divide the signal into the instruments that are playing and extracting the melody of each of them. Moreover, this process is long time consuming (Bello, 2007; Norman et al., 2004).

Figure 2 shows the harmonic frequency range of most common instruments, as we can observe the range frequencies overlap one with each other in most of the hole range. That is the reason we are composing a set of songs with a particular mixing and mastering processes (see Table 1) in order to extract the melody and the pattern rhythm.

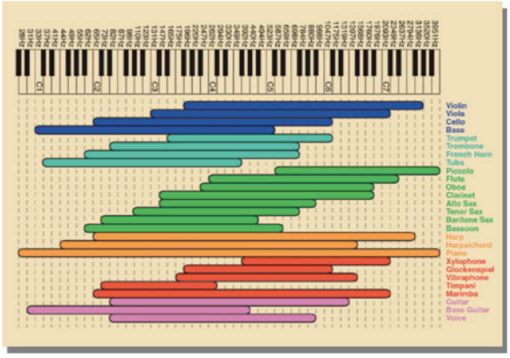

Figure 2: the harmonic frequency range

3 Conclusions and Future Trends

The representation of the first pieces of knowledge based on concept maps that evolve dynamically with regard to music and audio features has as a result a rich experience for the senses, thus the user is immersed in a stimulate way of learning through the visual and audio representation of the concept map.

We plan to evaluate the environment in a real classroom, comparing the results obtaining by students that make use of the system with students that do not use the system in their daily visual representation tasks.

As a future trend we pose a question for further research on this trend: could the system suggest new knowledge based on the evolution of the musical structure of a song? Can we achieve this feature by construct new node-link relations between already existing concepts according to the initial melody-concept relation?

4 Acknowledgments

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HOW TO FORM AND TRANSFORM POLYMERS

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Abstract. The rapid advances in the theoretical understanding of organic reactions and the technological development of research instruments necessitate not only continual examination and revision of the organic chemistry theory and laboratory curriculum but also look for learning tools, thus encouraging students to use meaningful mode learning patterns. We select concept maps as a powerful tool to organize the concepts presented in an Introductory Organic Chemistry Course. Many students are not familiar with concept map, so the teachers presented, at the beginning of the course, general information about their construction and use. At the end of the course it is expected that, by using concept maps, the knowledge that the students acquired is retained, as opposed to that acquired through traditional rote learning techniques.

1 Introduction

In an Introductory Organic Chemistry Course where traditional teaching techniques are used, the students are presented with course contents as a list of topics that they need to study through out the course. Looking to improve the learning process, we selected concept mapping as an alternative tool to promote learning.

2 Discussion

Many students are not familiar with concept maps, so at the beginning of the course (march, 2008), the professors gave a presentation on general information about them and their use and construction.

We needed a session to explain the general theory underlying concept maps, and the difference between rote learning and meaningful learning. After that, we presented an initial list of organic chemistry concepts (parking lot of concepts) included in the course, and began working with a few of them to build a preliminary map.

Among the list of concepts we chose, was a very general one: **"Polymer":** The selection was made because students use polymers in daily life in form of containers (PET), fibres (nylon) or food (starch, meat) so, they have information and prior knowledge about them.

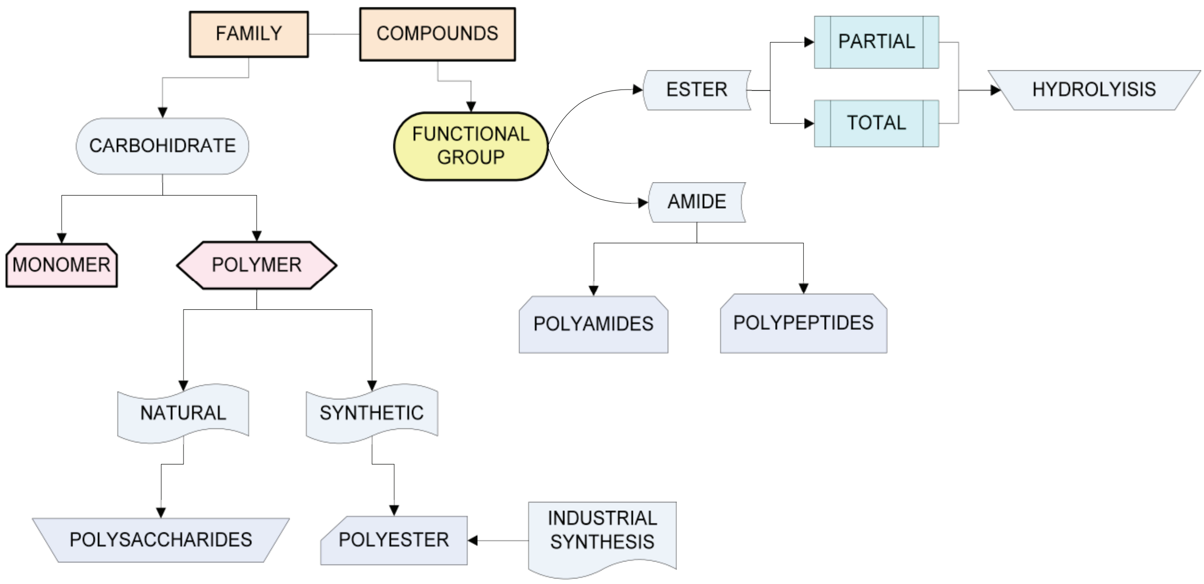
The course is theoretical and experimental, so the acquisition of knowledge is mediated with concrete experiments and hand on activities. In the classroom we presented the material to be learned with examples relatable to the learners prior knowledge and the topics that are studding in the related courses. After some working sessions we defined the context for the Concept Map. We selected as Focus Question "**How to form and transform Polymers?**" to specify the problem the concept map should help them to solve. At the end of the course, we hope that each student will have created his or her own concept map for the concepts studied during the course.

The concepts analysed through the course are:

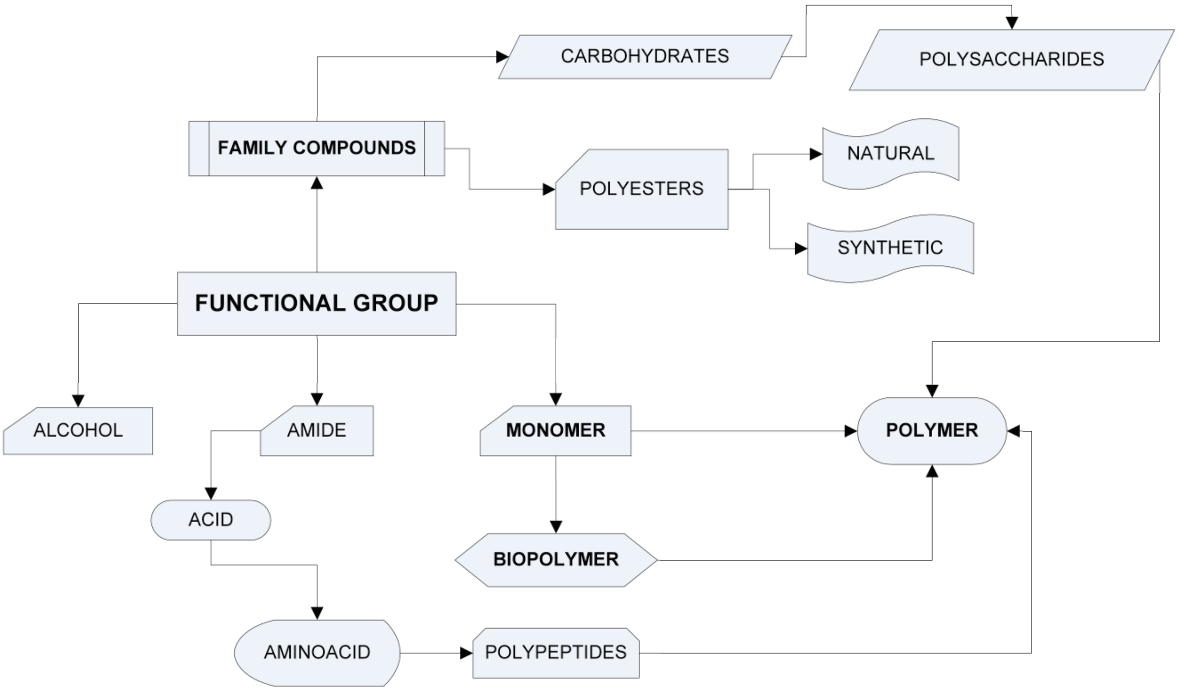
1. Acid.
2. Amine.
3. Amide
4. Amino acid.
5. Alcohol
6. Biopolymer
7. Carbohydrate
8. Condensation
9. Functional group.
10. Family compounds
11. Industrial synthesis
12. Partial hydrolysis.
13. Total hydrolysis
14. Monomer
15. Natural

16. Polymer
17. Polyamides
18. Polyesters
19. Polypeptide
20. Polysaccharides
21. Research Synthetic

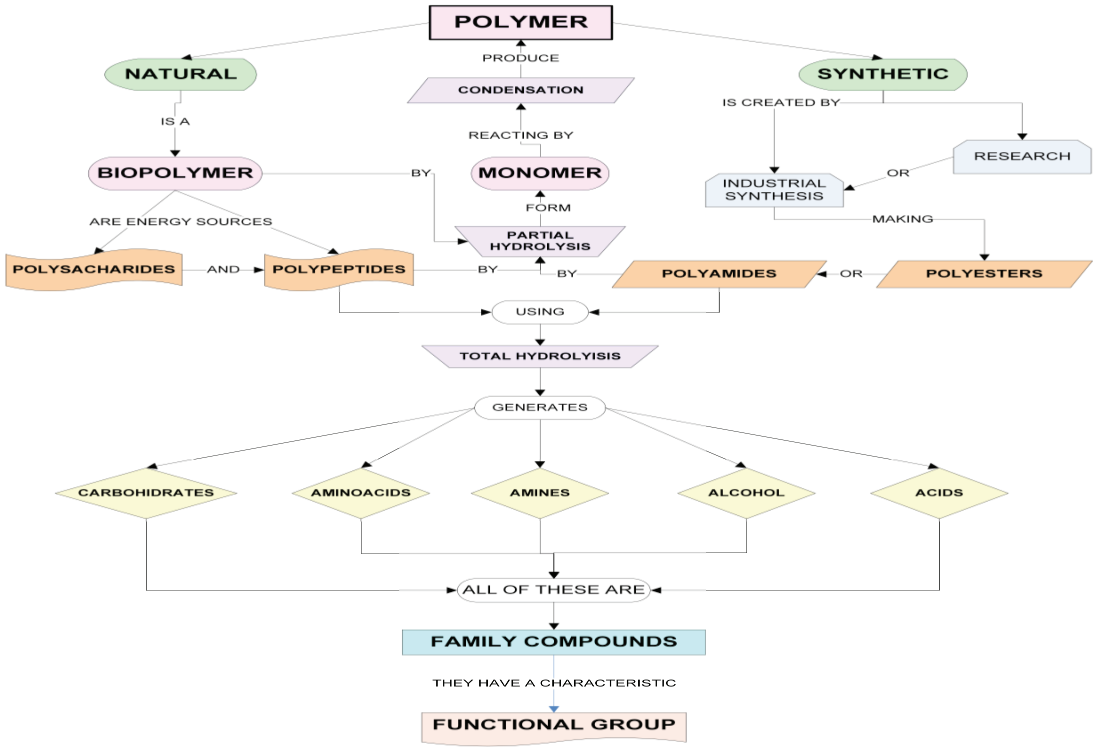
We present 4 examples of concept maps made by the students during the Organic Chemistry course. We chose these maps because they represent the evolution of their knowledge throughout this course. The first one was made at the beginning of the course, with some of the concepts that were selected by the students according to their prior knowledge. The following maps (2^{nd}, 3^{rd}, 4^{th}) were made with all the concepts **(parking lot concepts)** and were focused answering de **Focus Question "How to form and transform polymers?"** throughout the course. The course was divided into 4 stages, at the end of each one a map was constructed.



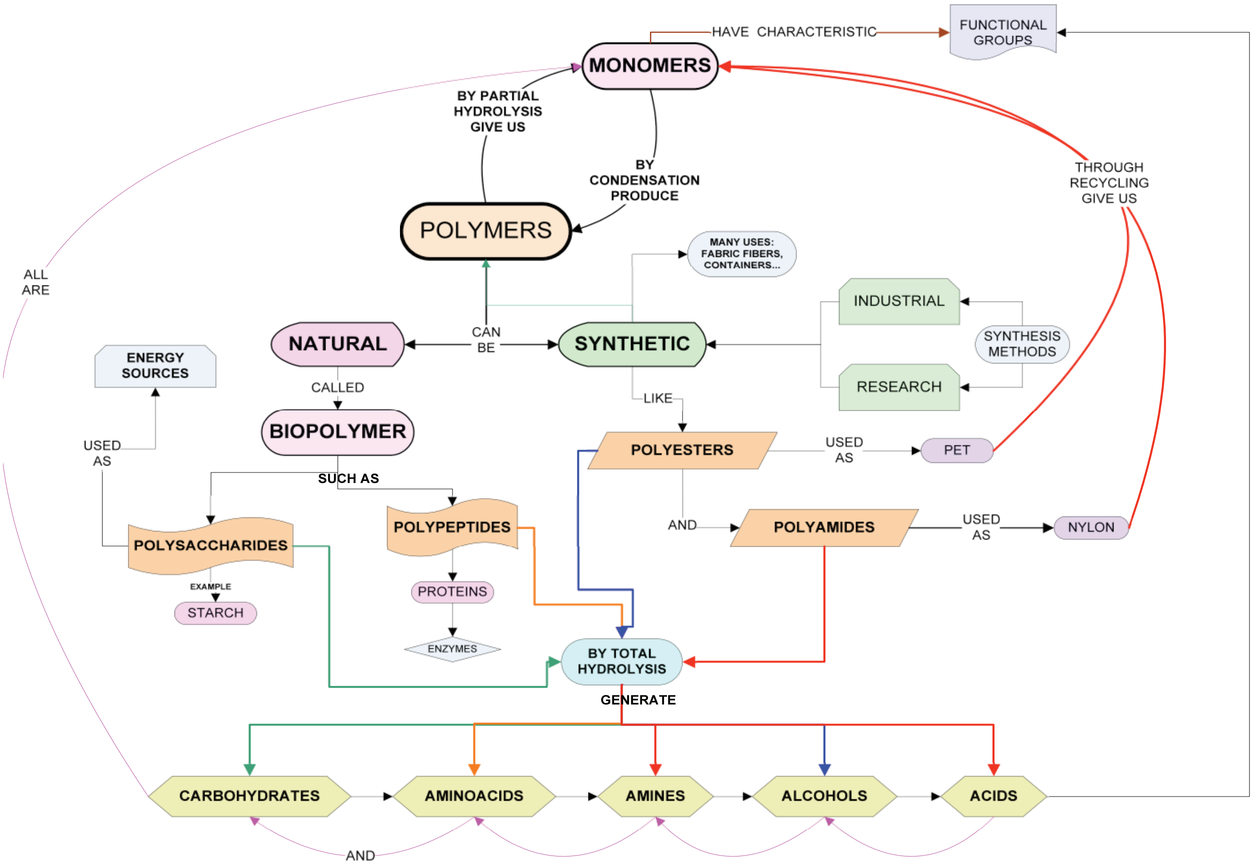
1^{st} STAGE: "How to Form and Transform Polymers?"



2nd STAGE: "How to Form and Transform Polymers?"



3rd STAGE: "How to Form and Transform Polymers?"



4th STAGE: "How to Form and Transform Polymers?"

3 Conclusions

As the evaluation of the group continued, according to the topic "How to form and transform polymers?" we noticed that the group of students that used concept maps as a study technic had a higher performance than those who used the traditional tools of study.

We expect students will obtain more meaningful learning through the use of concept maps and will have learned how to use these maps in the creation of new knowledge in their studies in general and in any situation in their lives.

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LEARNERS' PERCEPTIONS AND USE OF DIFFERENTLY DESIGNED SCHEMATIC CONCEPT MAPS ON THE FORMATION OF MENTAL REPRESENTATIONS FOR DIFFERENT LEARNING TASKS

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Abstract. Research on the effectiveness of concept maps on learning has long being neglecting three critical issues; i.e., the schematically structured maps, learners' perceptions of the maps, and the various ways of presenting concept structures. When concepts are associated by logical or causal rather than by subsumption relations, variations in selecting concepts and describing their relations may present different perspectives of interpreting knowledge, which may be suitable for different cognitive tasks. This study investigated how three map provision conditions—comprehensive maps, thematic maps, and no maps—influenced learners' formations of mental representations for two history articles, and how these representations related to coherent comprehension and syntheses of key arguments in the articles. The findings showed that people are active evaluators for the usefulness of the provided concept maps. Because different designs of concept map work better with different cognitive tasks, teachers are advised to progressively present the concept structures from the core themes to details.

1 Introduction

Concept maps have been argued to be able to exploit learners' visual memory, to reduce the syntactic complexity and redundancy of textual information, to economize the storage and retrieval of information, and to improve reading comprehension or relational knowledge, especially for the less skilled learners. On the other hand, research on graphic organizers also pointed out the possible limitative effects that providing adjunct displays may cause to learning. Many studies argued that graphically illustrating the organization of content may frame or shallow the way learners process the learning materials, to orient learners to focus more on the terms rather than on the relations or the general message of the text (Moore & Readence, 1984), and to make learners less cognitively engaged during their interactions with the text (Robinson & Kiewra, 1995). These inconsistent findings call for further investigations on the impact of adjunct concept maps on learning. In particular, three critical issues regarding the effectiveness of concept maps have been substantially understudied in the literature; i.e., the schematically structured maps, learners' perceptions of the maps, and the various ways of presenting concept structures.

According to Sternberg (2003) there are two prototypes of concept organizations; i.e., categories and schemas. Currently, the literature of concept maps primarily focused on the hierarchical maps (that feature the concepts as categories prototype). Concepts featuring schematic structures are often more pertinent to the essence of learning social sciences such as history. Instead of reciting the facts of historical events, history educators argued that students need to master the ideas that shape the disciplines of history research; i.e., the "second-order concepts", such as evidence, empathy, duration, causation, and change (Lee & Shemilt, 2003). These second-order concepts would be better represented by schematically structured concept maps.

Literature on reading comprehension shows that the memory of a text involves at least three levels of mental representations (Oakhill, Garnham, & Vonk, 1989): (a) the memory of the imagery or surface features of the way certain words, sentences, or structures are presented; (b) the local level representation that conveys the rudimentary or literal meanings of the semantic molecules that compose the discourse; and (c) the situation model or global level representation that reifies the way the learners interpret the meanings or the implications of a discourse. Concept maps, designed to graphically manifest the knowledge organization, are believed to be helpful for forming the global framework (Hall, Dansereau, & Skaggs, 1992). However, given the constructivist nature undergirding the theory of concept mapping that dismisses the notion of the best way of creating a concept map (Novak & Gowin, 1984), concept maps are rarely at its most representative form that corresponds seamlessly to the text especially when knowledge content is huge and complex. Therefore, in terms of study aids or advance organizer, the question is how different designs of concept maps would influence learners' abilities to handle different learning tasks and how to convey the instructional objectives through the design of adjunct concept maps. Via an experiment conducted in a high school in Taiwan with 88 participants, this study investigated the impact of three map-provision conditions (comprehensive map, thematic map, and no map) on (a) the constitution, (b) the coherence, (c) the interaction between the constitution and the coherence, of mental representations that high school students formed for two schematically structured passages about the most influential historical event in Taiwan history.

2 Methodology

An experiment was conducted in a computer lab of a high school in Taiwan. The participants were 88 10th grade students, who participated in this study as a part of a “creative learning project.” All of them had been introduced to the notion and the presentation of concept maps before this study, so they were ready for the experiment.

2.1 Experiment Instruments and Procedure

The experiment required the participants to complete the following tasks, and the reading materials were two news articles about the most serious uprising incident —“the 228 incident”— in Taiwan history. (a) Write down what they knew about the 228 incident. (b) Read the first text. (c) Answer 6 reflection questions. (d) Write down what they remembered about the first text, and how they referred to the provided concept map during their recalls. (e) Read the second text. (f) Answer the same 6 reflection questions from the step 3 about the second text. (g) Answer 2 local coherence questions and 4 global coherence questions. (h) Synthesize the two texts and write an assay about the causes of the 228 incident on the basis of the two texts, and how they referred to the provided concept map when they synthesized the contents. The participants were randomly assigned to one of three experimental conditions, i.e., comprehensive map group, thematic map group, and the no map group.

2.2 Data Analyses

Participants’ recalls of the first article were first broke down into lists of propositions. Then according to how each proposition represented its associated texts, all propositions were categorized into five types of representations. I.e., (a) duplicative representations, (b) analogical representations (c) problematic representations, and (d) deficit representations. In addition, the influence of the concept maps on the memorization of the texts could be observed from whether the generated propositions were supported by the concept maps or not. Therefore, the propositions generated to represent the news articles could be categorized into three types; i.e., those represented by both the comprehensive map and the thematic map, those represented by only the comprehensive map but not the thematic map, and those represented by no concept map. After the participants’ generated propositions were counted and categorized, along with their scores on the global and local coherent questions, the ANOVA and MANOVA statistical procedures were conducted to analyze how different formations of concept maps influenced the way the participants generated propositions and constructed their mental representations for the texts.

2.3 Findings

The multivariate analyses show that the three groups of participants did generate a significantly different amount of propositions across the four types, Wilks’ $\lambda=0.50$, $F(2, 85)=8.51$, $p<.001$, $\eta 2=0.29$. The follow-up analyses of variance show that the provision of different concept maps did lead to different propositional representations of the text. Between the three map groups, no significant difference was found regarding the number of valid propositions that represent the part of the text covered by both the comprehensive and the thematic concept maps, $F(2, 85)=0.40$, ns. The participants from the thematic map group generated the fewest valid propositions representing the text covered only by the comprehensive but not the thematic map, $F(2, 85)=10.67$, $p<.001$. In addition, for the six gist questions, the MANOVA analysis shows that there were significant differences in the results among the three groups, Wilks’ $\lambda=0.62$, $F(2, 85)=3.56$, $p<.001$, $\eta 2=0.21$, and the two map groups generally performed better than the no map group . Moreover, for the four global gist questions, comparison of the mean scores reveals that the no map group performed consistently poorer than the other two groups. Finally, analysis of the synthesized conclusions that the participants made from the two texts reveals significant differences in the number of valid, $F(2, 85)=6.37$, $p<.01$, and invalid propositions, $F(2, 85)=7.68$, $p<.001$ between the three groups. *Post hoc* analyses show that the differences were enhanced by the significant differences between the thematic map group and the no map group for the valid propositions, and between the thematic map group and the other two groups for the invalid propositions.

3 Conclusions

Previous research argued that concept maps may direct learners’ attention to individual terms rather than the grand messages (Moore & Readence, 1984), whereas this study showed that it is a matter of how the concept map is designed and how learners perceive the usefulness and purpose of it. Different designs of concept maps work differently with different types of learning tasks. That is, when the map is perceived as well corresponded with the text and suitable for the cognitive task at hand, it would be easier for learners to treat it as the proxy of the text for the task and serve as the "second stratum cue" (Robinson & Molina, 2002) that back up the textual representation. But when the correspondence is not intuitive or it does not directly connect with the task, learners would actively evaluate the effectiveness of the concept maps and decide how to use them in their learning, rather than passively influenced by the maps. Therefore, to meet learners' learning capacity and needs, it is advisable to present an interactive concept map starting from the most parsimonious and straight-to-the-points format, and gradually evolve on the details. Progressively demonstrating the concept maps from the core to details can help learners to develop their knowledge of the content with, rather than upon, the presentation of concept maps. So far, not many computer-based concept mapping programs feature such flexibility and interactivity of demonstrating various scopes of a concept map, and this would be an important function to be considered.

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MATHEMATICAL MODELLING OF PHYSICAL PHENOMENA WITH THE USE OF GOWINS´S VEE AND CONCEPT MAPS

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Abstract. At the Nacional Experimental University of Tachira (UNET), Venezuela, we have found that first year physics students often ignore the important role mathematics and particularly mathematical models play in the learning of physics. Students use equations frequently misunderstood as a set of 'cook-book' procedures applied to solve physics problems, without understanding the reason for using a particular function or model to solve a problem. This article explains a strategy for the teaching and learning of mathematical models commonly used in physic courses. It uses Concept Maps to improve understanding of basic conceptual structures involved in the mathematical modelling process of physical phenomena, and "Gowin´s vee" as a tool that facilitates the process of building student's own knowledge of a mathematical model for a particular experiment. Results reinforces the notion that in order to explain physical phenomena, the process of proposing appropriate mathematical models, verifying and justifying them is greatly facilitated through the combined usage of concept maps and vee diagrams and also serves to promote the process of "thinking about thinking" or more precisely metacognition.

1 Introduction

Mathematics is essential for the development and comprehension of physics. This science allows the construction of mathematical models to represent physical phenomena nevertheless students ignore the important role mathematics play in the learning of physics. They use equations often misunderstood as a set of 'cook-book' procedures applied to solve physics problems, without understanding the reason for using a particular function or model to solve a problem. This is evident when students have to create mathematical models to represent physical phenomena in the Physics laboratory. Thus we designed a new strategy based on the use of Concept Maps and Gowin´s vee due to the encouraging results obtained with these heuristic tools in our regular physics courses (Ramírez de M, Sanabria & Aspee, 2006; Sanabria & Ramírez, 2006).

2 The strategy

The strategy was implemented throughout four successive phases outlined in Figure 1. This strategy uses Concept Maps (Novak and Gowin, 1984) to improve understanding of basic conceptual structures involved in the mathematical modelling process of physical phenomena, and "Gowin´s vee" as a tool that facilitates the process of building student's own knowledge of a mathematical model for an experiment. During the initial sessions we encouraged students' use of concept mapping in order to explore basic mathematical function concepts as well as the concept of models in physics. Afterwards, students were encouraged to analyze and carry on experiments using Gowin´s vee to model physical phenomena.

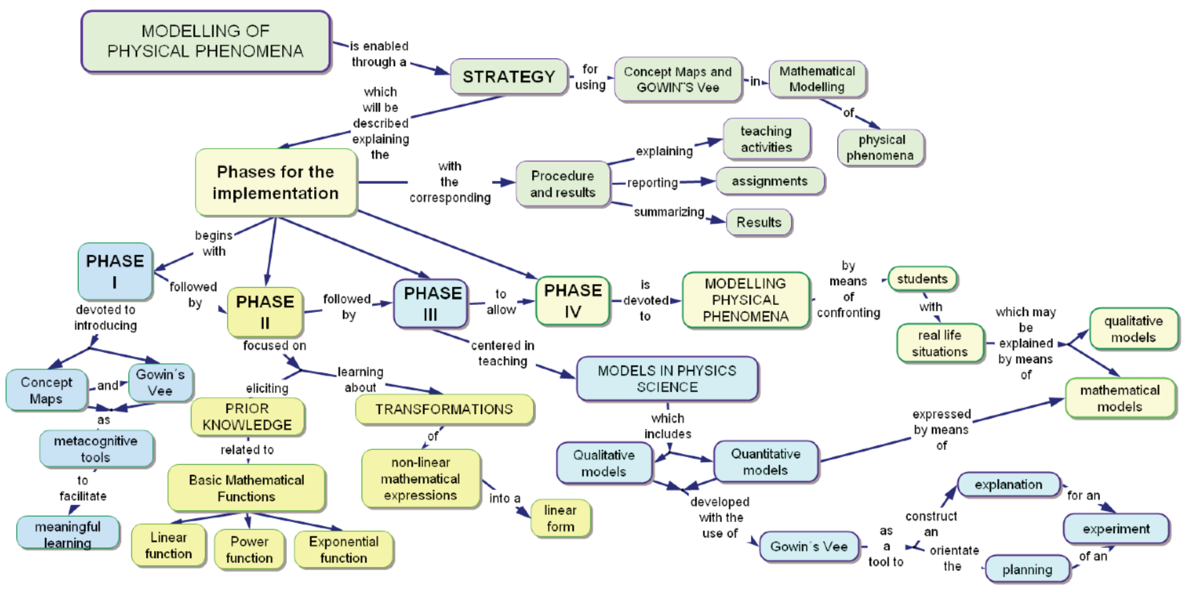

Figure 1. Concept Map of the Strategy for Mathematical modelling of physical phenomena.

3 Methodology and Results

PHASE	TEACHING ACTIVITIES AND ASSIGNEMENTS	RESULTS
I Learning about Concept Maps and Gowin's vee	-*Teaching activities*: Explain Concept Maps (Ramírez, Sanabria & Aspeé, 2006), and Gowin´s vee (Sanabria & Ramírez, 2006) -*Students Assignment*: Build concept maps for a single physics topic and a Gowin´s vee diagram for a simple real life experiment	Most of the students (84%) could produce the assigned maps successfully. Gowin´s vee seems to be more difficult for them when following up and reporting a simple experiment. (62% of the students completed them correctly).
II Comprehension of the mathematical functions: Linear Function Power Function Exponential Function	-*Teaching activities:* Linear Function, Power Function, and Exponential Function were explained by the teacher in a traditional way, without using Concept Maps or Gowin´s vee. -*Students Assignment*: Build concept maps for these basic mathematical functions.	Results were classified as follows: *a) Satisfactory:* Those maps which show clearly the main idea, the essence, subordinate concepts and relationship among them for a given mathematical function. (65%). *b) Insufficient* (35%): In this category we distinguish between maps exhibiting conceptual mistakes in mathematical prior knowledge (12%), and maps showing an incorrect application of the concept map heuristic tool (23%).
Transformation of non linear functions	-*Teaching activities:* Explain how these functions may be transformed into a linear form. -*Assignment:* Build a concept map to explain linear and nonlinear functions and how they may be transformed.	58% of the students ended up with satisfactory maps. Figure 2 shows a map made by a student about power function. Also, the concept map about transformations of linear and non linear functions made by a student is shown in Figure 3.
III Learning about models in science	-*Teaching activities*: Explanation of models in science. Quantitative and qualitative models. -*Assignment*: Build a concept map explaining the conceptual structure "model in science".	80% of the students, managed to produce maps evidencing acceptable understanding of the concept *"Model"* These results support previous findings evidencing that the easiest way for beginners to design a concept map is from the information given in a written text. In comparison, beginners find it more difficult to make a map from the contents given in a lesson. A lower percentage (58%) was obtained when students were asked to build concept maps in Phase II about mathematical functions following their class notes and what the teacher said in the lab class.
-*Quantitative models* -*Qualitative models* (which will not be explained in this article)	-*Teaching activities*: Explain Gowin´s vee as a tool to orientate the planning of an experiment. -*Assignment*: Make the experiment about a simple pendulum. Graph results and interpret them. Students must use Gowin´s vee to show their work.	Seventy four out of a hundred students managed to provide the adequate mathematical function (power function) for the set of values T against length of the string (L). The others incorrectly generated an exponential model from their analysis of the data graphed on a semi-logarithmic paper as they were convinced that an exponential function was an appropriate model. Students' concept maps about the mathematical functions helped them to find the adequate mathematical model.
IV Modelling of physical phenomena	-*Teaching activities*: Orientate the process of construction of Gowin´s vee, graph and mathematical models. -*Assignment*: Make each experiment. Graph results and interpret using Gowin´s vee.	Students get acquaintance with the use of Gowin´s vee and concept maps to understand physical phenomena and construct mathematical models to account for them. Also they finished with higher levels of confidence in their abilities to plan, carry out and analyze an experiment.

Table 2. Methodology and Results**.**

Figure 2 shows a map worked by a student to explain the concept *Power Function*. Figure 3 shows a map made by another student about *Linear and non linear functions*.

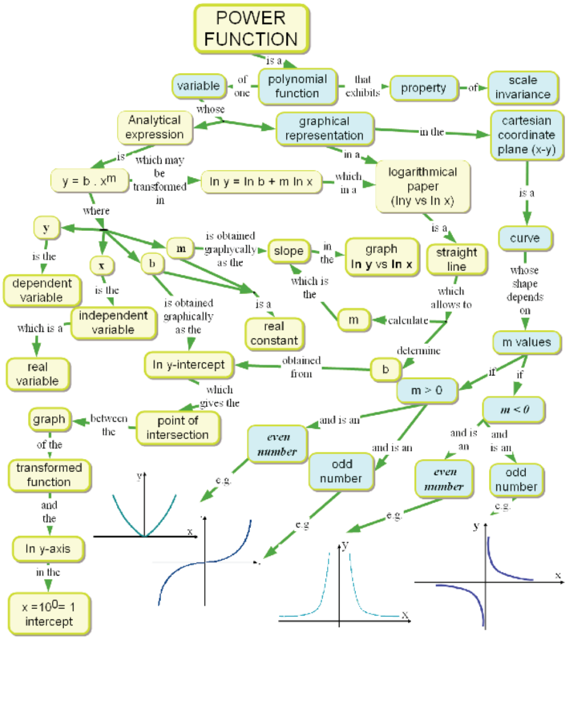

Figure 2. Student's Concept Map of "Power Function".

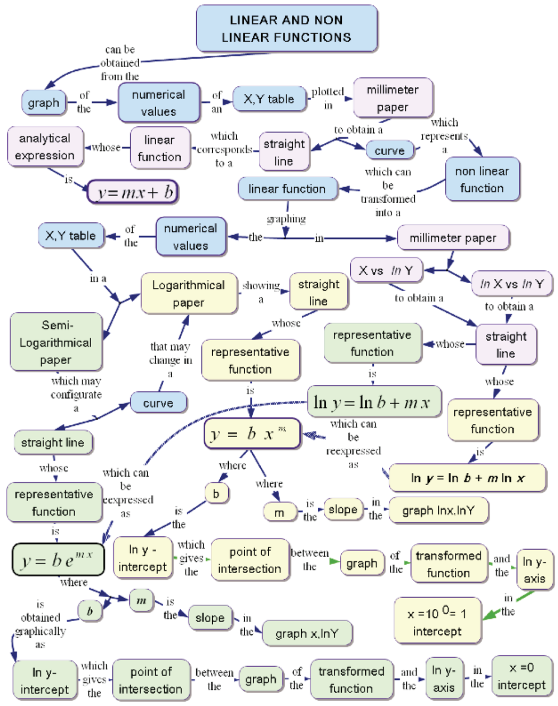

Figure 3. Student's Concept map of Linear and non linear functions.

As it was explained before, in phase III students are encouraged to use our own adaptation of Gowin´s vee (see Figure 4) in order to organize, plan and carry on the analysis of a physical phenomenon which may be explained by means of a quantitative model. The teacher explains the different steps and helps students to carry on the experiment using this heuristic tool. After that students are encouraged in Phase IV to develop their own Gowin´s vee for each experiment. Figure 5 shows the diagram produced by a student for the experiment about simple pendulum.

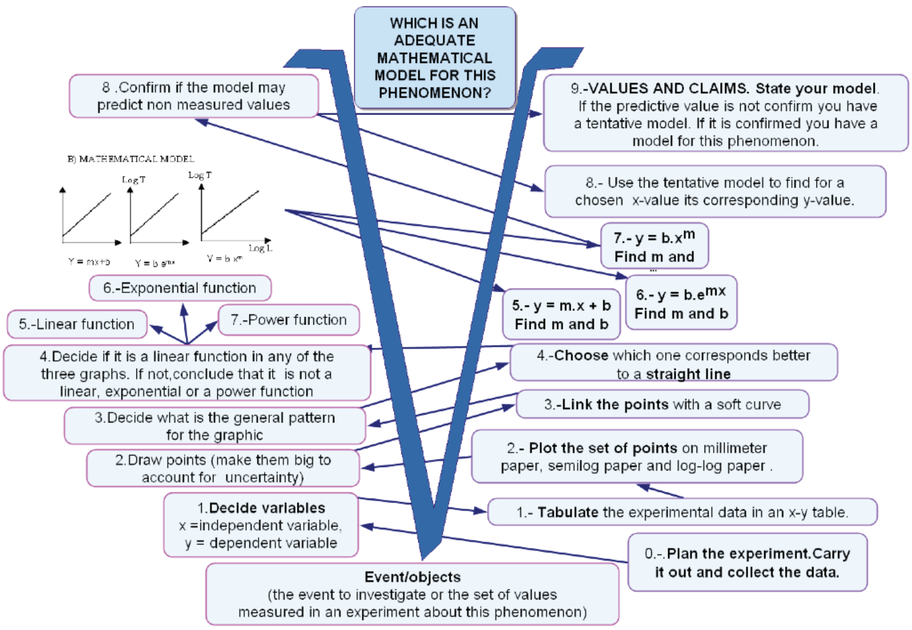

Figure 4. Adaptation of Gowin´s vee used with the students to analyze a physical phenomenon.

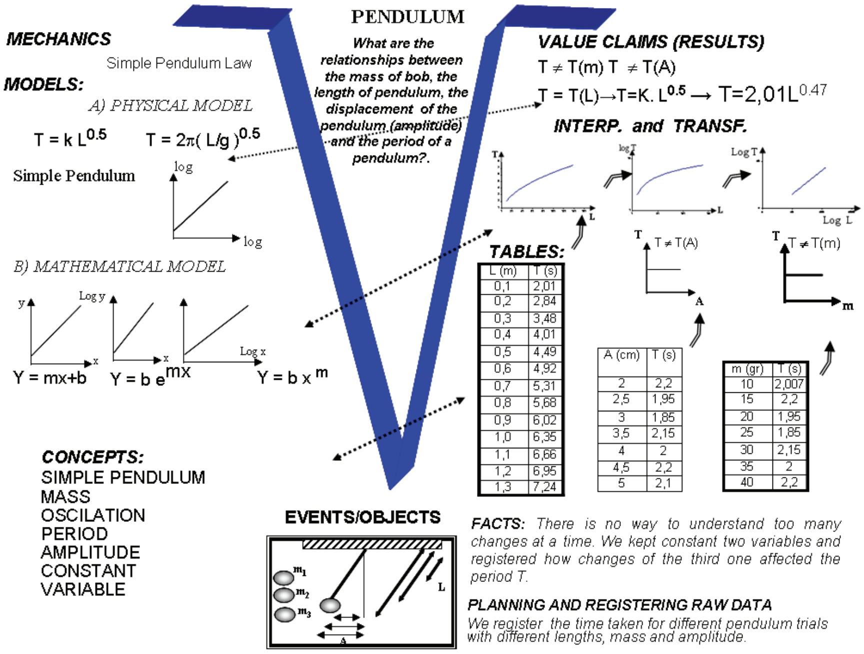

Figure 5. Gowin´s vee for the experiment of Pendulum made by a student.

4 Conclusions

Previous research results allowed us to propose that the main problems faced by students which fail the physics laboratory course were mainly due to (a) lack of motivation for studying models; (b) insufficient prior knowledge of the linear, power, exponential and functions; (c) Students' difficulties when explaining the process that leads them to build their models; (d) Students' difficulties in communicating results of their experiments.

We overcome these difficulties with a strategy that uses concept maps to improve understanding of concepts and basic conceptual structures involved in the mathematical modelling process of physical phenomena, and "Gowin´s vee" as an adapted tool that facilitates the process of building student's own knowledge of a mathematical model for a particular experiment.

The results after the application of the strategy showed that 81% of students passed the course. Results allows us to propose that improvement in overall performance along the lab course may be due to (a) An increase in student's motivation to develop the experiments with the aid of the heuristic tools concept maps and Gowin´s vee; (b) Consciousness of the necessity to improve knowledge about mathematical functions and the plotting of curves in order to find adequate models to explain physical phenomena and (c) An improvement in students' ability to communicate results and to interpret their findings while studying physical phenomena. We have continued using the strategy with satisfactory results. We are convinced that the process of proposing, verifying and explaining physical phenomena is greatly facilitated through the combine usage of concept maps and vee diagrams. Finally, the ability to model physical phenomena serves to promote the process of "thinking about thinking," or more precisely metacognition. This strategy can be adapted for other purposes and in other educational contexts.

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Mapping: Connecting Educators
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MEANINGFUL LEARNING IN THE PRACTICE

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Abstract: This work shows the key variables to put into practice the meaningful learning in the classroom. Some aspects of the research to take into account are: open work, motivation, context, creativity, concept map and curricular adaptation. It also shows the benefits it has for teachers and the improvement of students in both aspects behavioural and those related to good academic results.

1 Meaningful learning variables.

It is proved that Novak's concept map is very good for the learning process provided the following variables are considered.

The variables to put the meaningful learning into practice are:

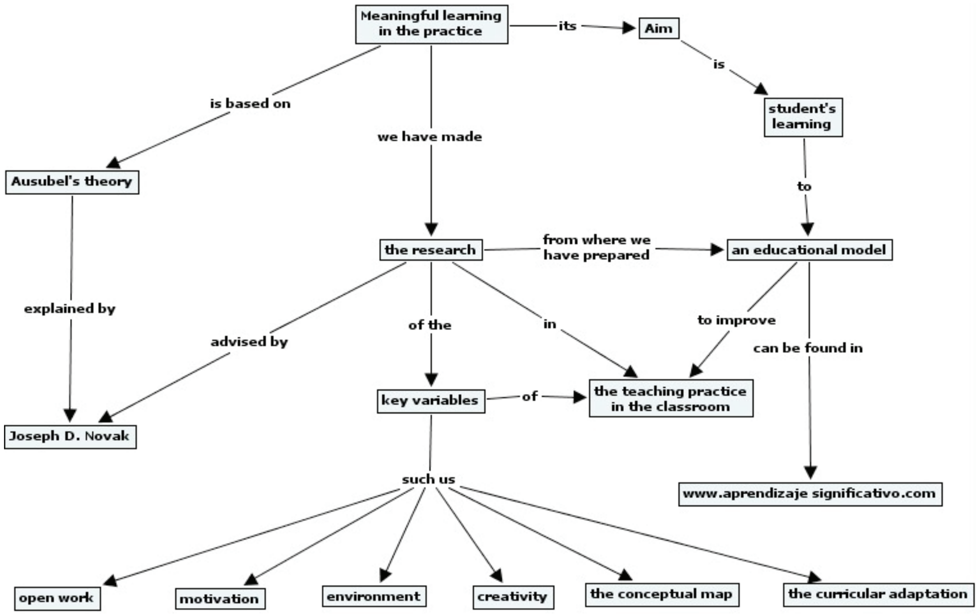
- Open work: to be able to work with different students.
- Motivation: to improve the classroom atmosphere and make the students be interested in the activities.
- Environment: to make a connection between what the students learn with what surrounds them.
- Creativity: to foster students' imagination and intelligence.
- Concept map: to connect concepts.
- Curricular adaptation: for the students with educational needs.

1.1 Open work

Open work fosters the meaningful learning making students more autonomous in the learning process.
To make students do open tasks and foster their self learning.

1.2 Motivation

Motivation is basic for the learning process and to keep a high level of work in the classroom.
In order to make learning positive, motivation must be part of the task, apart from other external motivations, with the adult consent. To use attractive and different materials is an incentive way to learn. Motivation is directly related to learning.



1.3 The environment

Students are more involved in the activities if the tasks are related to their daily life improving their participation in the learning process.

1.4 Creativity

Creativity is the field of imagination, inventiveness, divergence. Creativity is related to intelligence; being a combination, an association and a transformation of known elements to get a good new original result. Creativity makes it possible a great variety of ways to solve the same problem. To use the teacher's imagination and inventiveness makes students get new and divergent results.

1.5 The concept map

Concept maps are a powerful resource when learning concepts and they make concepts clear in terms of definition and relation. It is useful during and after the learning experience. Learning in a meaningful and connected way is fostered. Concept maps give meaning to the worked concepts. It manages to give enough connection to make solid structures of meaningful learning knowledge. (Novak 1984, Cañas 2000, González 2008).

1.6 Curricular adaptation

Students with educational needs can be benefit with the use of the concept map.
We can work the higher levels of the map with these students and both the higher and lower levels with the more advanced.

2 Advantages: heterogeneity and discipline

- Teachers are satisfied with the work done.
- Positive students' response.
- Students are devoted to work and learning.
- Discipline problems are reduced.
- It allows working with different kinds of students.
- All students can learn.
- Good learning results.
- Teachers are advisors of the educational activities.

3 Meaningful Learning Seminar

A Seminar with educators of different subjects and levels is periodically carried out at the Institut de Ciències de l'Educació in the Universitat de les Illes Balears. Its purpose consists in achieving meaningful learning experiences in the classroom. Teachers are required to learn how to control the principles of meaningful learning and put them into practice. They just have to advise learners on the production of their work and good results will be obtained.

During the Seminar teachers manage to control the principles of meaningful learning step by step. They realize that good results are obtained when a motivating open work is developed. In other words, schoolwork must be related to the environment, must involve high levels of creativity and significance to engage students in meaningful learning. Thus it becomes an exciting activity for both teachers and learners.

4 Training courses and seminars

We are running training courses and seminars in order to encourage teachers to use concept mapping, meaningful learning and collaborative work. These courses take place in several high schools and universities, such as the Institut de Ciències de l'Educació (ICE) of the Universitat de les Illes Balears, in the Associació de Mestres Rosa Sensat in Barcelona, in the Universitat de Girona, and in Secondary Schools from Menorca, Tenerife and Palma de Mallorca.

We organize talks in which trainee teachers have free entrance. Prior to participate in debates, students read our ebook during their academic year at the Universitat de les Illes Balears (Departament de les Ciències de l'Educació i Didàctiques específiques). They also elaborate works for a subject called General Didactics, led by professor Jerma Payeras.

Our ebook is freely available
As a result of that Seminar an ebook entitled "El aprendizaje significativo en la práctica. Cómo hacer el aprendizaje significativo en el aula" has been published. That ebook is freely available on the Internet www.aprendizajesignificativo.com (Ballester, 2002)

In March 2008 our ebook has already received 1,000.000 visits on its web page. At the moment we are working on its translation into English, which is expected to appear in. January 2009. That English book will be entitled "Meaningful learning experiences. How to do meaningful learning in the classroom ", and it will be freely available on the Internet.

5 The CD-ROM about Meaningful Learning Experiences promoted by the Canary Islands Government

The above mentioned CD-ROM comes from a free ebook published in the island of Tenerife (Canary Islands, Spain). A coach technical team, which received special support by the local government, followed that ebook module by module, applied it in some institutions and carried out some seminars in Primary and Secondary Schools in the whole island. Nowadays there are plenty of them.

During the current academic year (2007-2008) some modifications are being made to it in Tenerife. Moreover, meaningful learning experiences are also being accomplished in islands such as Las Palmas de Gran Canaria. By the way, we uploaded that CD-ROM making it freely available on the Net www.aprendizajesignificativo.com

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MOTIVATION AND LEARNING - KINDERGARTEN CHILDREN EXPERIENCES WITH C-MAPS IN AN ITALIAN SCHOOL[1]

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Abstract. As kindergarten teachers we have been trying to keep up-to-date in order to meet the needs of the more and more exuberant and lively children, and also of ever-changing society. Children coming from foreign countries, new technologies, and globalisation are the main challenges teachers must face, especially in kindergarten, which is so important to set out future pedagogical paths. In such a complex fabric it is a matter of urgency to find an educational weave able to promote self-reliant and confident individuals. The preservation of environment, as a highly ethical subject, is everybody's fundamental knowledge, and demands a cultural change. This is the reason why we believe it is very important to get children to understand and make them aware of such a value: little changes in everyday life can activate mechanisms for awareness, metacognition, love for their own countries and mindful employment of natural resources. Didactics becomes vital when it uses maps, laboratories, circle time, cooperative learning and metacognition.

1 Introduction

The "search-action" method gets children to master techniques of observation and activate strategies that are no longer casual, but directed to predetermined aims. Children gradually begin to build a scientific attitude by themselves, through the acquisition of competences coming from their gradual ability to observe, manipulate, discover, catch similarities and differences, advance and verify hypotheses, compare opinions, understand problems and give solutions.
Through:

- Stimulating activities to investigate children's spontaneous knowledge, which is fundamental for new learning (Clinic Conversation)
- Learning based on the child's needs and interests, to go on towards more and more complete ways of feeling and thinking (problem solving/research)
- The method of groups of peers: a setting where everybody influences everybody and is influenced by everybody, so that they can experience forms of empathy and can be charged with different tasks to "put themselves in other people's shoes", and by so doing overcome their natural individualism (cooperative learning)
- The observation of the different kinds of intelligence, to enable the children to get to know themselves and give value to their learning processes, to improve their self-esteem in order to "be able to be" ("saper essere")
- Strategies of metacognitive didactics to motivate the process of thinking (experiences are set in the area defined by Vygotskij as area of proximal development – which is the area of personality in strong expansion in early childhood)
- The building of concept maps, as a creative and stimulating means that gets children to think and give sense to their knowledge, negotiate their results with teachers and peers, in order to learn how to learn, together with the others.

2 Learning laboratories

The wide-ranging theme of earth, which goes from the exploration to the re-definition in a project dimension is to be presented gradually in the three orders of school in harmony with the pupils' cognitive psychology and learning rhythms, in the hypothesis of a vertical curriculum development of science, in the project *The Words of Science*. The concept words proposed to kindergarten children are: object, attribute, material. The didactic path to build the meaning of concept words makes children take part in stimulating activities. In the final steps, the building of maps enables the children to tell, negotiate, remember, organize, connect concepts, and gets knowledge and meanings to emerge. While teaching, the following principles must be regarded:

a) Children must be led to understand concepts through first-hand investigations. Words can isolate and keep meaning - says J. Dewey - only if they have been involved in our close contact with things.

[1] The teachers Iustini M.Teresa, Giovanna Cipollari e Felici Luigina, have collaborated in the project.

b) During investigation children observe, measure, interpret according to their abilities, and are led to reflection and gradual conceptualization. Educational actions must bring to conceptualization at every level of development

3 Itineraries with construction of c-maps formulated by 4- and 5-year old kindergarten children

3.1 Lived earth. Explored earth.

3.1.1 Prerequisites

- Sensory/perceptive experiences
- Experiences of manipulations
- Ability of sensory exploration
- Social ability
- Ability of problem solving

3.1.2 Objectives

- To discover the characteristics and components of the soil
- To discover the characteristics of the plots in the garden and near the school

3.1.3 Procedure

3.1.3.1 Step 1

(We always start from the children's spontaneous knowledge)
Group clinic conversation with questions and answers about "earth", in turns, and mutual listening (circle time).
"If I say the word "earth", what does it call to your mind?"
The children's answers:

- "It's where I put my feet"
- "It's what I trample on
- "Where I run

"Where can we find earth?"

- In the garden
- In the vegetable garden

"How many kinds of earth do you know?"

- There's the earth of the park where I play
- There's the earth of compost

3.1.3.2 Comment on Clinic Conversation

Earth is the space children *trample on* or *watch*. They cannot establish a connection between their direct experience of the country which is near the school and the images. Their cognitive matrix highlights a static representation of space, so the task is to promote the ability of relationship and association, by activating their emotional area.

3.1.3.3 Step 2. Exploration game: discovering the earth

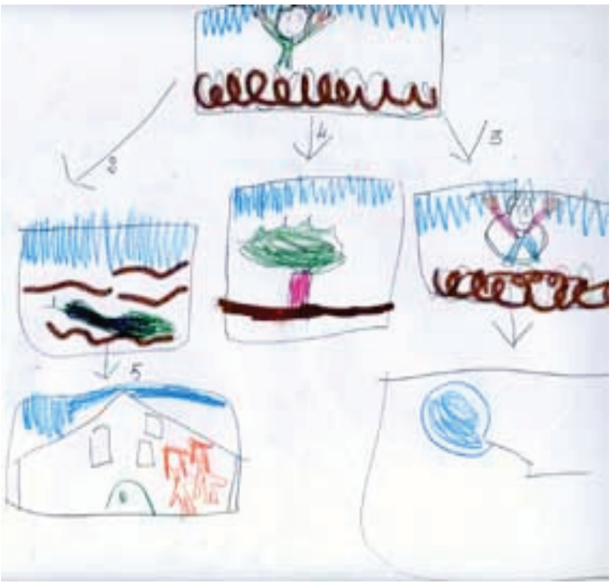
The children play freely in the spots they know, exploring the characteristics of the soil through direct touch, *("pasticciamento",* free handling). These are moments that can evoke shared emotions and sensations, and stimulate reflections and questions about the soil of the vegetable garden, the lawn, the flowers and the compost (coming from decaying plants). It is necessary to get the children to know other kinds of earth, for example a ploughed field.

3.1.3.4 Step 3

The teacher invites the children to walk on a ploughed field, touch the soil, crumble it and pick up clods to carry to school. The teacher's objective is not only to favour their sensory experiences, but to arouse their curiosity, which motivates active learning: "make to understand".

Fig. 1 : “Let’s go and investigate the earth closely. Move the magnifying glass and watch the soil: what can you see?”

After discussing about the characteristics of the soil starting from the first sensations (touch, sight and smell), the children are invited to watch the soil through a magnifying glass: “what else can you see? Is there anything in the earth?” Back to school, the children are invited to draw the maps. After drawing the C-maps, the children indicate the sequence and the links between images and captions. The teacher writes down their *tales*.



Map.1
1. Discovering the earth
2. We found a worm
3. Michele picked up the big earth
4. There was a big oak in the middle of the field
5. We went back to school with the earth and we watched the earth with the lens and there were some ants

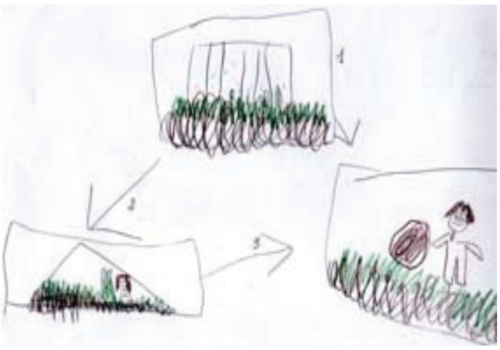
3.1.3.5 Step 4 Learning how to collect thoughts and share perceptions. Educating children to think before acting and make a choice

This question got the children to follow other strategies in order to discover the characteristics of the earth: ”Where do you want to dig for another clod, outside our school? “

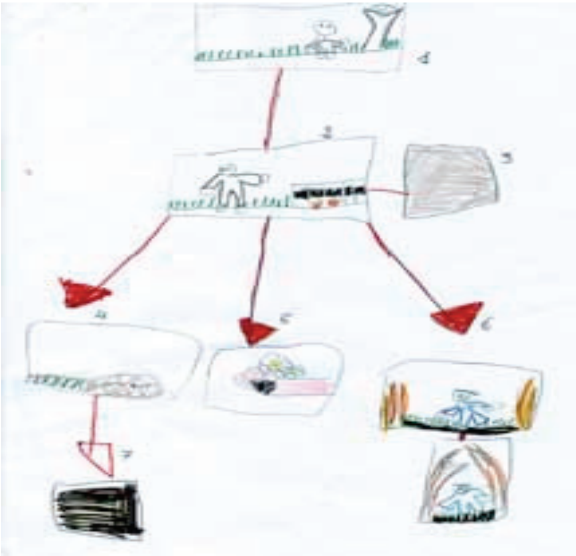
The children group themselves spontaneously with the common task to find the spot from where they have to pick up clods, they also have to decide how to take them. The different ways are compared. The children discuss and ask each other questions (cooperative learning).

The choice of clods: clods of a lawn, clods of violets, clods of vegetable garden

By repeating the experience the children get a first map: a topological map of the ground.
Organization of “the soil laboratory”: manipulation and exhibition of different kinds of soil (gardens, vegetable gardens, fields, compost); description of sensations (sight, smell, touch)



Map 2
1. “The earth of the compost was full of little seeds. It was grey and brown”
2. “The clod of the garden”
3. “The clod of the field was big, heavy and brown. And stank"

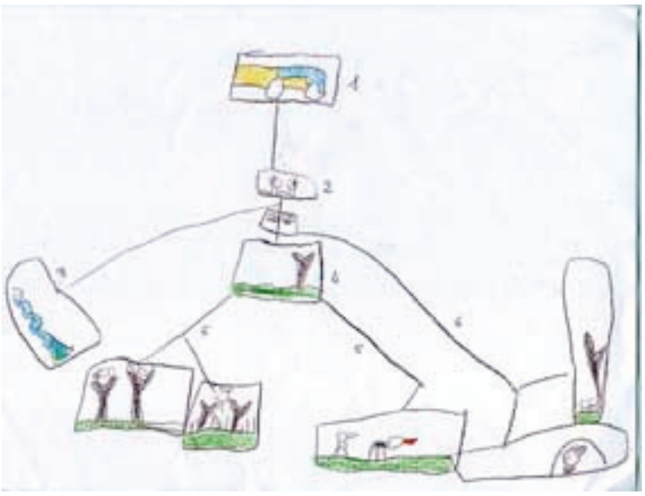


Map 3
The children say:
1. discovering the earth
2. the earth of compost
3. the colour of the earth of compost
4. the ploughed soil of the field
5. the clod of daisies
6. the earth of the path was hard
7. the colour of the soil in the field

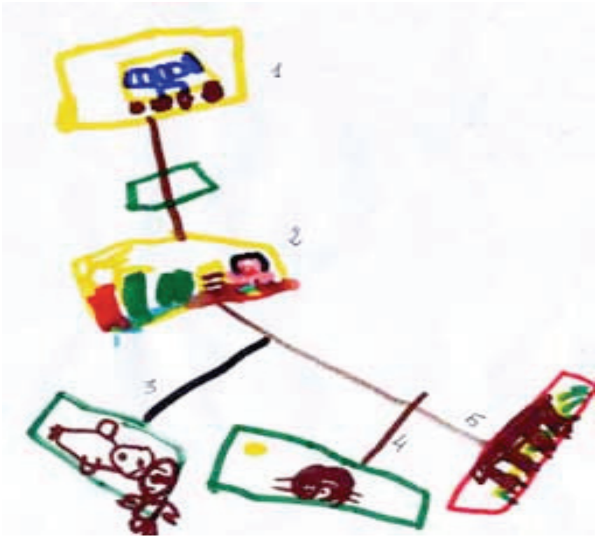
By repeating the activities in different situations, the children develop strategies that stimulate learning from a metacognitive perspective. This approach gets children to master the necessary abilities to build ideas and concepts. Their ability to organize the map becomes better and better. The children start asking questions about "why" and investigating according to their own interests. Questions must be stimulated and provoked. The teacher acts as "facilitator" for the investigation process and accompanies the work with argumentative hints.

The manipulation of maps plays a fundamental role in the gradual development of metacognitive abilities in order to stimulate children to build c-maps and to the correct use of language.

3.1.3.6 Step 5. C-maps of investigations on river



Map 4
1. The trip to discover the river
2. The feet on which we walked, and we watched with our own eyes
3. We saw the dead river and the river alive
4. There were trees
5. We saw flying animals



Map 5
1. The minibus of the trip (the green box is for the word)
2. The river
3. There were animals: little birds
4. The porcupine
5. The badger

4 The birth of a map (dramatization)

1. In the classroom, working in group, the children choose the moment of the experience they want to draw.
2. Each child draws on a sheet of paper.
3. They move to the gym with their drawings. (The children have already worked on spatial maps, identifying them first on the gym floor and then on paper. They place objects and drawings in the space to label concepts).
4. In the gym the children take place in the space, as if they were pieces on a chessboard, starting from the drawing on the initial issue or concept. They use language to establish the first relations between drawings and words and representing the experience they lived on the theatre.
5. The first maps are built in large spaces while playing. Concepts are represented by objects or drawings. Links are told by the children.

For the children the representation of their knowledge with drawings and lines is a very natural process because each drawing included in the c-map refers to the child's thought. The situations that are suitable for the evolution of a specific element are also suitable for the development of other elements.

5 Summary

This didactic experience wants to highlight the progress made starting from the children and their spontaneous ideas. The earth is what they trample under their feet and observe. Through an explorative game, they build c-maps, which help them make their knowledge richer. From the trampled and watched earth they pass to the manipulated and managed earth, to arrive at the question of its use. By doing so, the earth loses its static dimension and becomes something alive to touch, mould, work today and manage tomorrow, as a land that is not only physical, but also anthropological, with the responsibility to defend it as a common good.

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NICHO: FACILITATING A COLLABORATIVE NETWORK OF SCHOOLS

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Abstract. Theorists and practitioners propose collaborative learning as a recommended methodology within constructivist environments. Concept mapping in particular has been shown to be an effective tool to support collaboration among students. However, seldom are teachers and students provided with the appropriate communication and collaboration tools, many of which are commonplace in corporations and large organizations. In this paper we present *Nicho*, a set of software tools that facilitate the creation of a collaborative network of schools, enabling students and teachers to take advantage of communication and collaboration tools. *Nicho* provides students and teachers within an organization of schools with email, chat, CmapTools integration, and their own personal "space" for file storage, accessible from any computer in the school or remotely.

1 Introduction

Professionals in corporations and organizations in general are used to a certain set of computer functions without which it would be almost impossible for the organization to operate effectively. They are used to having their own unique personal identification within the organization's computer system (e.g. a "userid") that is used to locate colleagues within the organization through a global directory, and functions to communicate and collaborate with these colleagues through electronic mail (email), instant messaging, and more recently social networking environments and technologies like wikis, blogs, etc. Additionally, on a "personal" desktop computer, a laptop, or through a shared server, professionals have their own "space" in which they can store files, whether these are documents, spreadsheets, presentations, emails, etc. In organizations that have offices in multiple locations, which could be within the same city, region, country or international, this functionality is expected to be available organization-wide, transcending any physical distances.

Schools, for the most part, do not offer these functions to their professionals: teachers and school administrators. In many countries, public school teachers are not even provided with an email address, let alone facilities to collaborate with colleagues or a personal "space" to store files. It is not uncommon for teachers to share *hotmail* or *yahoo* emails with other teachers with whom they want to stay in touch. Providing this kind of functionality to students is seldom even considered -- usually providing "Internet access" is assumed to be sufficient. For the most part, the technology acquired in schools is purchased through a technology-centered decision making process that gives careful consideration to the "educational software" that needs to be installed on every machine, and gives very little thought to the needs of its main users, namely the teachers and their students. In organizations that include many schools, e.g. the Ministry of Education of a country, province, or state, the hardware and software configuration is determined for one school (usually a lab configuration), and multiplied by the number of schools to determine the total purchase of hardware and software.

The difference between the functions available to professionals in corporations and to teachers and students in schools is abysmal, even though the end-computer, whether desktop or laptop, is usually very similar in capacity. In public schools in most countries, seldom can a student work on a document, save it onto his/her personal space, and afterwards continue working on it from another computer within the school or from home; seldom can a teacher communicate electronically with other teachers, and even less frequently are students able to communicate electronically with students in other schools. Each school is configured as an island, with little or no communication with other schools in its parent organization, whether this is at the level of a school district, a state/province, or a country. The school system for these organizations as a whole is not designed, organized or implemented in a way that users, whether teacher or student, have the functionality available to allow them to effectively communicate and collaborate with other users in the organization.

Educational theories, supported by practitioners' studies, encourage collaborative learning among students (Scardamalia & Bereiter, 1993; Vygotsky, 1978). The best educational use we can make of the Internet is to facilitate the collaboration during knowledge construction among students, as opposed to consuming information by "cutting" and "pasting" from Web pages onto reports. However, the functionality available in schools seldom facilitates this collaboration. Concept maps have been shown to be a powerful tool for collaboration and sharing, and software programs like CmapTools (Cañas et al., 2004) support the collaborative construction and sharing of concept map based knowledge models. It is therefore critical that we provide schools with the powerful functionality that modern technology is capable of delivering.

In this paper we present *Nicho*, a software environment that provides teachers and students in a school, or group of schools, with their own unique userid, an email address, chat, and a personal space for storing documents; and this same environment configures CmapTools and a CmapServer for storage of knowledge models. In *Nicho,* students and teachers are able to access their "space" and their communication tools from any computer in the school, and from outside the school, e.g. the home or an Internet café. *Nicho* was designed for the Conéctate al Conocimiento (Tarté, 2006) project in Panamá, and is being deployed and used to provide a collaborative environment to public schools throughout the whole country.

2 A Collaborative Network of Schools

The Conéctate project was designed to be a collaborative network of schools, reaching elementary public schools throughout the entire country of Panama. At the time of this writing, nearly 700 schools have been incorporated, many in extremely rural areas. Classroom teachers participate in a two-week full-time workshop that emphasizes concept mapping, meaningful learning, and collaborative projects, based on a concept map-centric model (Novak & Cañas, 2004). Each of the schools has an Internet connection with a public IP address that allows a computer server -- which includes a CmapServer (Cañas, Hill, Granados, Pérez, & Pérez, 2003) that is installed in every school -- to be accessed from anywhere on Internet. Within the school, computers are installed in a computer lab or, more recently, laptops are provided that students can take to their classrooms. At each school, a local area network with a public connection to the Internet contains a server computer using Linux as the operating system running a CmapServer among other server programs. Clients are currently desktop and laptop computers running Windows XP. The network was conceived to provide teachers and students with an environment where they can collaborate and share in their knowledge construction using concept mapping and other tools.

3 Nicho

Nicho is an integrated set of software tools that facilitates the creation and management of a collaborative network environment for a group of schools. In general, it enables (a) the creation of unique userids for teachers and students, (b) the creation of a global directory and local directories of teachers and students, (c) the creation of email accounts based on the userids, (d) the creation of a "remote desktop" which provides users with a "space" to store documents accessible from any computer in the school, (e) a chat environment, (f) integration of a CmapServer, (g) remote accessibility to resources, (h) pre-configuration of applications such as email and chat clients, Web browser, and CmapTools.

3.1 The Nicho Architecture

Nicho provides the "glue" which brings together a collection of open-source and free-software components, with a single installer for easy setup, and a user-friendly, web-based interface for configuration and administration, as shown in Figure 1. In addition to a Linux server in each school, a group of global servers provide services to all schools. Among these, a Master LDAP directory[1] is used to manage a global directory of users for the organization (in the case of Conéctate, all public schools). A Jabber chat server[2], authenticated through the Master LDAP directory, provides chat functionality to all users. Email accounts are created through Google Mail[3], with a customized domain for the organization (e.g. "conectate.edu.pa"). At each school, a local LDAP directory[1] synchronizes its list of users with the Master directory, and stores additional information required for local administration of that school's users. The Samba[4] software on each school's server provides file storage and a "remote desktop" environment for each user, allowing the user to login from any Windows client computer in the school. A CmapServer is configured to authenticate users with the local LDAP directory. Finally, a Web server[5] provides Web-based configuration and administration of user accounts, as well as secure remote access to a user's files in his/her "space" (remote desktop).

3.2 Creation of userids

In Conéctate it was not possible to rely on official lists of students to create userids in batch. Additionally, since not all schools are initially connected to the Internet, the creation of unique userids needed to consider the case of schools where userids are created but need to be confirmed later, when the school becomes connected to the

[1] OpenLDAP, http://www.openldap.org
[2] OpenFire, http://www.igniterealtime.org/projects/openfire/index.jsp
[3] Google Apps Education Edition, http://www.google.com/a/help/intl/en/edu/index.html
[4] Samba, http://www.samba.org
[5] Apache Tomcat, http://tomcat.apache.org

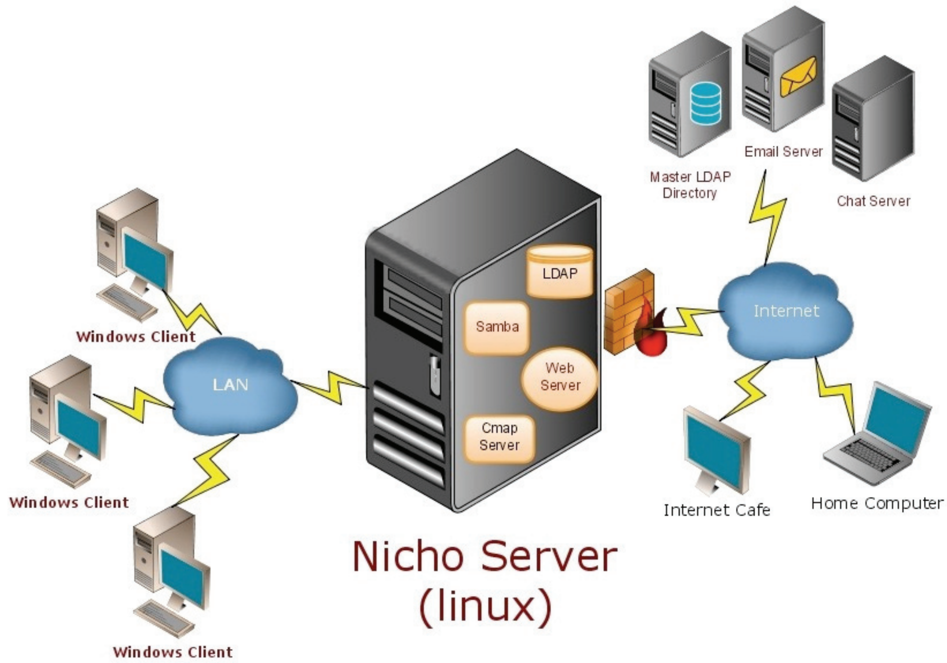

Figure 1. Nicho is a glue that brings together several components to provide a collaborative network environment to a group of schools.

Internet. Through the simple interface shown in Figure 2, *Nicho* relies on the personal information provided by the teacher and student him/herself (full name, birthday and age, grade, password, etc.). With this information, *Nicho* creates a userid that is unique within the organization by validating it with the Master LDAP directory (in the case of Conéctate, unique among all students and teachers in the country). If the school does not yet have an Internet connection, *Nicho* remembers that the userids need to be confirmed with the Master LDAP directory when the connection is established, in which case some students may be notified that their userids have changed. However, given the algorithm used to create the userid, based on full name and date of birth, the chance of this happening is quite low.

3.3 *Profiles and other functions*

Once *Nicho* has created a userid, it proceeds to create a personalized environment for the user. This consists of (a) an email account according to a preconfigured Google Mail domain (this step is taken at a later stage if the school does not yet have an Internet connection), (b) the setup necessary for accessing their "space" (remote desktop) in the Samba server upon login to the environment, (c) through KEA (Cañas et al., 2006), folders on the CmapServer with the appropriate permissions (each student has a folder in the CmapServer, and a shortcut to it from his class's folder; all users in Conéctate are given "annotate" permission on other users' folders), and a shortcut under the student's "My Cmaps" so he/she can easily access the folder on the CmapServer, (d) configuration of the CmapTools client, email client (Thunderbird), chat client (Spark) and Web browser (Firefox) with the student's or teacher's information (name, userid, password, etc.).

3.4 *Nicho usage*

Nicho sets up the user's environment during the account creation process, and the configuration can be modified through Web-based administration screens, but *Nicho* is not a program that "runs" on the user's computer. When the user, whether the teacher or student, logs in to the client computer by providing their userid and password, the environment is set so that the corresponding personal "desktop" is loaded from the school's server. The user has a personal drive available in which to store all of his/her files (including the standard Windows XP folders: My Documents, Desktop, etc., as well as the My Cmaps folder from CmapTools). This drive is mapped to the user's private storage space on the server. From the first time the user logs in, email and chat are available to start communicating with other students and teachers. Through the chat client or through *Nicho* Web pages, users can easily locate other users throughout the organization. The student's "space" is available from any computer in the school, whether it is at a computer lab, in the classroom, in the library, or on a laptop. From remote sites (e.g. at home or an Internet café), users can access their "space" via a Web browser, allowing them to download files, work on them, and upload them again to their space.

Figure 2. Through a simple screen the student provides the information necessary to create a userid.

4 Summary

Through a simple set of Web-based user interface screens, *Nicho* enables students and teachers to create their own user account with a personal "space" in the local school's server, an email account, and a remote desktop with pre-configured application profiles for chat, email, CmapTools, and other programs. Within the Conéctate al Conocimiento project, *Nicho* has provided the means to implement a collaborative network of schools, providing students and teachers in the project with collaboration and communication functionalities normally found only in corporations.

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NOVAK AND VYGOTSKY AND THE REPRESENTATION OF THE SCIENTIFIC CONCEPT

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Abstract. Vygotsky gives a theory for the scientific concept formation and the process within are constructed the meanings, that theory is suggestive to establish a relation with the concept map and the way this one, represents the relation between concepts. The similarity between the Vygotsky's linguistic metaphor and the Novak's visual-spatial metaphor is more than a coincidence. In this paper are analyzed the Novak and Vygotsky's perspectives about the scientific concept with two purposes. One goal is the introduction of conceptual elements of the sociocultural theory that could help to understand the semiotic functions of the concept map within the context of the educational practices and learning processes. Other purpose is the redescription of the concept map in terms of cultural psychology for the reason that the concept map will useful to the study of concept formation and the understanding of the verbal thinking.

1 Introduction

The concept map could be used for mediate and facilitate the scientific concept learning, there are several ways to help the learning process and depends on the activity system witch is part the concept map. The activities could be realized by individuals, in collaboration between pairs or in groups, with or with out the teacher guidance, among other possibilities (Novak & Gowin, 1984; Novak, 1998). The research had demonstrated the efficacy of concept map to help the scientific concept learning (Novak & Musonda, 1991; Novak, 1998, 2002), most of research had used Ausubel's learning theory (Ausubel, 2002) and the Novak's theory of education (Novak, 1982, 1998; Novak & Gowin, 1988).

A previous paper had contributed analyzing the concept map as *cultural artifact* and their semiotic function that make of it a mediational mean for the learning (Aguilar Tamayo, 2006a). This paper will be analyzed in Vygotsky's perspective the concept of *scientific concept*, and the concept map will be used as a metaphor to understand some of the aspects of the Vygotsky's perspective. This analysis pretend to be useful for the understanding of Vygotsky's theory, and to make visible the concept map inside the sociocultural theory, this implies a reconstruction of the concept map as a research object it self, along with contributing to a *theory of concept map* (Aguilar Tamayo, 2005, 2006b, 2006a).

2 The concept

The concepts are mental representations that allow to the individual recognize and categorize events and objects. The externalization of the mental representation needs symbols like the words, signals or draws among others. Novak (1998) consider the *word* as a *label* that represents the concept. The mental representation can be named using words and communicated trough the language.

Taking in example the word *chair*, this one had a variety of referents; the label of *chair* can be referred to a particular object or a group of things with function and characteristics that make them similar or in the same category. The concepts are generalizations elaborated from events, objects or other concepts. The concept's label, in Novak perspective, is the word, and for Vygotsky, the word, is a *means for concept formation* (Vygotski, 2001 p. 126). The externalization of the concept happen trough the word, or said it with more accuracy, trough the language.

The concept is the *word meaning* (Fodor, 1999. p. 19) that is the unit of analysis for the understanding of verbal thinking (Vygotsky, 1987 p. 46). The construction of the meaning is a generalization process (Vygotsky, 1987 p. 47), process that is implies the creation of the relation between concepts, the meaning not only depend on the material referent (objects, material reality), as well depend on other concepts.

Pozo (1994) considerer authors like J. Piaget, D. Ausubel and L. S. Vygotsky with a common theoretical perspective: *theories of re-structuring*. A common issue is the interest about the concept learning and the study of concept formation (Pozo, 1994. p. 168), other similarity is the difference that the authors make between every day concepts and scientific concepts.

Pozo (19984, p. 215) founds in the meaningful learning theory some aspects that Vygotsky never get develop. Even Vygotsky describes the concept formation process, and the social and cultural context where this happen, he not presents a specific educational proposal to help the concept formation; this is quite different with Ausubel (2002) and Novak (1982; 1998, Novak y Gowin, 1988), this authors suggest instructional strategies to help the concept learning. However, Vygotsky did mention the concept formation take place when the learner participates in a goal directed activity that implies demand for the learner (Vygotski, 2001 p. 123).

Ausubel and Vygotsky both recognize the relevance of previous knowledge for the formation or acquisition of new concepts (Vygotski, 2001 p. 195; Ausubel, 2002 p. 40) and the significance of the instruction for the concept leaning. They agree that the process of subordination-generalization is part of the learning of scientific concepts (Pozo, 1994 p. 220; Vygotski, 2001 p. 215; Ausubel, 2002 p. 261). Novak, Ausubel and Vygotsky criticized the rote learning (Novak, 1998 p. 154-155; Ausubel, 2002 p. 32; Vygotski, 2001 p. 185)

Using the Ausubel's theory, Novak conceives the concept map technique. This technique allow the propositional and conceptual structures representations, trough this, Novak analyzed the human cognitive structure and the same time Novak creates a visual-spatial representation with other characteristics. Ausubel, Novak and Vygotsky shares a metaphor; the net of concepts and the organized and hierarchical structures, metaphors that are represented on the concept map.

3 Every day concept and the scientific concept

For Vygotsky (2001) the formation of the scientific concept requires that the learner participates within a specific environment designed for that purpose; the scientific concept is learned within formal education. The every day concept could be formed as result of casual communicative interactions, or social and cultural organized interaction associated to concrete experiences.

Vygotsky discriminate the external structure of the word from the internal one. The external structure of the word depends on the relations with objects and the uses in social and cultural context, because that, the structure of the meaning is not related to a symbolic structure (Vygotski, 2001 p. 114). In the case of the child, the word meaning is given as results of the communication process with adults (Vygotski, 2001 p. 150). In the formal process of communication, for instance the instruction in classroom, the word meaning is given for a net of concepts and their relation are related to a knowledge domain or scientific discourse. The internal structure of the word is a symbolic structure where the concepts are means for the construction of new meanings, making new relation with new concepts or reorganizing the concepts, according with Vygotsky, this processes is an act of thinking (Vygotski, 2001 p. 184) mediated by meaning or by the concepts (Vygotski, 2001 p. 342).

In Vygotskyan terms the concept map is a symbolic system that allow to the human, within the elaboration process, explore the meaning of the word, or could said to, the concept elaboration. The concept map is a method for the exteriorization of the human representation, helps to get ahead of the external structure of the word constructing relation between concepts, this require the generalization processes, a dynamic process of making meaning, using concepts to give meaning to others concepts.

4 Metaphors and representations of the concept map and the scientific concept

The concept map is a representation as well a metaphor of the conceptual structure from a knowledge domain. The concept map is a representation of the human cognitive structure, the elaboration process of the concept map helps to make visible the previous cognitive structures and, if the activities demand it, developing new cognitive structures.

Is not possible in this paper present in more detailed way the Vygotsky's theory of concept formation, even so, is possible and relevant to clarify that for Vygotsky, the genuine concept is the scientific concept, the every day concept is a pseudo-concept because the origin and function in thinking (Vygotski, 2001 p. 251). The data at Vygotsky's time indicate the scientific concept formation take place until the puberty or adolescent age, between 12 y 14 year old. Considering this, the child have not arises a development enough to conceptual thinking. However, contemporary research mentioned by Pozo (1994) and original research by Novak (Novak y Musonda, 1991) indicated learning of scientific concept could be more early that Vygotsky's suppositions.

Even Vygotsky not considered possible the conceptual think in child, the author make clear that many of the pseudo-conceptual thinking are essential to develop the conceptual thinking. The every day concept are a case of pseudo-concept, their function and structure make them a pseudo-concept and not a *genuine concept* but they are important for the acquisition or scientific concepts (Vygotski, 2001 p. 164, 251)

The conceptual structure present in a determinate concept map is a representation of a moment or stage of thinking, or a stage within the process. The construction of the meaning is for Vygotsky a dynamic process of generalization. Lines down are quoted Vygotsky's description of this process. Knowing the concept mapping process, the next quote seems fits well to understand it.

> […] Only within a system can the concept acquire conscious awareness and a voluntary nature. Conscious awareness and the presence of a system are synonyms when we are speaking of concepts, just spontaneity, lack of conscious awareness, and the absence of a system are three *different words for designating the nature of the child's concept*.
>
> […]If conscious awareness means generalization, it is obvious that generalization, in turn, means nothing other than the formation of a higher concept (*Oberbegriff - ubergeordneter Begriff*) in a system of generalization that includes the given concept as a particular case. However, if a higher concept arises above the given concept, there must be several subordinate concepts that include it. Moreover, the relationships of these other subordinate concepts to the given concept must be defined by the system created by the higher concept. If this were not so, the higher concept would not be higher that the given concept. This higher concept presupposes both a hierarchical system and concepts subordinate and systematically related to the given concept. Thus, the generalization of the concept leads to its localization within a definite system of relationships of generality. These relationship are the foundation and the most natural and important connections among concepts. Thus, at one and the same time, generalization implies the conscious awareness and the systematization of concepts (Vygotsky, 1987 p. 191-192; Vygotski, 2001 p. 215)

The generalization is a process of meaning making, uses the concepts to make relations and to create new meanings, some of the outcome are a concept net flexible depending on relation between concept and their subordination could be redefine dynamically, as it happen in the concept mapping process.

5 Conclusions

In the perspective of this work the concept map is regard as research object it self, this implies some de-contextualization from the origin a theoretical background, in this way, the concept map is visible for others disciplines and theories, and diversify the analysis, in example, considering the concept map as cultural artifact (see: Aguilar Tamayo, 2006b, 2006a). This kind of analysis do not mean the complete abandon of original theoretical background but allow developing new concept for the interpretation of the concept map and the educational and research practices with it (i. e. Aguilar Tamayo, 2004)

The concept map could be useful, inside the sociocultural psychology, as a method for research de concept learning, the developing of technologies like the CmapTools gives the opportunity for registering elaboration process data and not only the results of the activity. The concept map is an important technique for the research; helps to produce formal representation to interpret, and at the same time provide a method to provoke the process in study, in this case, the concept formation or the learning of scientific concept. For Novak perspective it is obvious the concept map uses in research, the relevant in this paper is the analysis that shows the concept map in other theoretical context, that open new questions and new ways to understand the semiotic function of concept map as Novak itself had placed into discussion (see: Aguilar Tamayo, 2006a)

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ONLINE MATHEMATICS WITH INTERACTIVE CONCEPT MAPS

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Abstract. There has not been a free and easy-to-use utility to handle both authoring and presentation of large graphs online, especially with mathematical content. On one hand, concept map editors are ideal for authoring graphs, but publishing capabilities may be limited. On the other hand, numerous browsing and layout tools exist for publishing content generated elsewhere. We present a transformation tool Xcm2kg that tries to solve the problem by integrating authoring with IHMC CmapTools to publishing based on TouchGraph. GXL is used as an intermediate format to facilitate interoperability with other graph-based applications. The tool is demonstrated with concept maps drawn on an undergraduate mathematics course.

1 Introduction: Concept Mapping for Mathematics

Concept maps enable representing large thematic entities in compact form. Concept maps are effective as constructive learning tools (Novak, 1990), and they have been successfully applied to multitude of domains. Although there have been several studies related to concept mapping in mathematics (Afamasaga-Fuata'i, 2004; Baralos, 2002; Caldwell et al., 2006; Fuhrmann, 1999; Kujansuu, 2003; Schmittau, 2004), we believe that concept mapping has yet more to offer for both mathematics education and general description of mathematical content. Mathematics is well suited for hypertext representation (Mayans, 2004), and concept maps can be interpreted as localized visualizations of hypertext. Mathematics is grounded on precise concepts that are further based on more elementary concepts, formally linked with *definition-proposition-proof* –chains. Concept maps allow one to see the main concepts and results of a theory at a glance, helping to follow the proofs as well.

To our knowledge, there is no free and usable utility to handle both authoring and presentation of large graphs with mathematical content online. The problem lies in the inability of the current concept mapping software to present conveniently anything else than textual data, and the lack of interoperability between them. Recent programs usually use XML-based storage formats, but no *de facto* format does exist. Mathematical formulas may have to be converted manually to images, which is not practical with large texts. MathML (MathML, 2003) helps, but needs software support both for editing and publishing. TeX-like concise formatting, supported by some publishing packages (e.g. PhpMathPublisher, http://www.xm1math.net) and wikis (e.g. MediaWiki, http://www.mediawiki.org) would be more efficient, especially for mathematically oriented users.

In this paper, we present a transformation tool Xcm2kg that tries to solve this authoring vs. browsing problem by supporting concept map authoring with IHMC CmapTools (http://cmap.ihmc.us) and publishing with enhanced TouchGraph (http://touchgraph.sf.net) technology. Xcm2kg also facilitates interoperability with other graph drawing applications by using GXL (Graph eXchange Language) as an intermediate format. GXL is a data interchange format between graph-based presentation and software analysis tools (Winter, 2001). We demonstrate the tool by converting hand-drawn concept maps from an undergraduate mathematics course (Kujansuu, 2003) to CmapTools and comparing them with TouchGraph-based user interface KeyGraph.

2 From Concept Maps to Interactive Graphs

In this section, we describe Xcm2kg transformation tool with related software.

2.1 IHMC CmapTools

IHMC CmapTools (Cañas et al., 2004) is a Java-based concept mapping environment developed by the Institute of Human and Machine Cognition. Its strength lies in ease of use and modeling graphical layout of nodes and edges. Model elements can also contain additional resources like pictures, other documents, concept maps, and WWW links. Concept maps are modeled as hypergraphs: edge can be connected to multiple nodes. Mathematical content can be written using a WYSIWYG MathML editor. CmapTools supports several output formats: concept maps can be exported as a textual outline, HTML document, or in multiple XML formats.

While CmapTools is adequate for authoring, its default HTML output has limitations, because concept map is exported as a single image. This can be impractical with large (over 50 nodes) graphs – especially if the graph is not partitioned to subgraphs. A limitation in graph metamodel is that unlike in UML, roles cannot be attached to endpoints of an edge. User can still choose whether the edges are directed or not. Despite its minor shortcomings, CmapTools is suitable for creation of reduced size concept maps. Using a distributed server, the software also works as collaborative tool, where maps can be distributed and even edited simultaneously.

2.2 TouchGraph LinkBrowser

TouchGraph is an innovative, partially open source graph browsing component developed by Alex Shapiro. TouchGraph supports interactive browsing of arbitrarily large graphs because the view can be restricted to a local portion of the graph. The graph is browsed in an applet. Links can be opened in a separate frame. Despite of the visually attractive layout, the user can get lost in a large graph, which moving of the nodes does not help. Naturally, careful design of the graph structure and appearance of the nodes makes the navigation easier. Edges in the graph are directed, but no additional attributes, e.g. linking phrases, can be attached to them.

TouchGraph LinkBrowser is an application developed from the user interface component, which attaches a URL link to each node, making it possible to use LinkBrowser to navigate WWW pages. Additionally, each node can have a *tooltip* (hint) which is shown if the mouse cursor is left on the node. The hint can show HTML-formatted text, including pictures and URL-links. TouchGraph LinkBrowser uses an XML-based format for graph presentation. LinkBrowser can also be used as a basic graph editor, but creating graphs is rather tedious compared to concept mapping software, especially if nodes link to external resources.

2.3 Xcm2kg and KeyGraph

Xcm2kg is a conversion utility that converts concept maps from CmapTools XCM format to KeyGraph, a graph visualization component based on TouchGraph. The conversion is done with two separate filters, Xcm2gxl and Gxl2TouchGraph. The overall process is shown in **Figure 1**. External resources (i.e. pictures, URL links, concept maps) are shown as hints in LinkBrowser nodes. References to external concept maps are passed to a PHP script that loads the concept map into an applet. MathML markup is converted to images and shown directly in TouchGraph nodes similar to background pictures. Xcm2kg is implemented in Java and published as open source as a part of ConceptUtils transformation framework (http://conceptutils.sf.net).

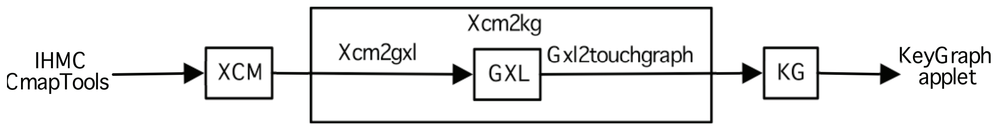

Figure 1. Xcm2kg transformation tool chain.

Xcm2gxl converts XCM file from CmapTools to a generic graph interchange format, GXL. JGraph (http://www.jgraph.com) component is used for internal representation of the graph model during conversion. MathML markup is converted to images using JEuclid (http://jeuclid.sf.net). References and node/edge labels are preserved as attributes. Layout information is presented as a *style* attribute. Using GXL in transformation enables the conversion of any GXL-formatted file to TouchGraph readable format. For example, JGraphpad editor in JGraph package supports GXL, and Graphviz toolkit (http://www.graphviz.org) contains bidirectional DOT-GXL transformation utilities. Representation of attribute data can differ between GXL files acquired from different sources and layout is generally not preserved, but at least the structure of the graph is representable.

Gxl2TouchGraph converts GXL file to KeyGraph format. KeyGraph is an extension to TouchGraph LinkBrowser 1.20, improving the user interface and expanding the graph format. Enhancements to XML format include edge labels (linking phrases), support for background images, and multiline text. Keyboard-based navigation was added to user interface. If multiple nodes are present, the one nearest to the arrow direction is selected. Pictures can be shown as hints or directly in LinkBrowser nodes. URL links can be local (opened in another frame) or external (opened in new browser window). N-ary relations supported by CmapTools are resolved in KeyGraph by generating corresponding edges for all possible combinations. Finally, KeyGraph includes a simple framework that eases publishing concept maps and linking between maps. A PHP-script generates a list of available KeyGraph files and frames for the applet, concept map lists, and local links.

3 Transformation Example

The transformation example is based on an undergraduate mathematics course (Kujansuu, 2003). **Figure 2** is one of the student-drawn maps, which were evaluated and compared to another map drawn by the teacher.

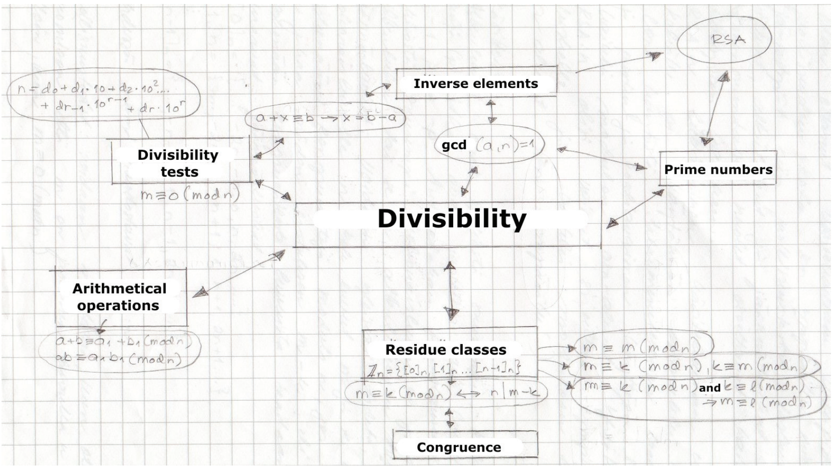

Figure 2. Original, hand-drawn concept map (labels translated from Finnish).

Figure 3 shows the HTML page generated by CmapTools with alternative ways of encoding mathematical text: the image in *Residue classes* was generated using TeX. The formulas under *Congruence* and beside *Series representation* were written using the formula editor, represented as Unicode text and MathML respectively.

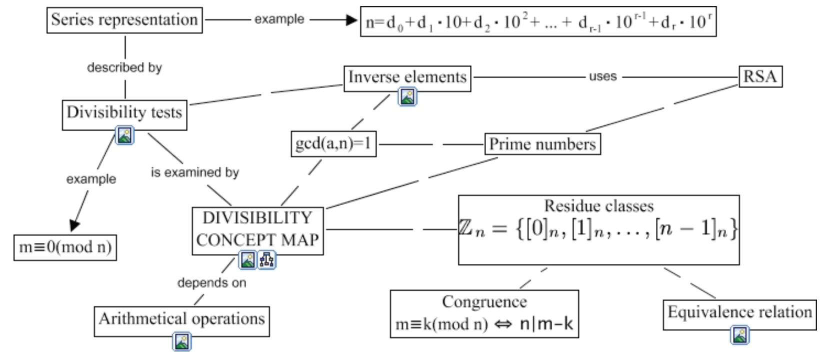

Figure 3. Web page concept map generated by IHMC CmapTools.

Figure 4 shows the dynamic view generated by Xcm2kg in KeyGraph. Note the slight differences in formatting generated from different sources. The hint in *Equivalence relation* links to TeX-generated images.

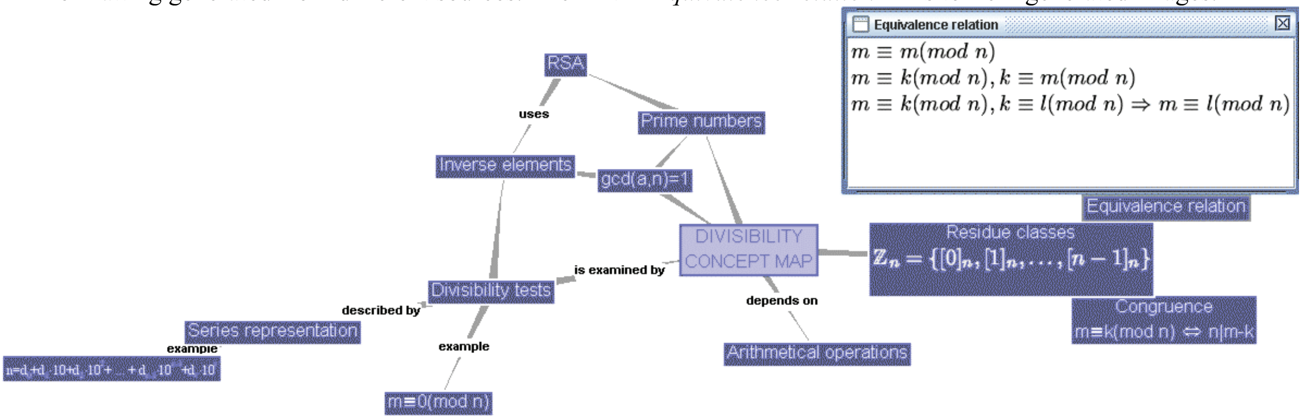

Figure 4. Concept map in KeyGraph visualization.

Even with a small map like this one can see the benefits of the visualization. The view is dynamic and interactive. Resources in tooltips are shown with less effort compared to HTML generated by CmapTools. The visible locality length and zoom can be configured, adapting the view to graphs and nodes of different size.

4 Discussion

Xcm2kg is currently a prototype. Xcm2kg does not preserve font, color or other style information about the graph except relative node positions. All such info is stored in the XCM file, so basically some of it could be used in conversion as well. Another problem is related to resource file names in XCM output. When concept map is exported to XCM, resource file names are not preserved. The names are converted similar to their description strings that are shown in the concept map. This can lead to name collisions if different resources are described with same names. Fortunately, the problem is not present in CmapTool's newer concept map format CXL, but a transformation component for it is not yet implemented. The output format Xcm2kg uses is downwards compatible with TouchGraph LinkBrowser 1.20. However, Xcm2kg features some extensions that are implemented only in KeyGraph package, the most visible additions being edge labels and image nodes.

Future work in Xcm2kg includes generalized support for GXL-KeyGraph -conversion. This would require a standard way to represent style in GXL files. A promising approach might be using a SVG file for describing layout, separating it from the data model (Minas, 2002). In general, support for visual styles used in CmapTools should be improved. The ConceptUtils framework should be extended to account new formats in transformation, such as FreeMind (http://freemind.sf.net) mind maps. Finally, the tool should be tested more extensively in different settings, especially with mathematical content. For example, concept mapping could be applied to works like *Comprehensive Mathematics for Computer Scientists* (http://math.ifi.unizh.ch/bmwcs), or Metamath (http://metamath.org) that contain cross-referenced indexes about definitions and proofs. Other online mathematics collections, such as Wikibooks (http://en.wikibooks.org/wiki/Mathematics_bookshelf), or Weisstein's *MathWorld* (http://mathworld.wolfram.com) would also benefit from visual representation of the context.

5 Summary

Xcm2kg converts concept maps from IHMC CmapTools XCM format to KeyGraph, a graph user interface format based on TouchGraph. GXL is used as an intermediate format, making the conversion framework extensible. Xcm2kg's purpose is to simplify concept map authoring and web publishing, especially in the mathematics domain – both for learning material and general description of mathematical content. While being a simple converter and a prototype, it integrates CmapTools and KeyGraph in a natural way.

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ONTOLOGIES: A SOLUTION FOR THE LEARNING

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Abstract. This paper presents an ontology model used for specifying a knowledge domain in the teaching/learning process and a proper methodology for the personalization of the didactic/training experience of single students basing on their didactic objectives and domains, their acquired knowledge and learning preferences. In our vision, it is important to preserve a specific ontology used in the definition of a given didactic domain that could be reused in different learning contexts. Therefore, particular attention is given to a number of operations that allow to recover and adjust the existing ontologies. Today's topical and growing Social phenomenon on the Web is represented by the folksonomies, and moving forward by the so-called **Social** Semantic Tagging, or simply, "rich tagging". This study outlines its framework and use.

1 Introduction

A needful condition for the success of a formative experience in the formal learning context is an obligatory relation among quality- validity-credibility of contents (Erkunt, H. 2004).

In accordance with an objective paradigm, the credibility of a didactic source fundamentally depends on several base factors that are included in specific taxonomies. For major experts, especially in ITS domains, the learning by ontology seems to be the nearest solution to share the content validity.

In this paper different strategies were investigated in order to approach the objective validity of knowledge. Our experience, conducted within the centre of research in Learning and Knowledge, has allowed us to look exhaustively at the ontological solutions for the learning and to manage domains more easily. Ontologies are conceived as an instrument for reusing and sharing the knowledge; so a typical operation in such a direction is a comparison among different ontologies to identify a possible correspondence (*Ontology Matching*) or to merge them (*Ontology Merging*).

The research, conducted in our centre, takes into account new perspectives on the knowledge and their representation. The Web 2.0 technologies are transforming the access modalities and the information management; the usage of different instruments, such as the social tagging, modifies the relationship that the students have with the knowledge. In the last section of the paper, it is presented an integration between ontologies and folksonomies (also known as *social tagging*). The folksonomy is the practice and method of collaboratively creating and managing tags to annotate and categorize content.

2 The Ontology Model

This model describes the knowledge domain through concepts (that represent topics for teaching) and relationships between concepts (that represent the connections between two topics).

The typical **relationships** between concepts are:

- *HasPart(x,y)*: the concept *y* is a component of the concept *x;*
- *IsRequiredBy(x,y)*: the acquisition of the concept *y* has as prerequisite the concept *x*;
- *SuggestedOrder(x,y)*: in order to encourage the learning process it is advisable to start by studying the concept *x* and then the concept *y*.

The *HasPart* relation is a hierarchical relationship; the *IsRequiredBy* relation indicates a bond with respect to the order of acquisition of two concepts; to end, the relationship *SuggestedOrder* suggests an order in the development of the learning process.

From a formal point of view, an ontology is represented by a multi-graph $G(V, A_1,\dots A_n)$ with a set of knots V that represent the single concepts and with a set of arrows A_i for each relation i .

In the following figure an example of ontology is depicted.

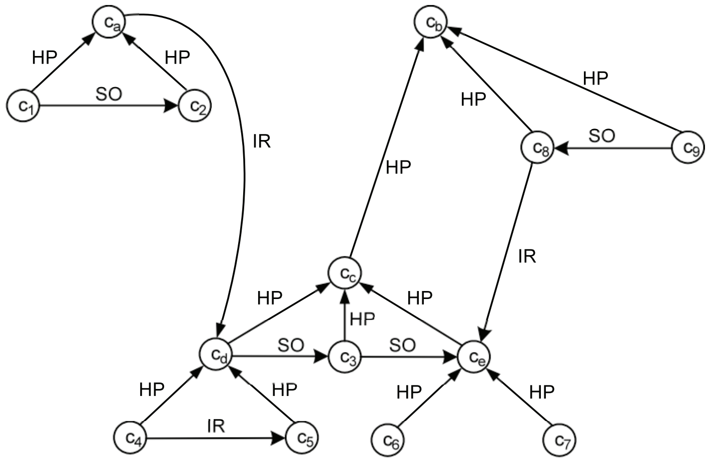

Figure 1: A typical ontology

This ontology, however, does not provide information about the best modalities for the knowledge transfer on the concepts. In other words, it is not "contextualized", being the term "**context**" the characteristics of the learners that have to learn the specific domain, the modalities of interaction with the learning material related to the ontology and the learning objectives concerned with the fixed ontology.

In order to "contextualize" an ontology, it is possible to associate a couple to each concept (property, value), this is named "teaching preferences". The properties specify the optimal modalities of knowledge transfer for each concept. These properties can be represented by the *didactic method*, the *typology of the activity*, the *interactive level*, etc.

2.1 The generation process of a Learning Path

The generation phase of a Learning Path LP, foresees the following input data:

- an ontology $O(C, (R_1,\dots,R_n))$ where C is the set of concepts and $R_1,\dots,R_n$ are the relationships between the concepts;
- a set of objective concepts *TC*;
- a relationship of decomposition *D* (for example the relationship *HasPart*);
- an ordered list *A* of some order relationships used to define the elements of the Learning Path (for example the relationship *IsRequiredBy*);
- an ordered list *B* of some order relationships used to define the elements of the Learning Path (for example the relationships *IsRequiredBy* and *SuggestedOrder*);
- a learner's cognitive state *CS*.

Taking into account these input data, the algorithm can be described using the following diagrams $A' = A \cup D$ and $B' = B \cup D$.

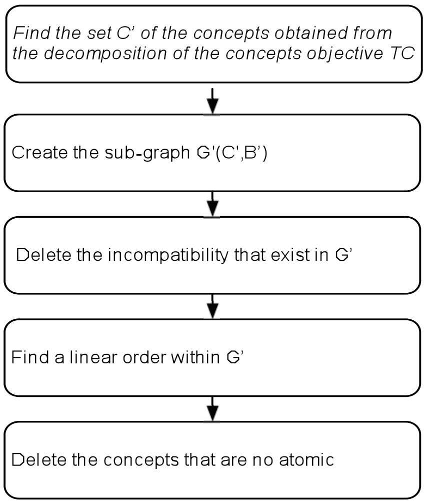

Figure 2 The algorithm of the LP generation

3 Modifying and extending an ontology

The ontologies are not static and evolve in time by the addition of new information which take into account the different changes in the interested domain. So, it needs a suitable strategy to manage the various versions of an ontology. We define as "*ontology versioning*" the capability to manage the changes within the ontology through the creation of different versions of them. The changes are referred to as domain changes, shared conceptualization, specification. A support to the versioning is needed since any change to the ontologies can produce some inconsistency problems with respect to the related objects (documents, web pages, learning objects, tasks..).

Though, given that the ontologies are considered as instruments for the knowledge sharing and reusing, it is important to compare them for individualizing possible correspondences (*ontology matching*) or merging them (*ontology merging*) to increase the knowledge base. The *ontology matching* is often associated to the *ontology merging*; the **union** and the **intersection** are the most used approaches. In the *union* approach, the resulting ontology is constituted by all the entities defined in the source ontologies. On the contrary, in the *intersection* approach the resulting ontology is given only by the sections of the source ontologies that overlap.

4 Ontologies and folksonomies: towards Ontonomies, a knowledge representation tool considering the semantic side of social processes.

The vision of our Pole is, coherently with the Knowledge Model for Learning based on the social constructivism and connectionism (Cross, 2006; Siemens 2006), to experiment a convergence process between the Web 2.0 and the Semantic Web. It is necessary to invest in a method/solutions able to support the management of high level educational objects and the collaborative ontology creation, according to a mediated approach which goes from folksonomies and social tagging processes (Mates, 2004), (Petrucco, 2006) to formalizable knowledge extraction.

The management of the high-level educational objective allows to answer to the users' needs to express their educational requirements in a natural language and to interact with ontology target concepts for defining personalized learning experiences. A Collective Intelligence Management Systems, able to integrate the social side of Web 2.0 and Semantic Web, can have functionalities of learning requirements sharing or learning objectives rating.

The attention is focused on the **Social Semantic Tagging**, or simply, "**rich tagging**", enabling to start a good communication process with didactic ontologies built through a bottom up method and able to receive feedbacks from the lower part (the networking layer). This action can be divided in two micro-objectives: RichTags for ontology learning, RichTags for learning resource update and, in particular, RichTags for learner profile update helping the system to recommend and suggest the best personalized "learning experience". This set of indicators also contributes to build more or less heterogeneous collaborative groups for specific collaborative didactic activities.

5 Summary

This paper has showed an ontology model for describing a specific knowledge domain through concepts and typical relationships between them. One of the fundamental aspects of the ontology management, is to allow the ontologies developers to compare the existing ontologies in view of their possible reusing in other contexts. In general, a full management of the ontologies within a learning platform can allow a teacher, or a general user, to carry out different operations, such as versioning, merging and matching of ontologies.

The formalizing approach based on ontologies for the knowledge representation in distributed and shared learning experiences has provided methods and tools able to support a dynamic process through which lexicons and meanings are negotiated and renegotiated, inside and outside specific learning and teaching communities.

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PARTICIPATION AND LEARNING: PLANNING STUDENT SERVICES IN A UNIVERSITY CAMPUS

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Abstract. Participation is increasingly considered an effective way of problem solving. The present work, based on a case study developed in an Italian university campus, investigates the potentialities deriving from combining methods such as mental maps and concept maps, pertaining respectively to cultural geography and cognitive psychology, with a participative attitude towards decision making. Starting from a territorial and environmental analysis and subsequently turning to the representation of conceptual structures, the study examines issues related to student services planning. The paper considers both aspects linked to social and cultural topics (such as place identity and connotation, sense of community and social cohesion) and intrinsic factors, more relevant from a "technical" perspective (such as the peculiarities of the individual services). The outcome is a complex architecture, made of theoretical and practical features, marked by internal and external interconnections, resulting in different kinds of networking.

1 Introduction

The aim of this paper is to show how cognitive mapping, such as mental mapping and concept mapping, can be valuable aids in planning student services in a university campus through the "integration of teaching, research and community service" (Subotzky, 1999).

From a theoretical point of view, there are two main assumptions in the present work:
- that cognitive mapping is a process made of psychological transformations by which an individual works out information about his everyday spatial environment (Downs & Stea, 1973);
- that mapping, from a geographical perspective, is concerned with "ontological and epistemological questions about the nature, fabrication, communication and authentication of knowledge of the external world." (Cosgrove, 1999).

Mapping, in general, is based on graphical representation through a visual architecture of signs (Cosgrove, 1999); what distinguishes mental from concept mapping, are the objects of this representation and their organization: more free that of mental mapping (Tuan, 1975), grounded basically on perception, imagery and memory; mainly hierarchical that of concept mapping, concerning knowledge structures (Novak & Gowin, 1984).

This work wants to prove that better results, in this specific field, can be obtained from a combination of the two methods, that starting from an evaluation of the subjective experience of a circumscribed environment, subsequently develops a conceptual analysis of the needs expressed.
From a practical viewpoint such methods prove noteworthy mainly because they:
- enhance the participation process (Škerlavaj, M. & Dimovski, 2007);
- allow improvement in the decision making process (Kane, M., & McMahon, P. Q., 2002);

This article is based on a case study involving 25 students of the Faculty of Letters and Philosophy of Arezzo (Italy). The students attended a first year course of Geography and were therefore familiar with topics related to mental maps and space perception and analysis. The location of the Faculty itself, is somehow ideal for the work proposed, as it is sited in a restricted and well delimited area, inside a park, very near to the railway station and the city centre. Starting from their perception of the campus, the students were asked to draw a mental map of their usual routes, halting-places and of the services (both those already supplied and those they would like to be). To accomplish this part of the work they were given a topographic map on which they marked with different colours the requested information. The second step was that of discussing with the students the main features of their maps, in order to highlight problems, expectations and positive aspects related to the campus. From this discussion I derived all the information needed to work out concept maps useful to develop hypothesis concerning student services planning (that is a fundamental part of my present work at the University).. The last step concerns the final discussion of these maps with the students involved in the whole process, in order to obtain two different results:
- to gather their last comments on the proposal, thus accomplishing the feedback process;
- to show them the concept mapping method, in order to give them an important interdisciplinary learning tool.

2 Case study description

2.1 Step 1. The mental maps

What seems more relevant to stress in this context, is that mental maps are used for describing places or routes and that they focus on spatial connections, taking into consideration elements pertaining to the concept of space, elaborated from an individual point of view. They therefore convey a subjective experience of the environment grounded in memories and determined by conceptual systems, normative conditioning and socialization processes (Soini, 2001).

Moreover, the participating value is strengthened by the fact that students are participants involved in the environment they are required to analyze, in the sense meant by Cosgrove (1999) and O' Keefe (1978).

The maps worked out by students were analyzed starting from these basic assumptions and as they were asked to concentrate on a specific topic, the result was a synthesis between the topographic and the thematic map (O' Keefe & Nadel, 1978).

Five main features were pointed out, with reference to their usual routes:
- extension;
- direction indicators;
- access points;
- peripheral zones;
- area outside the campus.

Given to the fact that students were expressly asked to indicate their routes on the map, a good deal of intentionality comes out of their spatial behaviour (O'Keefe & Nadel, 1978). Combining all this information with that deriving from halting-places, both crowded and deserted spaces were identified. This mapping represents the starting point for the subsequent location of services. Among others, four main significant topics came out, concerning: study, recreational and cultural activities, mobility and place connotation.

2.2 Step 2. The concept maps

While mental mapping displayed a wide scenery of topics through a graphical spatial location, concept mapping allowed to pick out each single topic and develop its conceptual structure.

The advantages of this method were essentially three:
- the possibility to accomplish an analytical exam of each issue, expressing appropriate relationships between concepts, according to the principle of inclusivity (Valente da Costa, J., Lopes da Rocha, F. E., Favero, E.L., 2004);
- the possibility to show interrelations between different issues, rendering the complex architecture both of thinking and of problem solving;
- the possibility to show the structure of argument and conclusion (Huff, 1990).

One of the main features of the four concept maps resulting from the analysis of mental maps and the discussion is their interconnection. Figure 1, for example, which focuses on recreational and cultural activities, is interlinked with that on connotation (Figure 2), while that on studying (Figure 3) is interlinked with the one concerning mobility (Figure 4).

Moreover, the analytical structure and organization of concepts allows the description of both their intrinsic nature and their external reflections (see Fig. 1 and 3), so in each map it is possible to analyze the characteristics of starting concepts, but also their consequences in a wider context. For example, in Fig. 1, we find that recreational and cultural activities can be either sports or cultural, but we also find that they produce socialization, dialogue and involvement.

Another important feature, emerging from the maps, is the manifold idea of network they convey: on one side the community network, linking the different bodies of the academic world (students, professors and employees); on the other that interconnecting the several sectors of the university structure.

As for their content, the maps highlight different kinds of concept related to values such as: socialization, dialogue, involvement and sense of community (Fig. 1) or place identity and social cohesion (Fig. 2); concrete (nearly technical) aspects of the planning process, for instance the different kinds of rooms for recreational and cultural activities (in Fig. 1) and for studying (in Fig. 3), or the very many aspects developed in the map on mobility (Fig. 4). Where possible, examples suggested by students are given, such as those concerning a basketball court, an auditorium and an arena (Fig. 1) or those pertaining to connotation (museum and monument) in Fig. 2, so stressing (and therefore strengthening) the participation process.

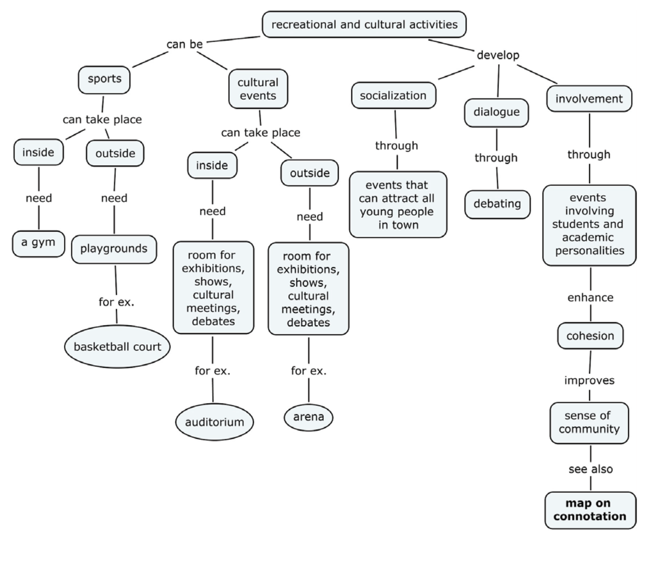

Figure 1. Concept map for recreational and cultural activities.

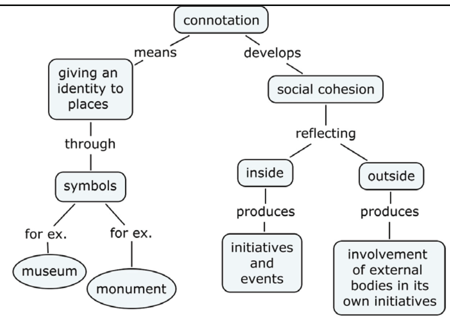

Figure 2. Concept map for connotation.

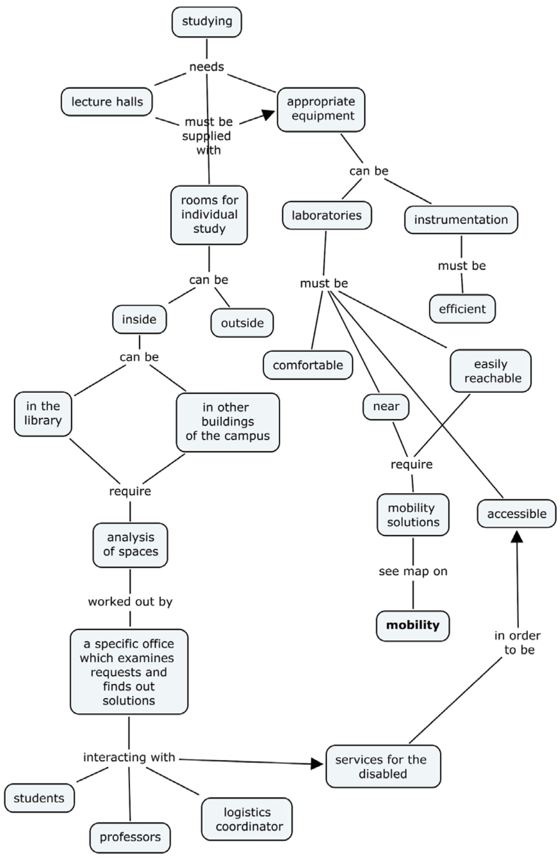

Figure 3. Concept map for studying

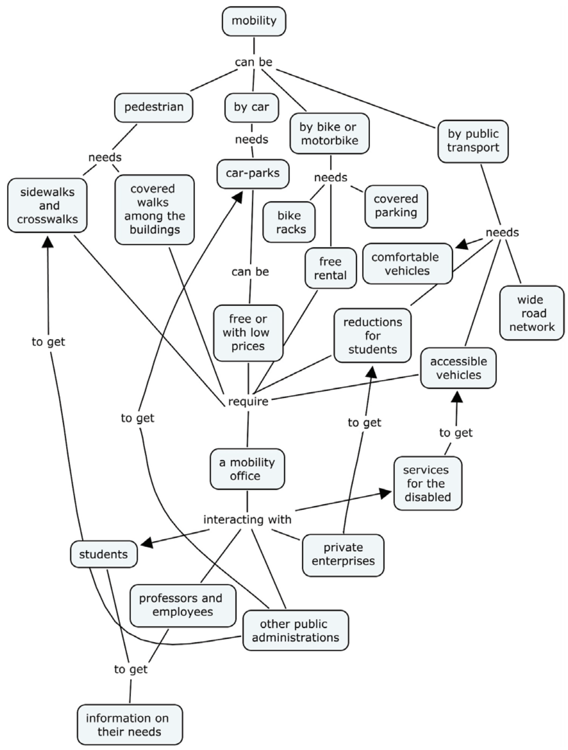

Figure 4. Concept map for mobility

From a theoretical viewpoint one significant achievement is that some conceptually developed topics, such as mobility and place connotation, have deep implications from the point of view of geography as well (especially cultural geography). This was, somehow, the starting point of the present work, as these topics are rooted in concepts such as territoriality, sustainability and place identity (Vallega, 2003; Uzzell, Pol & Badenas, 2002). So another important result of the study was its coherence, as it not only shifted the focus of the analysis to the field of knowledge structures, but it also added new information from the perspective of the discipline which originated it, in a sort of circular movement which made conclusions strengthen initial assumptions. From the perspective assumed by Kaplan (1973), it is relevant to mark that the students' work strongly reflected at least two of the four points pertaining to psychological processes, that is: “evaluation of what is good or bad” and “action relative to the environment”.

3 Summary

Mental maps and concept maps prove to be powerful tools for expressing and analyzing the needs of university stakeholders, such as students, through their participation in the process. While mental mapping turns out to be a more suitable method for describing needs in territorial and environmental contexts, with reference to the underlying cultural and social identity; concept mapping allows to deepen each single aspect of a problem or phenomenon, showing its inner and outer interconnections, due to its complex and broadening architecture. Best results appear to derive from a combination of the two methods which allow to exploit participating techniques so enhancing social cohesion, through the development of a deeper sense of community, and to improve decision making, planning and evaluation, through intra-organizational learning.

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PATAGONIA ARGENTINA: AN EDUCATIONAL EXPERIENCE APPLYING CMAPTOOLS, DEVELOPING A DIDACTIC RESOURCE AND ITS USE AS A TOOL FOR MEANINGFUL AND COLLABORATIVE LEARNING

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Abstract: The advantages of CmapTools software program, as a tool for developing a pedagogic resource to be used in the curricula of secondary school. This program used as a platform to present, in a clear and motivating way, the activities and different resources that will be used by the students in learning a curricular content. The use of CmapTools, by students, to do concept mapping for knowledge construction and their meaningful and collaborative learning. Finally the importance of concept mapping in secondary school for both teachers and students in the process of learning.

1 Introduction

The use of digital means, and particularly CmapTools -developed by the IHMC- aims at training students in the use of concepts, principles and skills for the analysis and design of information. It also tries to help the student to comprehend keys, paradigms and tendencies of digital culture and its impact in social and communicative behavior.

The project was developed during 2007 and applied in a public school, "Liceo N° 1 José Figueroa Alcorta", depending of the Government of the City of Buenos Aires, Argentina, with students of 4th year of secondary school (16 to 17 years), - with limited economic resources-. This project aims at: a) helping these students to access to technology, as, otherwise, it would be more difficult for them to do so for, as in most cases, they have no computers at home; and b) developing their creativity and innovation skills promoting a better inclusion in a highly technological world.

For several reasons, a special characteristic of students of this school is their rare commitment to study, which is evident in their low performance, small participation in class, difficulties in written and oral expression, and scarce association of ideas and meaningful thought. These factors have motivated the application of this tool, like a resource to improve their way of expression and learning from knowledge building in a meaningful way.

2 Project Synthesis

This project proposes the study, regionally and as a whole, of a unit of Geography of 4th year secondary school, which studies Patagonia Argentina in its physical, social and economic aspects (Ontoria, 1994). The students, using visual-learning tools, research on Patagonia. They prepare concept maps in CmapTools using the information searched in the Web and the interaction with Google Earth and Google Map for geographic location, for knowledge building and collaborative learning.

3 Project Development

CmapTools were used as a platform to develop this project, because this program offers public server and on-line application. In addition, this program provides the link with other resources such as Web links, Google Earth and Google Map thematic maps, Power Point and documents for the presentation of activities, or another concept maps; available in any computer connected to the web.

Finally, a Web page was created, containing all the information needed to carry out the research activities required, and, with the advantage that it can be used again in other classes or by other teachers.

The didactic resource in Figure 1 shows the topics to be developed, the final activity and the references of the resources to be used. Its address is:
http://cmapspublic3.ihmc.us/servlet/SBReadResourceServlet?rid=1208641111890_576463427_4847&partName=htmltext

This page is the result of the work Patagonia Argentina, done in CmapTools, and saved in the folder PA// IHMC Public Cmap (3).

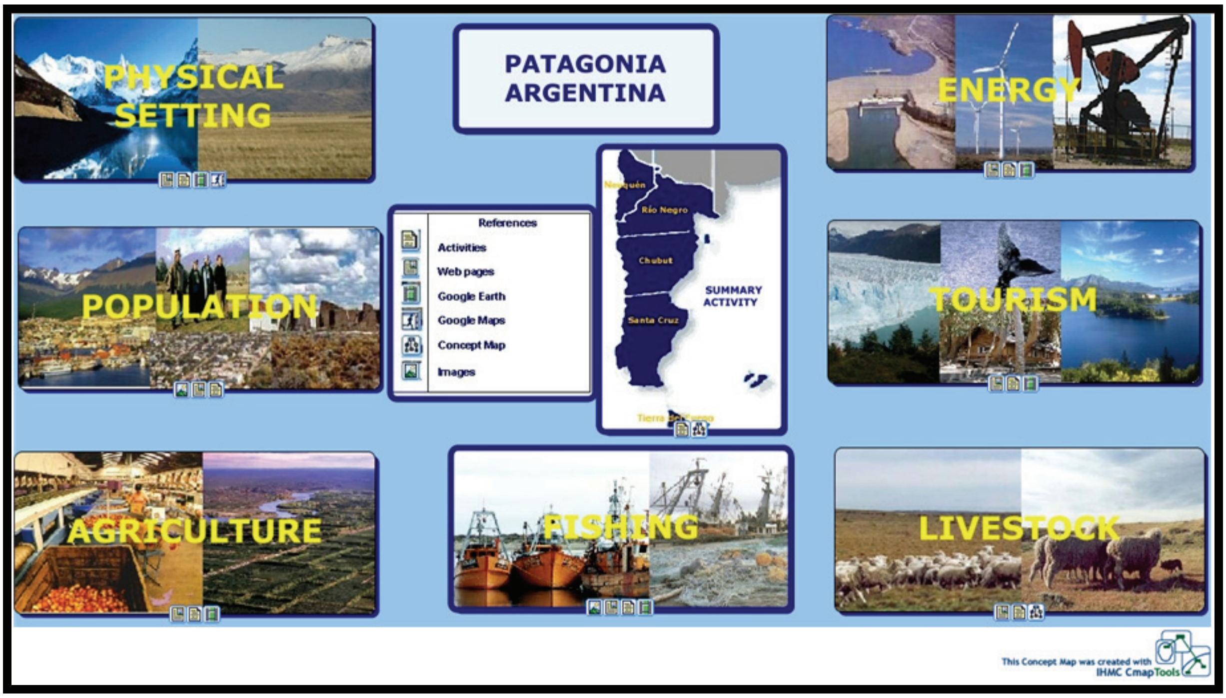


Figure 1

In order to encourage the student's meaningful learning, emphasis was made on the organization and selection of the information presented, taking into consideration, what the learners already know (Ausubel, 1968). To accomplish it the following activities took place: selection of reliable and valuable Web links, concept mapping to access to information, and, as final activity, elaboration of specific cartography on Google Earth and Google Maps.

In every sub item (physical setting, population, agriculture, etc.) students must do the activities prepared in concept maps using the resources proposed. In the final activity, the student must build a concept map in collaboration, and linking the resulting maps of every subtopic as dimensions or levels of the summary map. (Novak, 1998). In the summary activity a model of map, which allows the student to consider the whole structure of the region as a unit, is proposed.

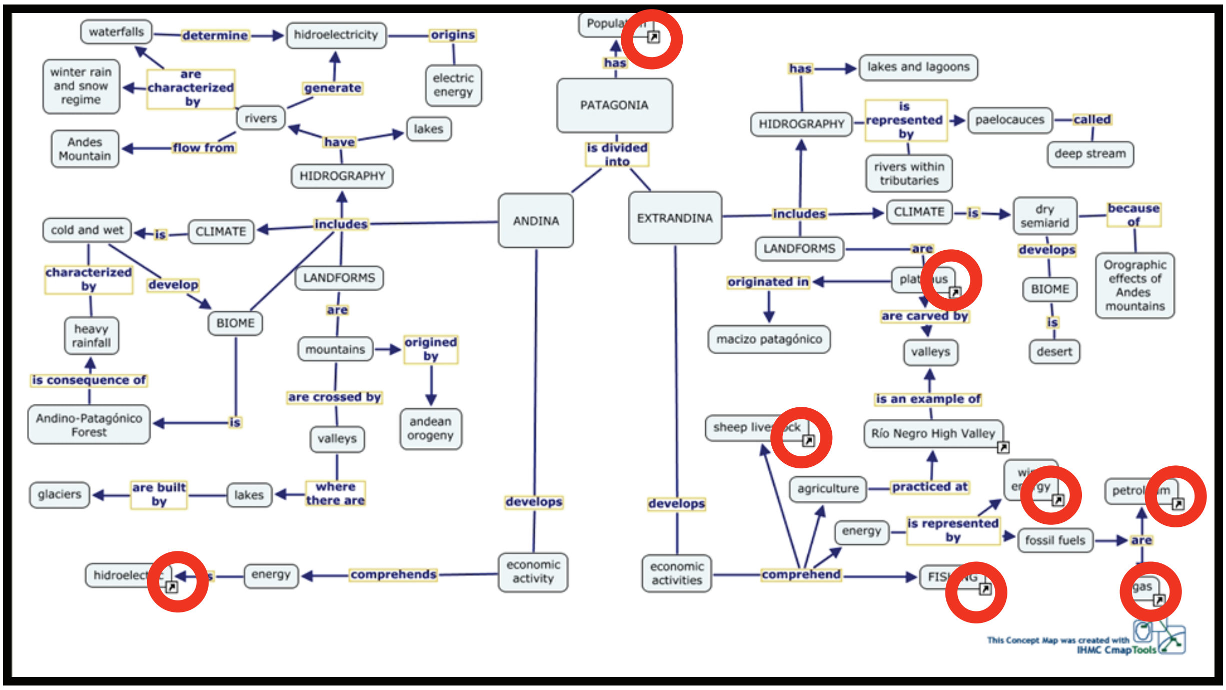
4 Experience implementation

The students prepared the concept maps on every subtopic to study about the region, following the proposed activities and the information obtained from the Web links, cartographic and concept maps. Although it was the first time the students were handling virtual tools for concept mapping, being CmapTools a very intuitive and friendly-use program, it was easy for the students to understand how to use the program, to do the work and to keep it in a folder of the Cmap Public Server.

After preparing their concept maps on every subtopic in groups –since in this school there is not a computer available for each student- using the same program, an activity of synchronous collaboration was made, all the groups together, elaborating a summary map.

As soon as a concept map on every subtopic (Population, Energy, Fishing, Agriculture and Livestock) was obtained, working in groups, those maps were linked, obtaining only one concept map built by the entire class (Figure 2), which could be found at:
http://cmapspublic3.ihmc.us/servlet/SBReadResourceServlet?rid=1208699945250_44012042_9090&partName=htmltext

In this way, significant knowledge was achieved, due to the important contribution of all pupils.



Picture 2 – Summary map. The shortcut arrows on the concepts bottom right corner are the links to the subtopic maps.

5 Advantages

5.1 For teachers

The use of free software programs, easy to download and with minimum hardware requirements, and compatible with the ubiquity characteristic of the Web 2.0, like CmapTools, become technological tools, all of them helping pedagogic projects. (Novak & Cañas, 2004). Likewise, the simplicity of its use, allows to develop didactic resources following the proper pedagogic needs, without the assistance of computer experts, and practically, without previous special technical knowledge. These characteristics demonstrate the possibility of re-usability of these resources in new situations, contexts, in addition to the possibility of being able to share them.

The application of a large range of resources inside the presentation -as Web links, simulations, images, videos, maps, etc- help the teacher to improve the process of education, bringing the student over to reality, especially in subjects where the image has an important role in the illustration, such as Geography.

The use of software programs for concept mapping also allows the teacher to observe how the student builds the knowledge (Novak & Gowin, 1988), his wise moves and errors, and to advise and orient him in this meaningful learning process.

Likewise, the methodology applied in this project, and specially, the use of concept maps, facilitates and promotes the interaction of the different disciplines (Morin, 1998), connecting concepts of concept maps developed in other subjects.

5.2 For students

With the application of concept maps students develop autonomy in the knowledge building, develop skills associated with reading and writing, by linking and hyper linking that favor constructive learning.

The students gain access to new computer tools from a content curricular, and acquire new efficient methodologies for the study. In the particular case of this experience, realized with students of more limited economic resources and with difficult access to technology, it is a way of preparing them for a better social inclusion in this highly technological world. Concept mapping with computer tools favor motivation, innovation, and creativity in students, being all of them important conditions for their future labor integration. (Barkley, 2005)

From my personal experience in teaching, I have verified that the students show major predisposition to study, to work in class, and achieve better performance, when they apply specialized computer tools in knowledge building. Those students, who in a traditional class are passive and indifferent, show a positive and proactive attitude towards work. I have also observed that concept mapping using CmapTools generates an additional motivation in students that feel they taking part in their knowledge building, having discovered their own wise moves and errors, and enabling them to remember much more what they learn.

Another additional advantage of the use of concept mapping, is that it avoids the mechanism of "copy and paste", since the student necessarily must elaborate the information. When concept maps are prepared it is essential to realize a good analysis of the information (Novak, 1998). This proposal makes the student more reflective, with capacity of analysis of information and discourages him to study by heart.

There is also a more active participation of the student, since, in addition to reading, he can write in the network. It also facilitates the interaction and creation of his proper productions, encouraging collaborative, cooperatively and open learning. The collaborative work promotes the socialization of learning and achieves a more improved and finished product favored by the interactions, negotiations and dialogues that cause the new knowledge. Students learn one of others, developing not only individual but group responsibility in learning.

1. Conclusions

After applying this project when teaching the Patagonian Region, I have verified that much more positive results can be achieved when concept mapping and innovative tools as CmapTools are used instead of traditional methods of education.

Sometimes, some students show their preference to traditional methods, since these demands less effort; nevertheless, the same students admit that they remembered much more what they had learnt and it was easier for them to integrate their knowledge using this methodology. Moreover, in future occasions they chose this tool for new activities.

The application of synchronous collaboration, proposed by the program, promotes a more active participation of students, since it facilitates dialogue and consensus, inside each group and among all groups, in the building of knowledge. It also improves the place of the teacher in his central roll in facilitating the learning process.

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PROPOSITIONAL ANALYSIS MODEL TO THE COMPARISON OF EXPERT TEACHERS' CONCEPT MAPS

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Abstract. This paper aims at going one step forward in the extraction of expert knowledge from good teachers. We present here a preliminary crosscutting analysis of 4 conceptual maps from 4 teachers. In order to do it we base in the Propositional Analysis Model (PAM) suggested by Campos and Gaspar (2005) in order to extract the joint conceptual core from the four cases. With this analysis we can move forward into the definition of good teaching key elements. This will allow us to establish good starting points in training junior teachers.

1 Introduction: Researching about expert teachers

Four years ago we started the Visibility Project: "Elicit and representation of university teacher's knowledge with good teaching practices: knowledge engineering to improve the quality of university teaching in the European convergence Framework".

The main objective of this project is to show good teaching practices in Higher Education. And to give guidelines for the training of junior teachers and to review the training practices for more senior teachers.

Six Spanish universities are involved in this Project; it is funded by the Spanish Minister of Education and Science through its R+D scheme. We have studied around 75 cases in different scientific areas. For more information on this Project please refer to Zabalza and Muradás. (This was a paper given in the previous Edition of this conference.)

2 Extraction and representation of expert knowledge from teachers with good teaching practices

We used semi-structured interviews in our project in order to extract knowledge, followed by the creation of conceptual maps to represent the teacher's knowledge.

We expected to obtain information on four big headings:
a) Their biography (in order to find out about the story of their lives and the different stages that they have gone through in order to reach their current stage).
b) Their teaching practices from the beginning of their careers till the present (how did they use to teach at the beginning of their career and how they teach now). We took into consideration a series of basic elements in the teaching practice.
c) Their ideas, opinions and satisfaction with their work and their results.

In this paper we will focus on the maps that we talk about in section b, and, more specifically on the ones that focus on the ways teachers plan their teaching.

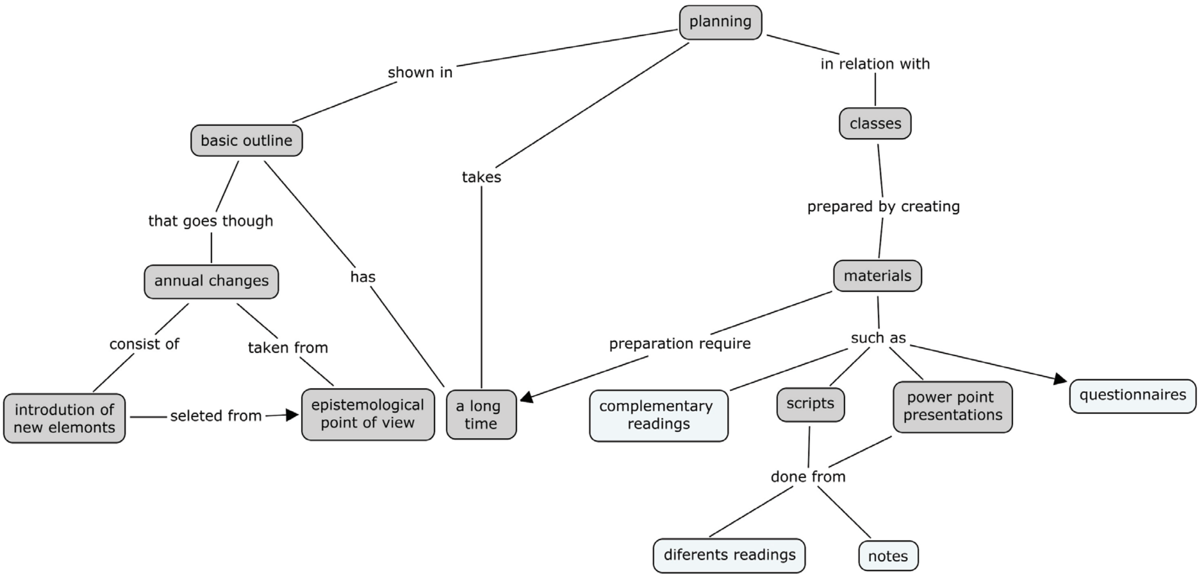
3 Comparison of conceptual maps: Propositional Analysis Model (PAM)

PAM according to its creators is: is a discourse analysis method that leads to the understanding of the logical-conceptual and epistemological structure of a given text. It can be used to study any type of text. (Campos and Gaspar, 1997, 2005)

Taking the text, it transforms it in propositions with the structure CRC (concept – relation – concept). This structure (called propositional map) it is the same as it is used in the creation of conceptual maps, that's why we think that both models are symmetric and it can complement each other.

We don't take PAM in its full extension. What we are really interested in finding out about is the similarities that exist between different teachers maps; this would allow us to understand the common elements that lecturers use.

We will start by creating what in the PAM is known as conceptual core, namely each one of the four maps that we will work with in the case (see MC 4-6).



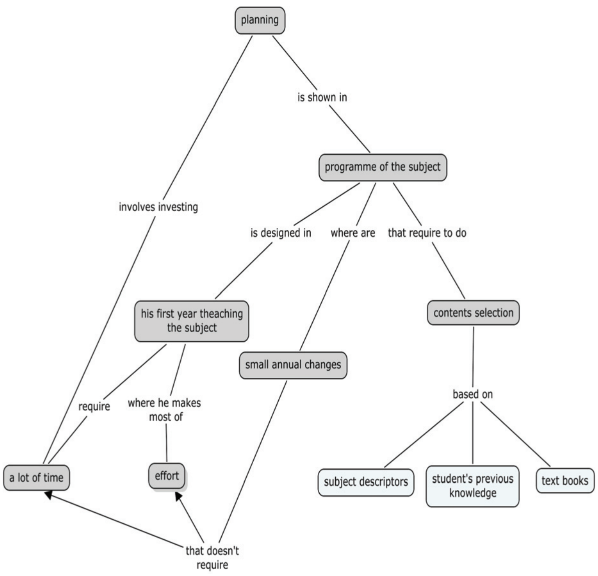
CM 4: IZC Conceptual Core

Next we will analyse the correspondence in three levels:

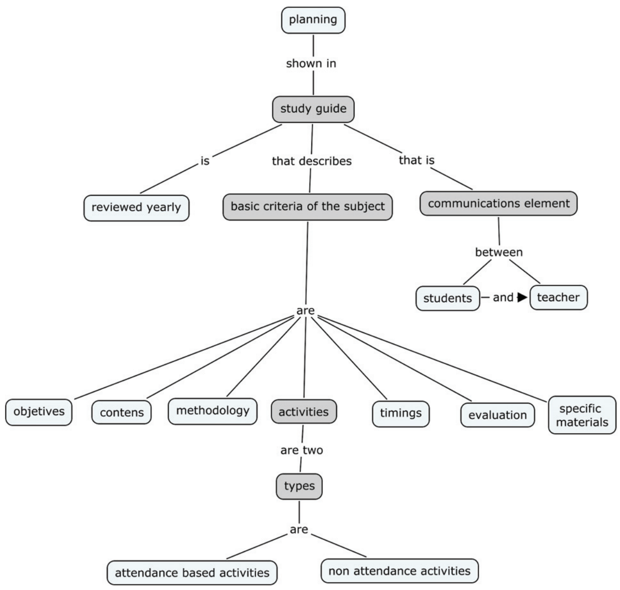
a) Conceptual correspondence: what Concepts appear repeatedly in the different maps.

b) Relational correspondence: to see if the links established by the concepts from section a) have any sort of correspondence.

c) Correspondence with the core: to identify the Concepts that correspond with each other within the core.



CM 5: DD Concept Core



CM 6: MTC Concept Core

In that way we can put together what would be the shared conceptual core of these teachers in relation to, in this case, the planning of their teaching.

3.1 *Conceptual correspondence*

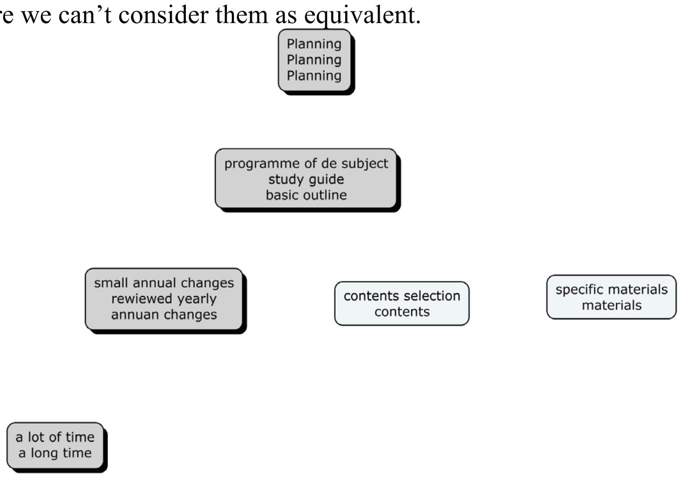
As you can see looking at the MC7 there is a correspondence in six concepts (three come up in the three cases and the other three come up in two of them). If we refer to the conceptual correspondence levels, we can say that:

It is the same (same word or expression is used) in two of the concepts (planning and a long time ago).

It is equivalent (it has got very strong semantic similarities) in three of the concepts (annual changes, contents and materials).

It is referential (it has a peak semantic similarity) in one of the Concepts: subject programme; basic outline; studies guide. These concepts can refer to a common element (the programme or subject guide) or to more different concepts.

We must add, that during the interview we didn't explore the significance that teachers gave to this concept, therefore we can't consider them as equivalent.



$$cc = \frac{3 + \frac{3}{3}}{14} = 0{,}285$$

CM 7: Conceptual Correspondence (all concepts) and Correspondence with the Core (grey concepts)

3.2 *Correspondence with the Core*

If we refer to the conceptual core (those Concepts that are part of more than one sentence) the correspondence increases to four concepts out of the 5-10 that exist in the different cases.

This indicates that they share a common conceptual organisation regarding the teaching Planning. This, as a result, identifies a product, the programme. And it considers it as a dynamic, annual cycle process that takes a lot of time for the teacher. $c = \frac{4}{7} = 0{,}571$

As you can see this gives us little information about how the teacher plans, which leads us to believe that:

1) Planning is an individual process with different meanings for each teacher.

2) The interview didn't explore this issue in depth.

3.3 *Relational Correspondence*

The links involved in the correspondence (MC10) are the following:

Identical: it is shown in (it appears in the three cases). This correspondence has more to do with the person who has done the map than with the expert.

Equivalent: These links are to do with the teacher and they literally appear in the interviews.

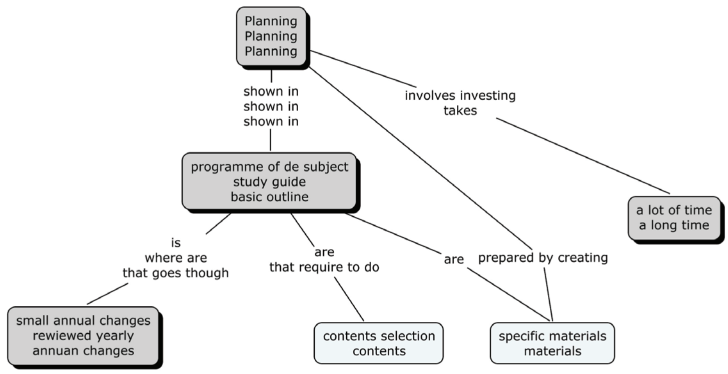
MTC	DD	IZC
is	Where are	That goes though
	Involves investing	takes

Referential:

MTC	DD	IZC
are	That require to do	
are		Prepared by creating

These links are only referential because they are part of different sentences. This confuses the comparison between links.

$$cr = \frac{2 + \frac{6}{3}}{6} = 0,666 \qquad q = (cc)(cr) = 0,285 \cdot 0,833 = 0,237 \; q_{corr} = q + c = 0,237 + 0,571 = 0,808$$



CM 8: Concept Map with Relational Correspondence

4 Summary

We can group the conclusions into two axes, the ones that refer to the expert knowledge that has been extracted, and the ones that refer more to the methodology.

The links that refer to the interviewed teachers' expert knowledge:

The conceptual core that has to do with planning is not very wide, between five and ten concepts. Which leads us to think that they are not able to articulate the cognitive process that they go through in order to plan their subjects?

The correspondence is narrowed down to superficial questions such as putting a programme together or to the perception of the time used. An important question such as the concept of change and revision is shown, although it is reduced to the annual cycles or academic courses. This takes flexibility out of their planning concept.

The planning process seems to be individual, and doesn't come from shared meanings, beyond the most institutionalised ones.

The links that refer to the methodology:

The PAM is an interesting tool regarding the conceptual correspondence and to the conceptual cores. But not so much regarding the relational correspondence, since we are not using a model as comparison criteria.

With this model we can, on one hand, extract the conceptual cores shared by the different experts in one area and, at the same time, to observe which things are left outside. These concepts are the ones that make that expert singular.

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SPONTANEOUS CONCEPT MAPPING AND ITS INFLUENCE ON KNOWLEDGE CONSOLIDATION IN GRADE 5

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Abstract. The present study deals with the implementation of concept mapping in grade 5 of German high school. Concept mapping was used as a means of knowledge consolidation. In order to check, if concept mapping positively affects a student's knowledge gain we compared two instructional treatments: a hands-on instruction with an additional concept mapping phase for knowledge consolidation and a hands-on instruction without a concept mapping phase. We implemented a knowledge test at three different times to assess students pre-knowledge, their short-term and long-term learning success. We also examined the "corrected complexity" of the cmaps on their effect on students' knowledge gain. In order to analyse which instructional type should precede a concept mapping phase we introduced as another treatment a teacher-centred instruction, followed by concept mapping. Our application of concept mapping positively affected a student's short-term learning success, but had no effect on his or her long-term learning success. We found a significant correlation between students' knowledge post-test scores and the "corrected complexity" of cmaps, but only if a hands-on instruction preceded the concept mapping phase.

1 Introduction

Concept mapping has often been used as an assessment technique of hands-on instructions (Novak, 1984; Rice, Ryan & Samson, 1998; Schaal, 2006; Yin, Vanides, Ruiz-Primo, Ayala & Shavelson, 2005). In our present study, concept mapping represents a hands-on knowledge consolidation method, helping our students to develop visual presentations of complex coherences and reflecting upon their newly acquired knowledge. It was used "spontaneously" (=the first time) in a 5th graders' natural science lesson after a (1) teacher-centred instruction and (2) a hands-on approach. In order to test whether concept mapping is an appropriate method for knowledge consolidation a third treatment was introduced: a hands-on instruction without concept mapping (treatment-3), Figure 1. For testing purpose, we compared treatment-2 with treatment-3. On the other hand, we compared treatment-1 with treatment-2, in order to test what kind of instruction should precede the concept mapping phase.

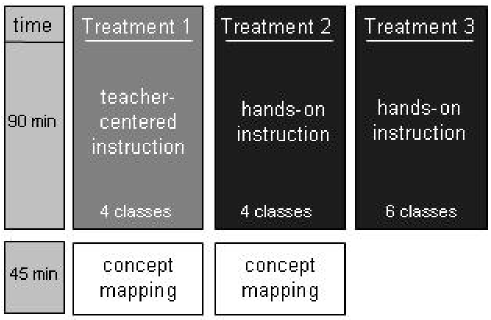

Figure 1. Treatment design and timeframe of the instructional period

2 Data collection

Altogether 397 5th graders from 16 natural science classes of German high school (highest stratification level [=Gymnasium] took part in our study. 162 of them participated in the actual concept mapping instructions, creating 81 concept maps in teamwork.

The concept mapping itself was mentioned as a knowledge consolidation phase after (1) a teacher-centred instruction and (2) a hands-on approach. Concept mapping was new to all of our pupils, and that is why we added a 10-minute introduction, before the actual cmapping phase started. Students had 35 min to complete their posters in teamwork. The specific subject was "water – basis of life". 31 pre-defined items were given to the students, but they were free to add new ones. The connections never were specified, our participants should find their own definitions. We created a knowledge test which consisted of 13 items, covering all discussed themes of the teacher-centred as well as of the hands-on approach. It was applied three times, one week before (K-1), immediately after the different treatments (K-2) and six weeks later (K-3), in order to test student's pre-knowledge, his or her short-term learning success and his or her long-term learning success, see Figure 2.

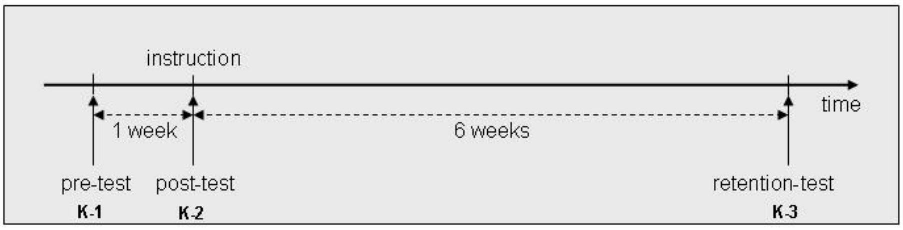

Figure 2. Knowledge-test design: Schedule of knowledge-test implementation (K-1, K-2, K-3)

3 Analysis

For every student, a pre-, post- and retention-test sum-score of all correct answers was calculated and analyzed to assess students' cognitive achievement. If students answered all items accurately they gained a maximum sum-score of 13 points per test. Consequently, every student's increase in knowledge, retention rate and decrease rate as well was recorded by calculating differential variables in the following way: increase in knowledge (K-2 minus K-1); retention rate (K-3 minus K-1); decrease rate (K-3 minus K-2). To test whether the concept mapping phase positively affects students' cognitive achievement and therefore presents an appropriate method for knowledge consolidation we compared the differential variables of treatment-2 with that of treatment-3.

Furthermore, we were interested in the level of concept maps' complexity in order to check whether the complexity correlates with students' cognitive achievement measured in the knowledge test. We defined complexity as the amount of connections which were autonomously made by the students within each concept map. Because students made a lot of different errors by connecting the pre-defined items we only got an "incorrect" complexity, containing methodical as well as content errors. For receiving the "corrected" complexity we had to exclude wrong connections, concerning the content. Therefore, we categorized the individual errors in error types. We defined six different error types and three possible reasons for errors, Table 1.

Table 1. Error type categories and possible reason for wrong connections

error types	description of error type	example for error type	possible reason for error
1	no connection – direction of arrow indicated	water → liquid	method and content not apprehended
2	no connection – no direction of arrow	water ↔ liquid water — liquid	
3	wrong connection – no direction of arrow	water ⇔ *cannot be* liquid	
4	right connection – no direction of arrow	water ↔ *can be* liquid water — *can be* liquid	method not apprehended
5	right connection – wrong direction of arrow	water ← *can be* liquid	
6	wrong connection – direction of arrow indicated	water → *cannot be* liquid	content not apprehended

10 % of the already analysed CMaps were selected randomly and analysed again by the same corrector three weeks after the first analysis in order to test objectivity of the error type categorisation. A second person was instructed into the error category system and analysed the same randomly picked 10 % of CMaps again. We calculated the Cohen's Kappa (κ) coefficient and hence gained two scores, describing the level for intra-observer and inter-observer coincidence which is an indicator for the objectivity degree (Zöfel, 2002). Both the Cohen's Kappa-score for intra-observer objectivity and inter-observer objectivity was very high (intra-observer:

κ = 0.97; inter-observer: κ = 0.95). Wolf (1997) defines Kappa-scores between 0.41 and 0.60 as “moderate”, between 0.61 and 0.80 as “substantial” and > 0.80 as “almost perfect”. So objectivity of error type categorization was ensured and we were able to calculate the “corrected complexity” and to correlate the corrected complexity values with the sum-scores of the knowledge post- and retention-test.

4 Results

Inter-group analysis of knowledge pre-test showed no significantly differences in students’ pre-knowledge between the three different treatments (Kruskal-Wallis test, chi-square = 4.270, $df = 3$, $p = .234$). Therefore, students’ knowledge scores of all treatments were comparable to another. Our results revealed that the increase in knowledge was significantly higher in the hands-on approach with additional concept mapping phase compared to the hands-on instruction without a concept mapping (Mann-Whitney U-test, $Z = -2.610$, $p = .009$), Figure 3. Unfortunately, students of the hands-on plus concept mapping phase forgot more of their newly acquired knowledge than these students who perceived no additional concept mapping (Mann-Whitney U-test, $Z = -2.701$, $p = .007$), Figure 3. Therefore, no significant differences in retention rates between treatment-2 and treatment-3 were recorded.

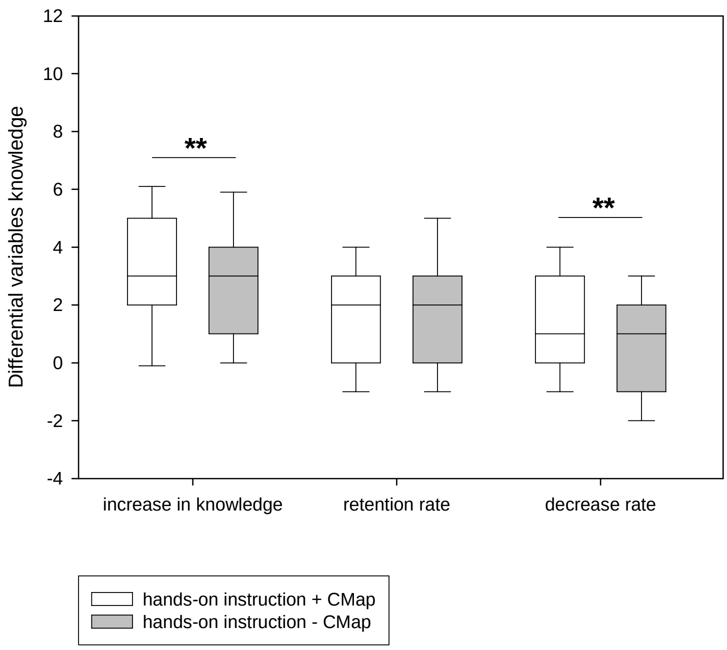

Figure 3. Between-group comparison of differential knowledge variables of treatment-2 (hands-on with concept mapping) and treatment-3 (hands-on without concept mapping); (* $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$)

We detected a positive correlation between the corrected complexity and the knowledge post-test scores in the hands-on approach (treatment-2) (Spearman: $r = 0.307$; $p = 0.01$), but not in treatment-1 (teacher-centred with concept mapping approach).

5 Summary

The analysis of retention rates revealed that the spontaneous concept mapping didn’t show an effect on long-term knowledge gain but enhanced students’ increase in knowledge. Although this method was totally new to all of our 5^{th} graders, concept mapping had a positive effect on knowledge achievement, even the first time it was introduced. The examination of the corrected complexity supports this positive learning effect of concept mapping. The more connections the students made in their concept maps the better they performed in the knowledge post-test. This correlation did not exist in the teacher-centred group. These results imply that concept mapping is an appropriate method for knowledge consolidation, but only associated with a precedent hands-on approach.

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STUDY OF CONCEPT MAPS USAGE EFFECT ON MEANINGFUL LEARNING FRONTIER IN BLOOM'S TAXONOMY FOR ATOMIC STRUCTURE MENTAL CONCEPTS

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Abstract. Ever since it was introduced by Joseph D. Novak, 'concept map' has continued to inspire a wide range of research. Concern with different aspects of this notion continues to stimulate an expanding body of literature, thereby adding new dimensions to the applicability of this framework to different aspects of teaching. The idea of applying this notion, as an originally first one of the kind, grew out of attempts to introduce a new creative method for teaching chemistry. The primary focus was on mental concepts in atomic structures contained in the chemistry textbook for second-grade Iranian high school students. Concept map and concept mapping are the two phenomena that are held to be dominantly involved in learning these structures. Therefore, the study addressed the effect of concept map usage on developing meaningful learning. Results indicated that significant differences between the scores of students who received concept mapping type instruction as opposed to those who didn't. Differences were also observed across genders. We examined meaningful learning frontier in the bloom's taxonomy with designing of the test's questions based on the bloom's taxonomy. Findings from test items based on Bloom's taxonomy suggested that meaningful learning frontier occurs from the application level above in the taxonomy. Implications of this study are expected to contribute to active learning process on the learner's part and pave the way for joint contributions from other fields, broader studies, and more enlightening results.

1 Introduction

Based on the Ausubel meaningful learning theory (Ausubel, 1960) Prof. Joseph D. Novak at Cornell University presented concept map as an instructional technique in the 1980's (Coffey et. al., 2003). According to Novak (1982), concept maps are tools for organizing and representing knowledge (Novak, 2004). Thence the use of concept maps has expanded rapidly since their introduction in the 1970's by Dr. Joseph Novak (Novak and Gowin 1984). Concept maps are two-dimensional, visual representations of the relationships between concepts representing individual knowledge, collaborative group consensus, and corporate memories (Cañas, Hill et al. 2004; Coffey, Eskridge et al. 2004).

From the beginning of genesis of concept map idea up to now, many researcher have been performed about efficacy of using this idea as an active education strategy, so that up to the present time, different dimensions of its use have been revealed.

Unfortunately, no step had been taken to use this educational strategy in the education system of us country before doing the research. For this reason, we decided to express dimensions of concept maps and the efficacy of its usage in increasing the educational achievement grades of students in an applied research, and also draw in sciences education; meantime, we are going to detect the new dimensions of its use.

For this reason, in one applied research with semi-empirical method by designing an operational teaching model on the basis of concept map, we have examined the efficacy of using this idea in learning the abstract concepts the atom structure unite for the first time in Iran.

2 Theoretical Framework

Our group Theoretical Framework based on this question that:" can the usage of concept map in teaching-learning process be effective for accessing learners to bloom's taxonomy levels and determine a definite frontier between these levels? (high order thinking skill). One way to describes high order thinking skill is using Bloom's taxonomy, the well known instructional model developed by Benjamin Bloom.

In 1956, Benjamin Bloom (Bloom, 1956) headed a group of educational psychologists who developed a classification of levels of intellectual behavior important in learning. Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation. It categorizes thinking skills from the concrete to the abstract—knowledge, comprehension, application, analysis, synthesis, evaluation. The ones considered higher-order skills are analysis, synthesis, and evaluation.

3 Methodology

The present research was performed in ninety-minute sessions based upon the design of concept map in classes of experiment group. The methodology was similar in each four classes and teachers used the concept map as an advance organizer before teaching on the basis of one similar model, and they expressed concepts and relationship between them while designing different questions. In next stage, the course was presented in form of simultaneous use of concept map and teaching. At the end teaching the concept maps presented were summarized and integrated for learners by the use of concept map. Finally, the students were asked to present the lesson by choosing a number of concepts from presented lesson that they draw the concept map of these concepts individually. Yet, they could complete their work by using the software Inspiration8 at home and discuss about it with teacher and their friends in determined groups by web. In order to practice a collaborative concept mapping, in this manner, they made the framework of their mind themselves. After finishing the session of research performance the skill of experiment groups students in concept mapping had increased significantly compared to the beginning of research in such a way that they expressed to use this method in order to learn the concepts of their own lessons and also suggested their friends using it (see in bottom figures)

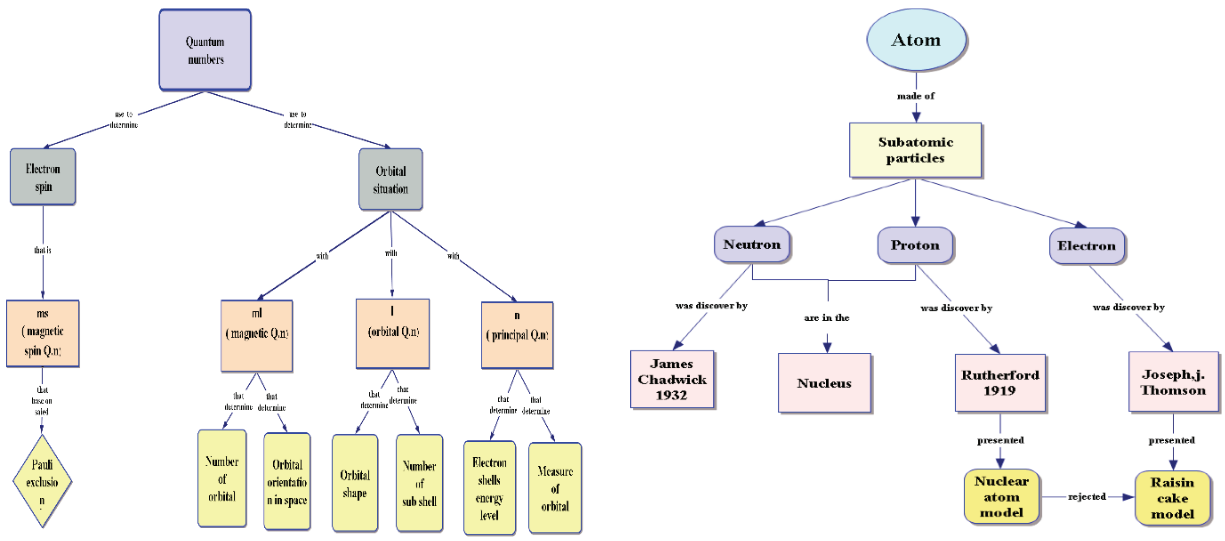

Figure 1.concept maps was provision by experiment group

4 Evaluation tools

The pre- Test and post- Test with similar question were used. They are designed according bloom's taxonomy levels. Samples of these questions are presented in table 1.

Sample of experiment group Questions	Level of bloom taxonomy
1. from which area possibility of electron are more than other area? a) The level of energy b) Orbital c) The electron's layer d) The electron sublayer	knowledge
2. The **nd** sublayer with…….electrons and the **np** sublayer with ……electrons are fulled? a)10-6 b) 6-10 c) 6-6 d) 10-10	comprehension
3. The pauli exclusion's principle according to which quantum's numbers are state? a) m_l b) L c) m_s d) n	analysis
4. which of the below sets are belonged to specified electron in the following orbital which are placed in the second sublayer? n=2, L=2, m_s=-1/2 b) n=3,L=1,m_s=+1/2 b) n=2, L=1,m_s=+1/2 d) n=3, L=2, m_s=-1/2 p_x p_y p_z	synthesis
5. The **magnetic's quantum's number** for a electron is **+1** ,so which of the following case is possible for this electron? a) n=1 b) m_s=-1/2 c) Exist in **p** layer d) L=3	evaluation
6. the **p** sublayer has ……….the same level of orbital energy,that are different in their quantities………. a) 5- m_l b) 3- L c) 5 – L d) 3- m_l	application

Table 1. Sample of experiment group Questions

5 Results and discussion

According our results, the efficacy of using concept maps to increase the achievement test grades of students in experiment groups compared to control groups are observed. In order to, the independent T test method was used (table 2).

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
POS_PER	Equal variances assumed	4.595	.034	-5.008	163	0.000	-2.61	0.52	-3.63	-1.58
	Equal variances not assumed			-5.054	160.151	0.000	-2.61	0.52	-3.62	-1.59

Table 2. Independent T test of the means of grades of difference the post-Test from pre-Test

The obtained results are intended to verification of first question of research. However , In order to study of the second question (main question of research) that ”have the students under the concept maps plans been more successful for access to high bloom's taxonomy levels compared to students of control groups? ”. Descriptive statistics of levels means have been presented in table 3. The results of independent T test have also been presented in table 4.

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
Knowledeg	control	87	7.03	.86	9.17E-02
	experiment	82	7.00	.89	9.82E-02
Comprehension	control	87	2.37	.68	7.33E-02
	experiment	82	2.52	.65	7.20E-02
Application	control	87	2.30	.72	7.69E-02
	experiment	82	2.43	.67	7.37E-02
Analysis	control	87	2.21	.82	8.83E-02
	experiment	82	2.60	.65	7.13E-02
Synthesis	control	87	.59	.50	5.31E-02
	experiment	82	.83	.38	4.18E-02
Evaluation	control	87	.90	.75	8.02E-02
	experiment	82	1.71	.58	6.37E-02

Table 3. Descriptive statistics of degree of student's access to bloom levels

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower	95% Confidence Interval of the Difference: Upper
Knowledeg	Equal variances assumed	1.506	.221	.257	167	.797	3.45E-02	.13	-.23	.30
	Equal variances not assumed			.257	165.408	.798	3.45E-02	.13	-.23	.30
Comprehension	Equal variances assumed	.443	.507	-1.521	167	.130	-.16	.10	-.36	4.66E-02
	Equal variances not assumed			-1.523	166.976	.130	-.16	.10	-.36	4.63E-02
Application	Equal variances assumed	.327	.568	-1.199	167	.232	-.13	.11	-.34	8.27E-02
	Equal variances not assumed			-1.202	166.974	.231	-.13	.11	-.34	8.23E-02
Analysis	Equal variances assumed	3.982	.048	-3.420	167	.001	-.39	.11	-.62	-.17
	Equal variances not assumed			-3.444	161.706	.001	-.39	.11	-.61	-.17
Synthesis	Equal variances assumed	50.788	.000	-3.568	167	.000	-.24	6.81E-02	-.38	-.11
	Equal variances not assumed			-3.596	160.269	.000	-.24	6.76E-02	-.38	-.11
Evaluation	Equal variances assumed	5.638	.019	-7.858	167	.000	-.81	.10	-1.01	-.61
	Equal variances not assumed			-7.918	160.851	.000	-.81	.10	-1.01	-.61

Table 4. Independent T test of means of student's access to bloom levels.

As seen in table 4, a meaningful difference is not observed between knowledge, understanding and application levels in control and experiment groups but a meaningful difference is observed in three high levels of bloom's taxonomy, which are analysis, synthesis and evaluation. Thus it can be judged about the frontier between levels.

6 Conclusion

The study of results obtained from the present research showed that the use of concept maps and concept mapping in learning-teaching process causes the increase in the grades of student's achievement test compared to other passive and conventional methods. It also causes the students of experiment groups are more successful than other students under conventional curriculum for the access to high levels of bloom's taxonomy (analysis, synthesis and evaluation). So that the meaningful difference is observed between three low levels and three high levels of bloom's taxonomy and there is a definite frontier between them which confirm students access of experiment groups to meaningful learning intended by the learning psychology of David Ausubel.

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

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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.

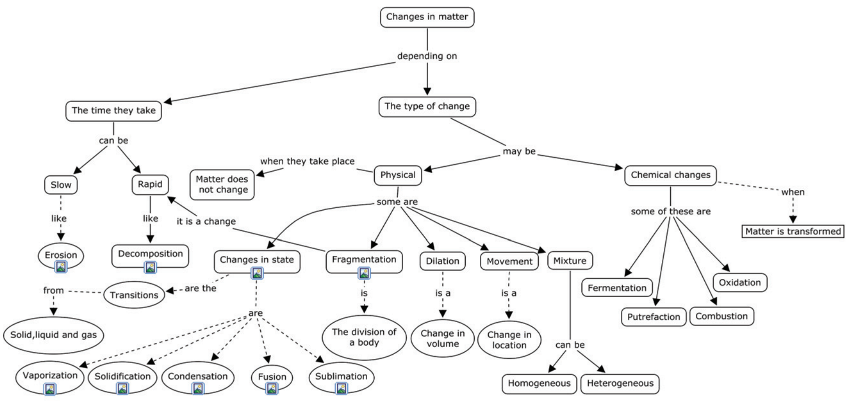

Figure 1. Concept map created by group A

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).

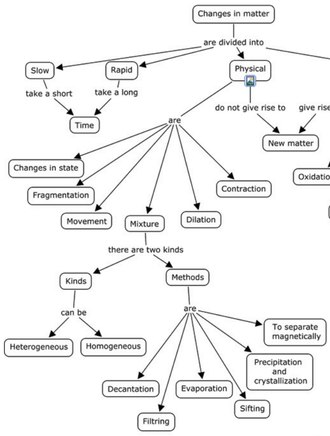

Figure 2. Concept map created by group B

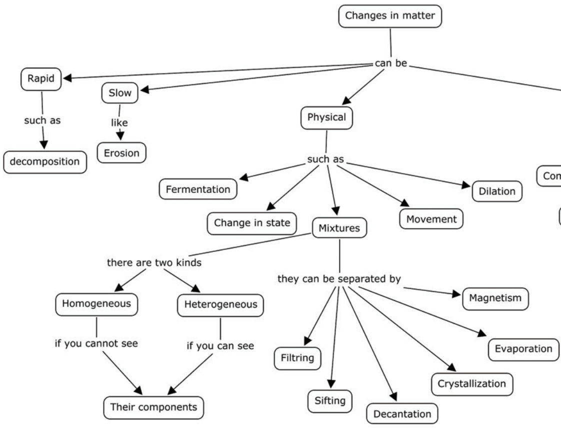

Figure 3. Concept map created by group C

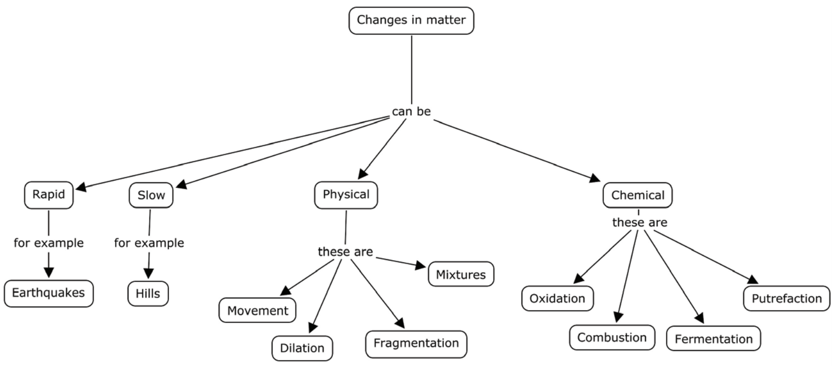

Figure 4. Concept map creado by group E

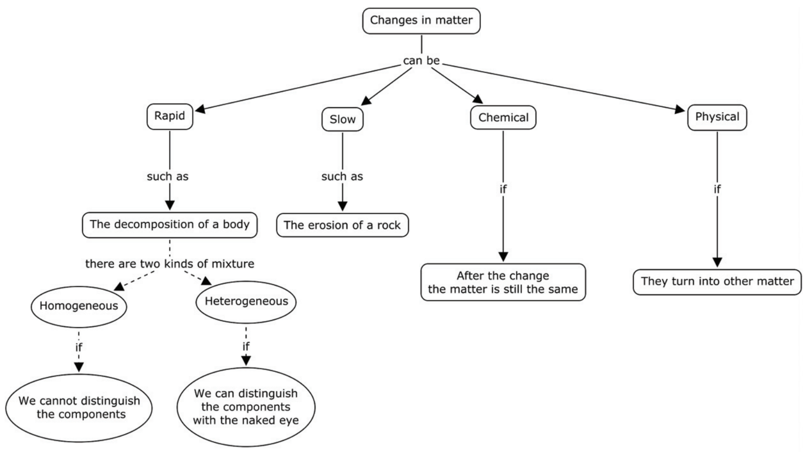

Figure 5. Concept map created by group F

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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THE CONSTRUCTION OF CONCEPT MAPS BY 10- AND 13-YEAR-OLDS IN GRAMMAR LESSONS

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Abstract: This study reports the results of a developmental training program that used concept maps in Hungarian grammar lessons, focusing on the effects regarding learning habits. Following a pre-test, subjects in the experimental group worked on a series of concept mapping exercises, while no such intervention occurred in the control group. All subjects were then administered a post-test in grammar and a questionnaire on their learning habits. The results show that students in the experimental group performed better on the post-test. They did not report a more frequent use of meaningful learning strategies, although they acknowledged their importance in learning.

1 Theoretical background

The teaching of learning strategies and techniques is very important in order to make the structuring and organizing of knowledge easier for learners. Memorisation and rote learning are the most often used learning strategies by Hungarian students (Artelt, Baumert, Julius-McElvany and Peschar 2003; B. Németh and Habók, 2006). Instead of these, the strategies of meaningful learning should be brought to the foreground. Informed by Ausubel's work (1968), Novak (1998, 1984) developed concept mapping, a method supporting meaningful learning. According to Ausubel's theory, meaningful learning takes place when new pieces of information are integrated with prior knowledge. Without this, they remain isolated elements in the cognitive structure, difficult to access. Students generally want to learn as quick as they can. In case they do not understand the learning material, they tend to choose a method less time-consuming than elaborating on details. They opt for rote learning, which, however, does not yield deep knowledge they could recall and apply more permanently. Techniques such as concept mapping can foster learning processes, but their acquisition also takes a long time.

Concept maps express meaningful relationships between concepts in the form of propositions. Propositions are two or more concept labels connected by linking words in a semantic unit. Propositions are the simplest constructions in the map. Linking words explain the connection between the labelled links. The concept labels and linking words can be concepts or main ideas. Concept maps comprise a net of propositions. In our research, concept maps are structured hierarchically, usually from the general to the specific.

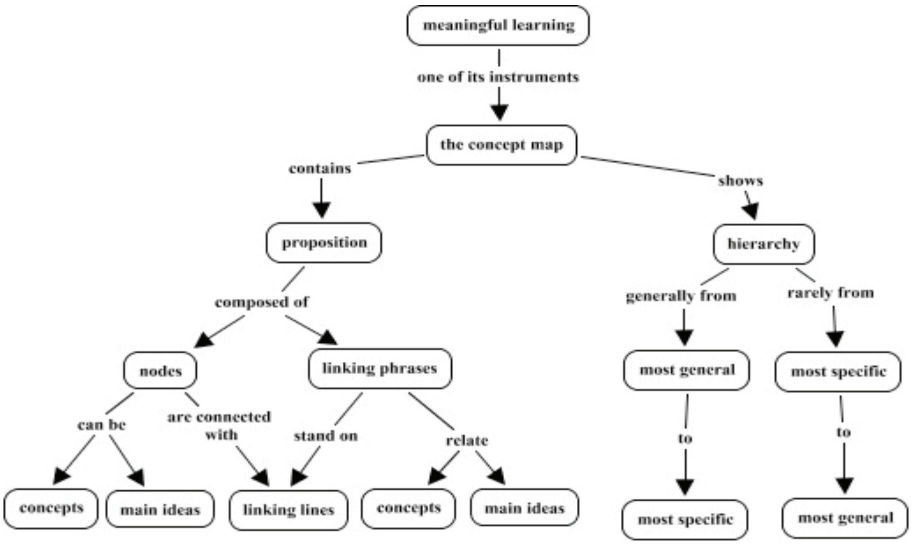


Figure 1. The elements and hierarchy of the concept map

Concept maps can be used in different contexts, for making plans, planning papers, outlining processes or extracting main ideas. They are an instrument for researching prior knowledge (Gurlitt, Renkl, Faulhaber and Fischer, 2007), exploring learning from texts (Hauser, Nückles and Renkl, 2006) or studying the comprehension of texts that students have to understand and learn. Concept maps are subjects of inquiry in different academic fields, e.g. biology (Kinchin, 2001) and chemistry (Branst, 2001). The research presented here focuses on grammar.

2 Aims and research questions

The main objectives were to examine what effect concept mapping has (1) on the process of learning, and (2), on subjects' knowledge of Hungarian grammar and learning habits. We expected improvement in a) text processing; b) finding the relationships within a text; c) locating the main concepts in a text; d) writing summaries and drawing diagrams; e) using a learning technique that they can also apply in other subjects; and f) using meaningful learning strategies instead of rote learning. That is, the developmental programme was designed to facilitate more a efficient understanding of sentences and texts.

3 Methods

3.1 Participants

Participants were 4th and 7th grade pupils. The experimental group consisted of three 4th grade classes (10-year-olds, n=65) and three 7th grade classes (13-year-olds, n=73), from three schools in Szeged, Hungary (two downtown, and one in the outskirts). The control group was selected from three schools from other Hungarian towns, with three classes per age group (10-year-olds, n=72; 13-year-olds, n=59) included in the study. Students were assigned randomly to either the experimental group or the control group.

3.2 Instruments and procedures

The developmental training programme in Hungarian grammar consisted of 25 sessions in the 4th grade and 31 sessions in the 7th. Grammar was targeted because this is among the least preferred subjects of Hungarian pupils (Csapó, 2004). Learning materials were developed for both grades, conforming to National curriculum (N. C.) requirements. The students worked on exercises during the Hungarian grammar lessons; one per lesson. Each exercise required five to ten minutes to complete. Each student had their own workbook with the exercises. First the students read the text of the given exercise alone, then, based on instructions given in the prompts in the workbook, they drew a concept map alone. Feedback was given when all students finished the exercise. The task types included: (1) completing a map by filling in the nodes and defining the linking words, and (2) constructing a map from scratch.

The spelling of the verbs in the imperative

We pronounce and spell the verbs in the imperative in different ways. When a verb ends in the imperative in d or gy, it is pronounced**, ggy** or **gy**, but it is spelled **-dj** or **-gyj**.

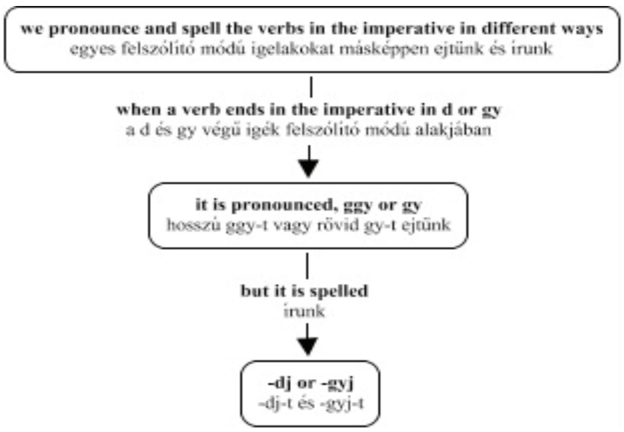
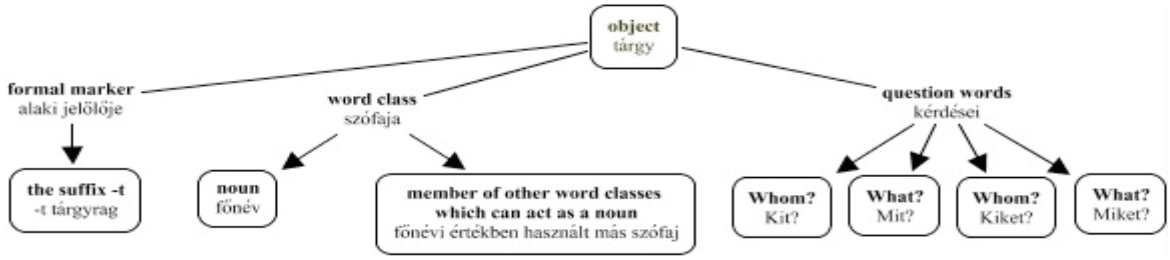


Figure 2. Sample task for 4th graders: Completing a map by filling in the nodes

The object

The suffix -t is the formal marker of the object in the sentence. As regards word class, an object in a sentence can generally be a noun or a member of other word classes which can act as a noun. Question words: whom? what?



3.2.1.1.1.1.1.1 Figure 3. *Sample task for 7th graders:* Constructing a map

4th and 7th graders were administered different tests. The pre-test was based on the subjects' previous knowledge, in accordance with N. C requirements. After the testing, the experimental group worked on a series of concept mapping tasks, while the control group was taught with traditional methodology. The post-test targeted new knowledge acquired after the pre-test.

3.3 Feedback for the students

The teachers' workbook included the completed maps as well, serving as expert maps, unified starting-points for all teachers. The students were presented the correct map after having completed their own. Each exercise was followed by feedback in different forms. (1) The teacher and the students discussed the solutions of the mapping task; the students could not consult their own maps. (2) The teacher and the students discussed the solution without the consulting the workbooks. (3) There was no feedback. – The teacher did not give instructions and help until the exercise at hand was completed. Having solved their task, the students could discuss it with the teacher and clarify any unclear details.

4 Results

4.1 Tests

On the grammar pre-test, there were no significant differences between the performances of 4th grade experimental and the control classes. However, differences could be found between the experimental and control classes among the 4th graders; the experimental groups performed better. We found significant differences between the Hungarian grammar pre-test and post-test in the experimental 4th grade classes, however, there were no significant differences between the control classes. Regarding the 7th graders, the experimental classes performed on the test the most successfully. Significant differences could not be detected between the pre-test and the post-test between the experimental and the control groups. It can be concluded that students with significantly poor pre-test results showed substantially higher achievements in both age groups after taking part in our concept mapping programme. This applies to both groups.

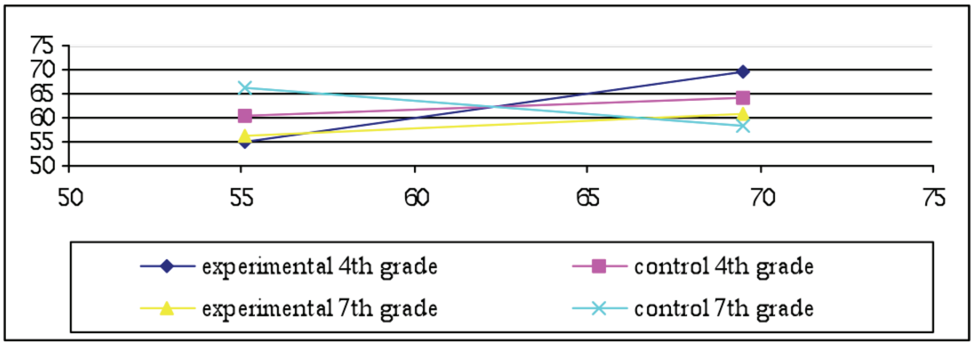


Figure 4. Pre-test and post-test performances in Hungarian grammar (%p)

4.2 Concept mapping exercises

The results of the concept-mapping program showed no significant differences between the 4th grade classes. In the 7th grade classes, the 2nd group achieved lower results, and the individual differences between the students were greater. The two task types showed significant differences: completing a map by filling in the nodes and defining the linking words proved to be easier. An explanation may be that this needs only surface understanding, while the construction of maps requires organization.

We investigated students' learning habits (12 items), targeting learning activities, memorization, concept map construction, summarizing. There are significant differences between the 4th and 7th classes concerning learning activities. The control group reported locating the most important concepts from a text, underlining the main concepts and taking notes significantly more often. However, no significant differences were found between the experimental and control groups as regards constructing concept maps and figures after the training program. Further research in this direction is necessary. The goal of our programme was to make students adopt a conscious use of learning strategies and techniques which promote meaningful learning as opposed to rote learning.

5 Conclusions

We carried out our research on concept mapping and its relation to grammar lessons in three primary schools. Our findings showed that concept mapping exercises are useful educational tools that clearly help to improve the efficiency of the researched subject.

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THE EFFECT OF DIFFERENT CONCEPT-MAPPING TECHNIQUES ON PROMOTING STUDENTS' LEARNING PROCESSES IN THE FIELD OF BUSINESS

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Abstract. This study reports about the effects of three concept-mapping techniques on promoting students' learning processes in the field of business sciences: expert map, fill-in-the-map and construct-a-map. The three techniques were used complementary to a management game and they differ in the degree of self-construction. Twenty-six ninth-grade students at a public high school took part in the study. The students were assigned to one of four groups: a control group and three concept-mapping groups (experimental groups). In order to measure the learning outcome, students of all groups were required to answer a knowledge test before and after the intervention. An increase in knowledge over time could be identified, but the groups did not differ significantly. However, interesting tendencies were identified: The groups who worked with fill-in-the-map and construct-a-map were superior to the expert map group. The expert map group showed the lowest increase in knowledge. Thus, one can assume that the requirement for self-construction (e. g. fill-in-the-map or construct-a-map) fosters learning better than working with pre-constructed maps (e. g. expert map). Furthermore, the control group, which did not use any of the mapping techniques as a complement to the management game, performed very well. Possibly, the management game itself fosters knowledge development so significantly that the effect of the mapping techniques is confounded. In light of these findings further research on the conditions under which it is useful to combine mapping techniques with complex tasks like management games is necessary.

1 Introduction

In the last decades concept-mapping techniques (Novak & Gowin, 1984) have often been used in order to support students' learning processes. Concept-mapping techniques are based on the assumption that knowledge has the structure of a semantic network (e. g. Collins & Quillian, 1969), and therefore concept-mapping helps students on the one hand to externalize and on the other hand to construct and elaborate their cognitive structure. Many research studies have been carried out with the aim of investigating concept maps as learning aids in science education (Nesbit & Adesope, 2006; O'Donnell, Dansereau & Hall, 2002). When concept-mapping is used in pedagogical contexts, the degree of pre-structuring can be varied. Learners are either required to construct the maps entirely by themselves (construct-a-map), to complete partly pre-constructed maps (fill-in-the-map) or to use completely pre-constructed maps (expert map). In a meta-analysis Nesbit and Adesope (2006) showed the advantage of construct-a-map over expert map. To date only little research has been done on the fill-in-the-map technique as a learning aid. One study conducted by Hardy and Stadelhofer (2006) shows that fill-in-the map supports the understanding of science contents better than construct-a-map. Since there are only few and diverse findings with regard to the fill-in-the-map technique, it is not possible to draw a general conclusion as to which concept-mapping technique is the most appropriate to support learning processes. Moreover, most studies focus on the well-structured domain of science, whereas research in the domain of business, which in many cases is more complex and abstract, has not yet been taken into account.

Thus, the aim of our study was to investigate the effects of three different concept-mapping techniques on promoting students' learning processes in the field of business sciences. The concept-mapping techniques were used complementary to the management game "Easy Business™". The study is part of a cooperation between the Technische Universität Dresden, the Robert Bosch Limited Liability Company and a public high school.

2 Research Methodology

2.1 Aim and Sample

The following research question guided our study: Which concept-mapping technique is the most effective for promoting students' learning processes in the field of business sciences?

Twenty-six ninth-grade students at a public high school located near Dresden took part in our study during the school year 2007/2008.

2.2 Design

The students played the management game "Easy Business™" in groups. The individual phases of the management game were complemented by classroom instruction. After finishing the management game, the class was divided into three different experimental groups and a control group. The respective concept-mapping technique was introduced to the experimental groups in order to support the students in consolidating the newly acquired knowledge. Assistance was provided when problems using the techniques arose. The control group did not learn any of the concept-mapping techniques. Before and after the treatment (management game +/- concept-mapping technique) a knowledge test was provided in the parallel forms A and B to all students (see **Figure 1**).

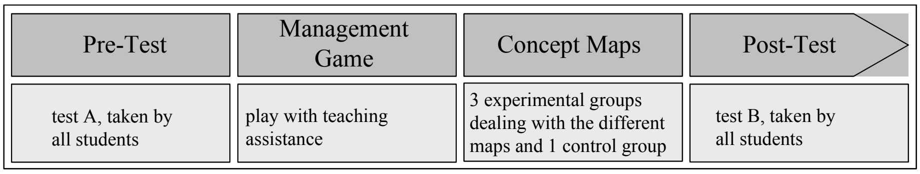

Figure 1: Research Design

2.2.1 Management Game “Easy Business™”

The management game used in this study aims at providing students with knowledge about the supply chain in an industrial company. It was designed as board game, which provides the opportunity to internalize the supply chain and the decisions involved. Moreover, students experience the effects of their decisions in the annual accounting.

2.2.2 Construct-A-Map, Fill-In-The-Map and Expert Map

The students in the experimental groups were requested to use mapping techniques to structure the knowledge acquired in the course of the management game.

The *expert map* group (M1) worked with a totally pre-constructed map showing the structure of the supply chain implemented in the management game. The *fill-in-the-map* group (M2) was given a map with some missing concepts and relations. These concepts and relations had to be put into the right position. The expert map is illustrated in **Figure 2**. The concepts and relations which had to be added in the fill-in-the-map are marked in this figure with dashed lines. A list of missing terms was provided as additional assistance.

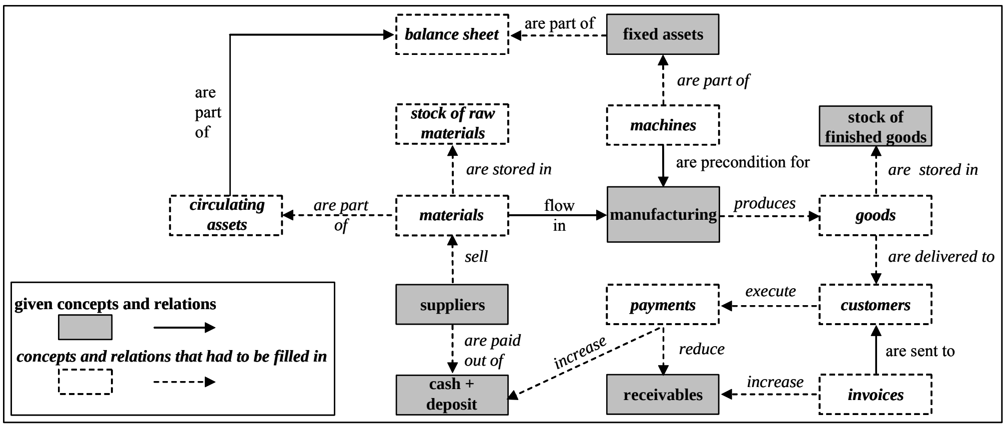

Figure 2: Expert Map

The *construct-a-map* group received only a list of concepts and relations, and the students had to construct the map completely by themselves. As a result, the self-construction requirement increases from expert map to construct-a-map (see **Figure 3**). Precise operation guidelines support all groups in working with the maps.

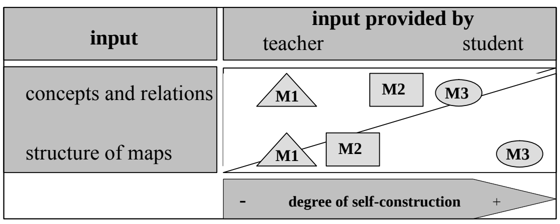

Figure 3: Concept-Mapping Techniques and the Requirement of Self-Construction

2.3 Data Gathering

The students took a knowledge test in parallel forms A and B. The two forms of parallel tests can be substituted so that they are homogeneous forms of one test. In this context the authors decided not to modify the surface structure of the questions but instead to develop two different questions on the same content area and at the same level of difficulty for A and B. This construction ensures that the results can be explained by the intervention and not by learning from the pre-test.

Following the taxonomy of Anderson and Krathwohl (2001), the cognitive process categories “remember” and “understand” in particular were combined with the knowledge dimensions “factual knowledge” and “conceptual knowledge”. Eight questions (two for each combination) were developed both for the pre-test and post-test. The tests were designed in a constructed response format including short answer and essay tasks. Questions in multiple-choice format were not included.

2.4 Data Analysis

Content analysis: The students’ answers were analyzed using a qualitative content analysis. A qualitative content analysis is a systematic, replicable technique for assigning words or phrases of a text to content categories based on explicit rules of coding. The coefficient of intersection measured 81%, indicating a high degree of inter-coder-reliability and underscoring the reliability of the category system. On the basis of the qualitative content analysis a test score could be calculated for each student.

ANOVA and t-test: To determine whether differences in knowledge increase between the pre-test and the post-test could be explained by the concept-mapping techniques, a two-way mixed analysis of variance was carried out with “group” as between-subjects factor and “time” as within-subjects factor. In addition, two one-way ANOVAs were carried out to compare the groups in the pre-test and post-test. Since neither the Kolmogorov-Smirnov-Tests of goodness and fit nor the Levene-Tests showed significant results, the prerequisites for conducting the ANOVA were given. In addition, t-tests were conducted.

3 Results

The students in all groups showed an increase in knowledge from pre-test to post-test. The construct-a-map group, the fill-in-the-map group and the control group showed a similar development. The fill-in-the-map group had the lowest prior knowledge, but also the highest increase in knowledge. The expert map group had the lowest increase in knowledge. Clearly, using a construct-a-map is superior to working with an expert map. In the pre-test the construct-a-map and the expert map groups achieved comparable scores, whereas in the post-test the construct-a-map group exceeded the expert map group. Thus, it seems that a completely pre-constructed map does not support the learning process as well as the other mapping techniques. However, the comparatively good results of the control group were surprising in this context (see **Figure 4**).

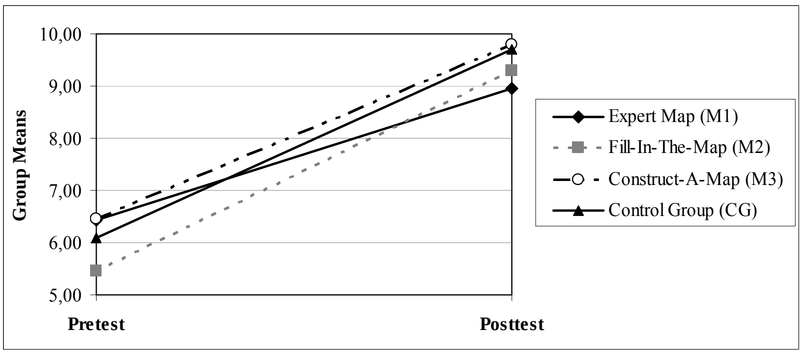

Figure 4: Results of Pre- and Post-Test

The two-way mixed ANOVA showed a main effect for the factor time (F= 227,516; p= .000). That means that a significant increase in knowledge over time was given for all groups. However no significant correlation between time and group could be identified. In other words, the groups did not significantly differ in their knowledge increase from pre-test to post-test. Further t-tests were conducted, contrasting the increase in knowledge of the groups pairwise. The means comparison of the fill-in-the-map group and the expert map group showed a nearly significant result (p= .057). The other pairwise comparisons as well as the comparison of the control group and all concept-mapping groups were not significant. The one-way ANOVAs, which compared the groups in regard to their test scores, showed no significant result for the pre-test and the post-test. Consequently, it could be assumed that the groups did not differ in knowledge in either their pre-test or their post-test scores.

4 Conclusions

On the whole, a difference between the groups could not be proved statistically. Our results do not allow conclusions as to which degree of structure in concept maps is the most effective for fostering the understanding of the supply chain in industrial companies. However, the numerical analysis shows that the fill-in-the map group had the highest increase in knowledge, and that the construct-a-map group was superior to the expert map group. These results are in line with findings of other studies: Nesbit and Adesope (2006), for example, also underscore the superiority of construct-a-map over expert maps. Likewise, Hardy and Stadelhofer (2006) emphasize the positive effect of fill-in-the-maps.

In particular the good results of the control group lead us to believe that possibly the management game itself distorts the effect of the mapping techniques. "Easy Business™" is a complex but comparatively well-structured management game. Thus, it may support students in structuring knowledge so that no additional mapping techniques are needed for understanding. This might be an explanation for the good results of the construct-a-map group in the post-test compared with the expert map group. To explain this phenomenon one may assume that the students' active involvement in self-construction strengthens the cognitive structure, whereas completely pre-structured maps may induce confoundations with the students' individually generated cognitive structure. In this case, students would be more challenged to match their own structure with the given pre-structure than to strengthen their cognitive structure by working through the contents a second time. Another explanation might be that the students may examine the expert map only superficially because the map seems plausible and students mistake plausibility for understanding the contents.

To sum up, our results confirm those of former studies which show that the construct-a-map technique and the fill-in-the-map technique are superior to expert maps. This seems to be true across domains. But, especially with regard to the fill-in-the-map technique more research is necessary. Our study gives some hints that fill-in-the-map provides both an adequate degree of structure and a sufficient potential for self-construction.

In our follow-up study we will increase the sample size in order to obtain statistically firmed results. Furthermore, with regard to the expert map we will develop special instructions in order to determine how to challenge the students to deal with the maps intensively rather than superficially. If possible, a fourth experimental group will be given material other than a concept map (e. g. a text) in order to work through the contents a second time. Thus, we hope to show whether the results can be explained by repeated work on the contents or by the mapping techniques. Future research will focus on the question of whether the supplementary application of mapping-techniques is more useful in the case of less highly structured management games than in the case of highly structured management games.

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THE RUNNING OF THE BULLS. A PRACTICAL USE OF CONCEPT MAPPING TO CAPTURE EXPERT KNOWLEDGE

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Abstract. The running of the bulls, one of the most famous events in the world, takes place every year during the San Fermin festival in Pamplona, Spain. It is extremely dangerous, especially for runners who are not sufficiently familiar with the rules. Through access to the tacit knowledge of an expert bull runner and the creation of a specific knowledge model, we may be able to reduce the risk to those participating in the event. The concept maps used for this purpose have given proof of their effectiveness when it comes to representing the reality of the run in a conceptually transparent manner. The resulting knowledge model includes three concept maps, with numerous links, relating to descriptive features of the run, the real dangers it entails and the characteristics that would be desirable in prospective runners. The model will provide an excellent tool for informing the debate among the various agents concerned, and their conclusions will lead to an improvement in safety conditions during the event.

1 Introduction

The running of the Bulls is one of the most famous spectacles in the world (see *http://www.sanferminencierro.com)*. It takes place every morning during the week of the annual San Fermin festivals, in Pamplona, Spain, celebrated between 7th and 14th of July. It is a very dangerous event (see http://www*.doctordanger.com*), especially for runners who are not sufficiently acquainted with the rules. Thus, year after year, most of those injured are foreigners. The accidents are very often the result of mistakes made by runners who are unaware of the risk involved and heedless of even a few basic guidelines. We realise that an event of this nature is influenced by a large number of variables of such a nature that they are very difficult to control. At the same time, however, we are convinced that a basic knowledge of these variables, especially among runners from abroad, would help to reduce the number of goring incidents and other injuries that take place every year, despite the warnings that are issued. What little information is available is in our view confusing, disorganised, linear, and invariably of a general nature. It is not possible through a municipal announcement to give more than a few basic and obvious tips. We believe that by making available information of a more specific, organised, and truly revealing nature, and underlining the real risks involved in the run, runners could be helped to monitor the risk more effectively. Access to the tacit knowledge of an expert in the intricacies of the running of the bulls might help us to improve the current state of affairs. The effectiveness of concept maps to represent knowledge of that type has been amply tested (Cañas et al., 2000; Coffey et al., 2002; Ericsson et al., 2006; Novak, 1998)**.** This study presents an example of access to the knowledge of an expert runner named Jokin Zuasti, one of the handful of runners acknowledged by the people of Pamplona to be the best and most experienced, and referred to by some of the locals as *los divinos (the divine)*. Concept maps were therefore used in this context and, as we shall see, once again proved their effectiveness.

2 Methodology

The approach used in this study relied on the method known as preSERVe (Coffey, Hoffman, Cañas & Ford, 2002) which is an iterative method of eliciting expert knowledge. It is a method that involves several stages: *Prepare, Scope, Elicit, Render, Verify,* and supports the construction of an informal but semantically rich representation of expert knowledge and the simultaneous creation and identification of critical supplementary resources that materially augment the representation. In parallel to this, we used concept maps to organise the information in a meaningful way and adapt the resulting knowledge model to enable users to interact with the information on the Internet.

The preparation stage was taken up with tasks such as selecting the subject matter and the expert who would be consulted and initiating contact with him. In the elicitation stage direct data was collected from the expert through the analysis of prior interviews (*http://www.pymesdenavarra.es/, http://www.sanferminencierro.com/*) and informal personal conversations. Further indirect data were obtained, by examining other documentary sources. This led to the creation of concept maps based on the analysis of the interview transcripts and the selection of data taken from several sources suggested by the expert, such as web sites, photographs, videos, texts, etc. The resulting maps were later checked by the expert. The material thus selected was used to create the knowledge model (see Figure 1).

Finally, the verification process consisted of a mechanical check to ensure that the menus linked to the various concepts dropped down correctly and, more importantly, the verification of the concepts and semantics of the various resources integrated into the final knowledge model. Decisions at all times were taken after negotiation and an exchange of views with the expert.

3 Results and discussion

Figure 1 presents a definition of the bull run with its characteristics and details of the people involved, and the sociological and geographical context in which it takes place. Also shown are the links attached to two different concepts on the map, one showing a scene from the run, the other the moment when the San Fermín festivals explode into life on July the sixth. The concept maps created from the basic knowledge of the expert are shown in Figures 2 and 3. Figure 2 shows the features the expert most strongly recommends runners to possess in order to avoid serious injury. There is a link to a photograph showing a runner at a moment of extreme danger, testing his capacity to react, handle the situation, and escape unscathed by standing still, waiting for the herd to pass and jumping over the fallen bull. Figure 3 is a concept map showing, again from the expert's point of view, the most frequent dangers to which runners are exposed. Also shown are some links attached to key concepts, such as a goring incident, crowding and specific actions that constitute a violation of the rules. We have highlighted those features of the run that are known only to the expert and which, despite their enormous importance, are not included in sufficient detail in the official advice to runners.

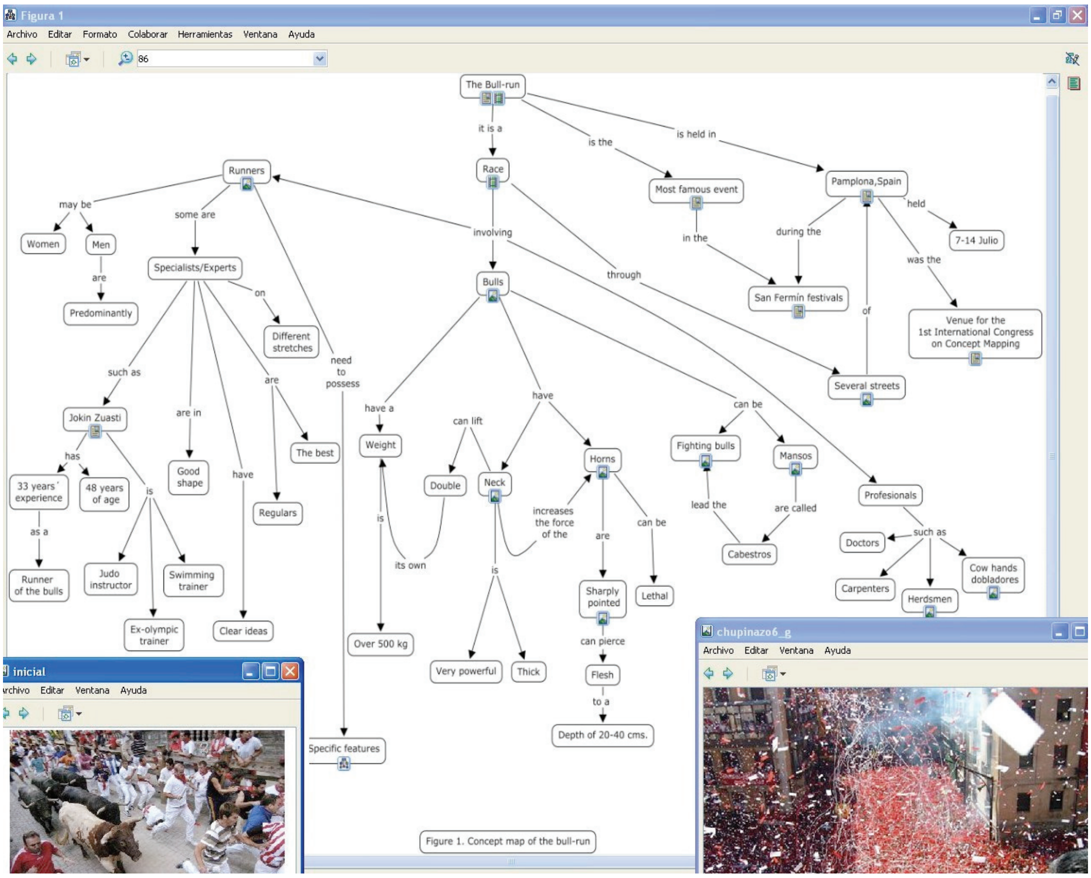

Figure 1.

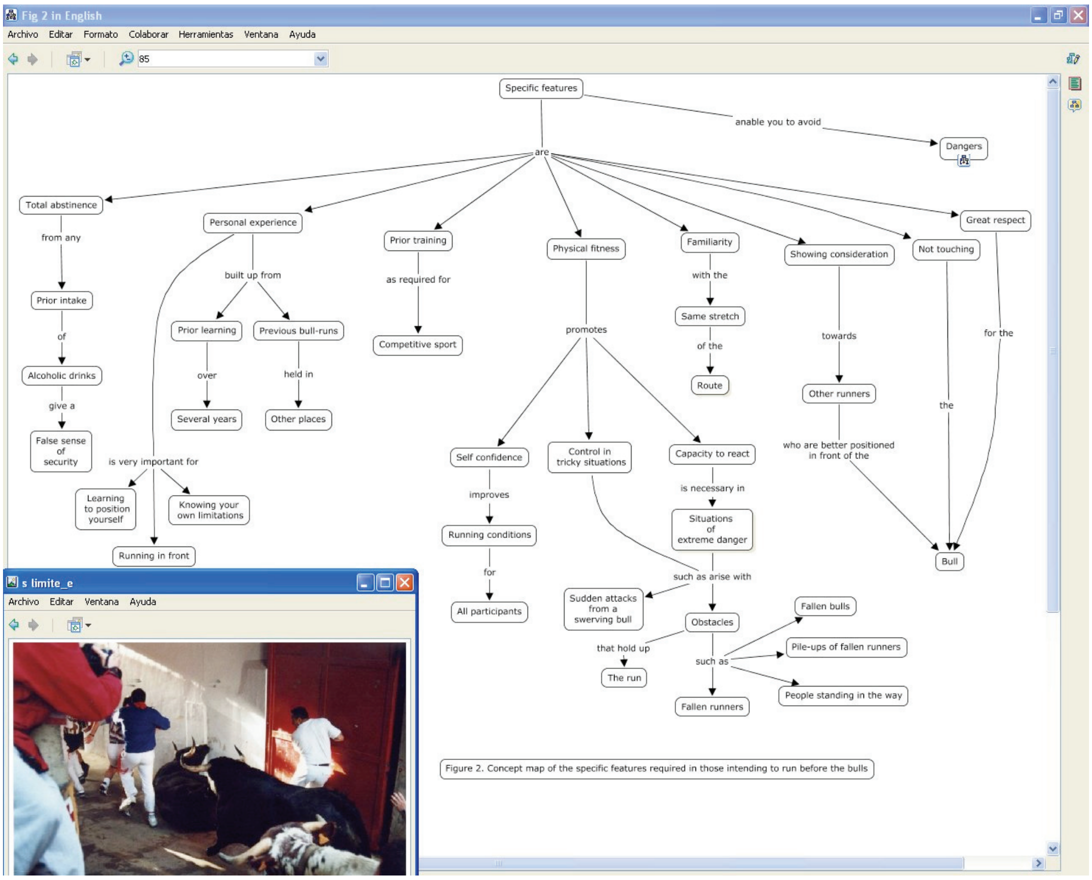

Figure 2.

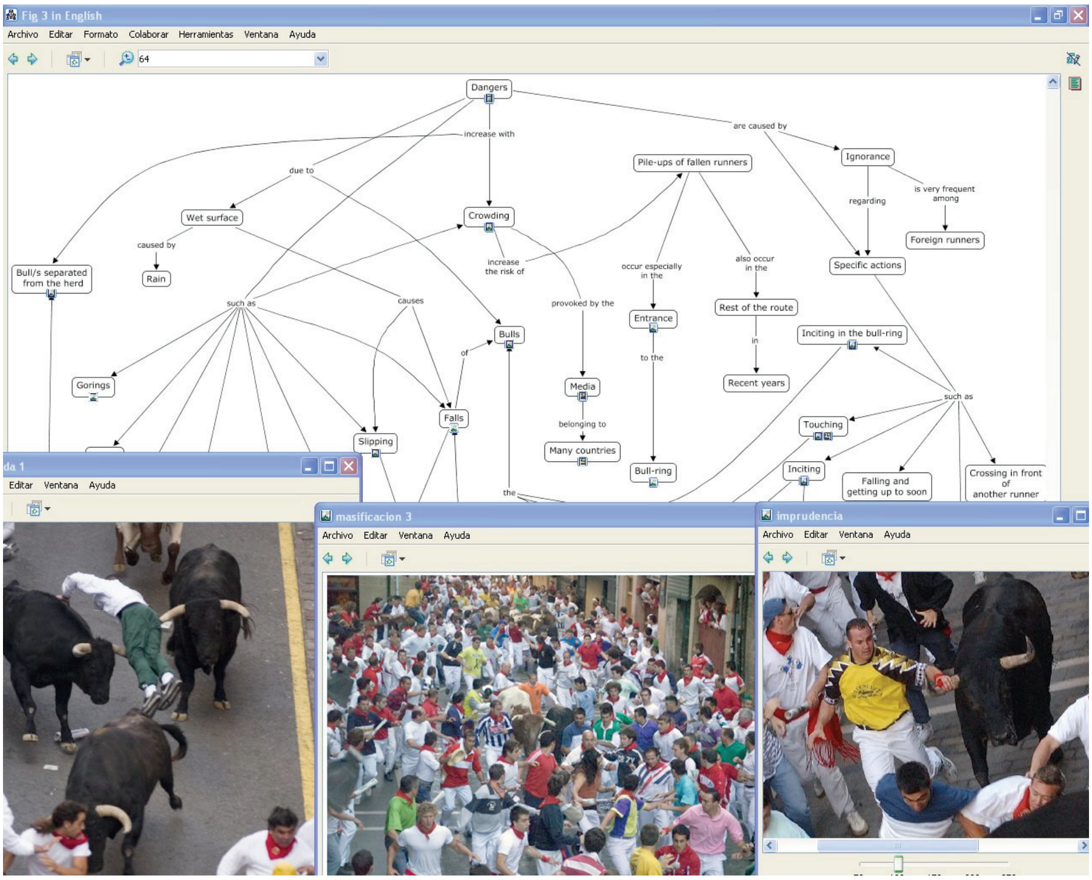

Figure 3.

4 Conclusions

Analysis of the experiences allows us to conclude that:

-The expert reflected deeply on his own knowledge and the concept maps resulting from negotiation and joint decision-making helped him to reconsider his own views in depth and clarify them as required, calling on faculties he did not possess at the start of the experience.

-As might be expected, the experience revealed that many of the details elicited from the expert are missing from official propaganda and standard reports. They belong exclusively to the stored knowledge of the expert who has experienced them. These details, which now feature on the maps in Figure 2 and 3, are the most striking and the ones most likely to encourage change in the behaviour of runners and thereby help to reduce the risk to which they are exposed.

-The expert runner is endowed with an outstanding capacity for analysis and the ability to keep a cool head in the kind situations of extreme danger that are inevitable in the bull run. He is able to rise to whatever the occasion demands. Thus, in tricky or dangerous situations, such as other runners being gored by the bull, people irresponsibly inciting the bull, bulls straggling behind or otherwise separating themselves from the rest of the herd, etc. he is able to react appropriately, ensure that others follow the rules and find a way out of the problem.

-Since the expertise of the seasoned runner which is the fruit of years of experience, cannot be improvised, novice or less experienced runners, usually foreigners, need to be better informed with information of high significance potential, such as that emerging from this research. This will encourage them to imitate the responsible conduct of the expert, do as he does, and thus contribute to ensuring as far as possible that the event proceeds as it ought, and to reducing to the minimum the number of accidents to runners.

-These issues, which go unmentioned in the official propaganda, will be passed on to the authorities in charge of the organization of the run. The model can be made available to the public, in print or online, throughout the festival period and just before the bull run, to try to ensure that prospective runners are suitably informed

-Finally the knowledge model created as a result of this research might be put to debate among the various agents concerned (runners, the authorities, institutional representatives, the media, and other active social agents). Their conclusions might lead to the continuous improvement of the safety conditions associated with the bull-run.

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THE VALUE PROPOSITION - THE ING.BS1.VAL MODEL
BASED ON THE BLUE OCEAN STRATEGY[1]

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Abstract. The Value Proposition is the heart of any Marketing Strategy., because it guides the company towards the Clients influencing strongly the formulation of Corporate and Business Strategy. InG.Bs1.val is a Management Model inserted into an office software program that incorporates Strategic Marketing concepts and a particular measurement scheme. This one helps the analysis of a specific situation to support the design of a Value Proposition for a Product or Service, in a given market segment, in a given time, individually and collectively, on professional, academic and corporate exercises and, finally, helping in design of the Corporate Marketing Strategy. The model uses CmapTools and other resources to facilitate the understanding of the academic methodology and provides exercises supporting documentation and a demo of the software, for understanding and evaluating the model.

1 Introduction. The Value Proposition: A Strategic Approach

The strategy requires considering the philosophical, ideological and functional company values, together with the social economic reality and their relevancies to the organization, for short, middle and long term. To tackle the issue from this perspective, it is useful to define the organization principles: mission, vision, values and style. The Mission is the *raison d'être* of an organization - something like its genetic code. The Vision describes a desired result, expected in future. The Values are what guide the entity as a whole: human, professional, social, geo-political values, and so on. Style is the organization's own particular way of thinking and acting.

An innovative and bold vision can be more easily converted into reality if it's accompanied by a Strategic Approach based on a particular Client-focused Value Proposition. If a company neglects defining their Value proposition, it will find that its strategies are not working because there is no clarity about what their Clients want or how the Company's strategy differs from its competitors.[2]

The Value Proposition is the heart of the Marketing Strategy because it guides the company towards the Clients, influencing strongly the Company's Corporate and Business Strategy formulation.

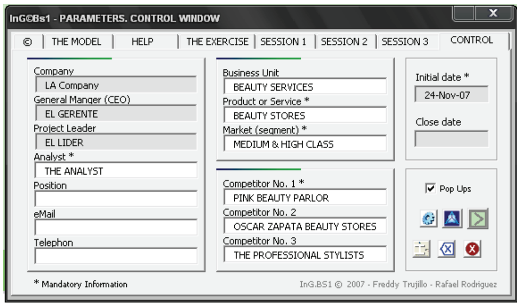
2 The InG.Bs1.val Model

InG.Bs1.val is a Management Model. The model incorporates concepts of Strategic Marketing, as well as a methodology for conducting a measurement in an analysis exercise for a specific situation, in order to design, pragmatically and quickly, the Value Proposition for a product or service in ONE (segment of) market, in A given time.

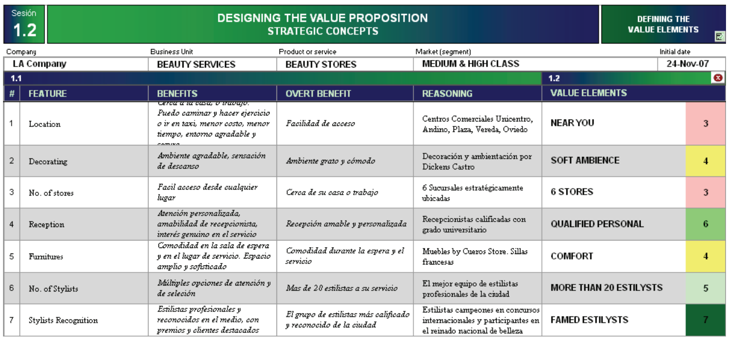
The Value Proposition is designed by focusing clients, face to the main competitors, in terms of functional and emotional components, arising from the purchase or use of the product or service, isolating them by features, and underlying benefits, to define the Value Elements of the product or service. The Value Elements are then measured in an empirical way, from different perspectives based on the numeric scale of the model.

The exercise is conducted in three sessions, each one with four steps. In numerical and graphical forms, the model presents the "Value Profiles" of the Product or Service, in real scenarios, challenged versus key competitors and the company's strategic priority. The graphic analysis of the Value Elements facilitates the understanding and re-valuation of the exercise. The judicious assessment of all profiles facilitates the identification of benefits that are representative and overt for clients. The analyst can translate them, element by element, in promises and action initiatives. Finally he or she assesses the reasons that the client has to believe in the Product or Service and/or the company, defining the "dramatic difference" in the market, to summarize the new value proposition for the Product or Service. The following charts show the help and control windows, as selected windows from sessions 1, 2 and 3.

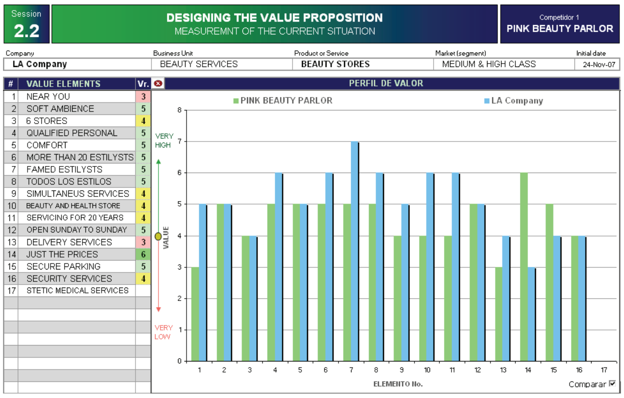
[1] W. Chan Kim and R. Mauborgne. 2004
[2] Robert S. Kaplan, David Norton. 1996



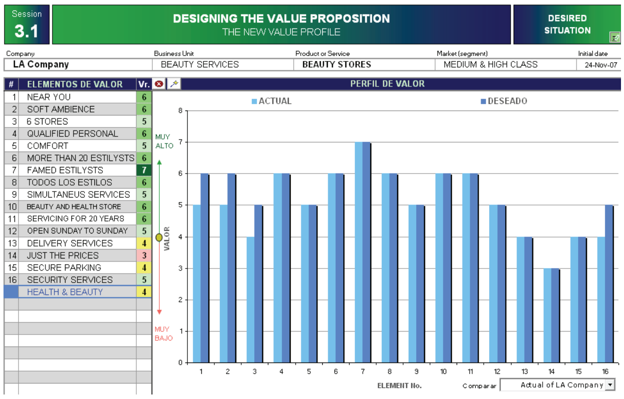
Help and Control Window



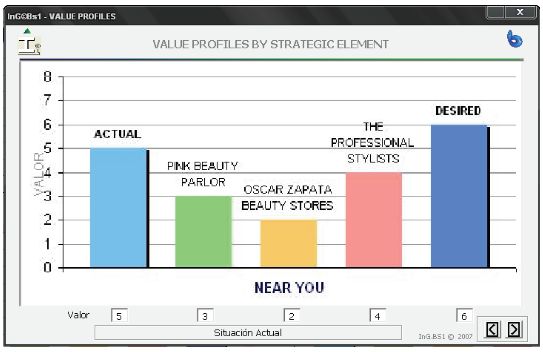
Session 1.3 Value Elements. Strategic Importance



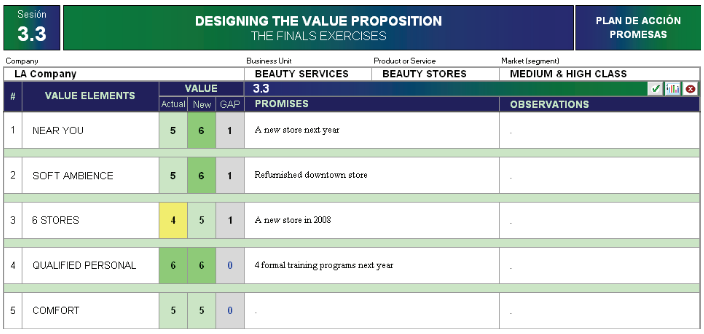
Session 2.3 Measurement of the situation face to Real Competitor 2



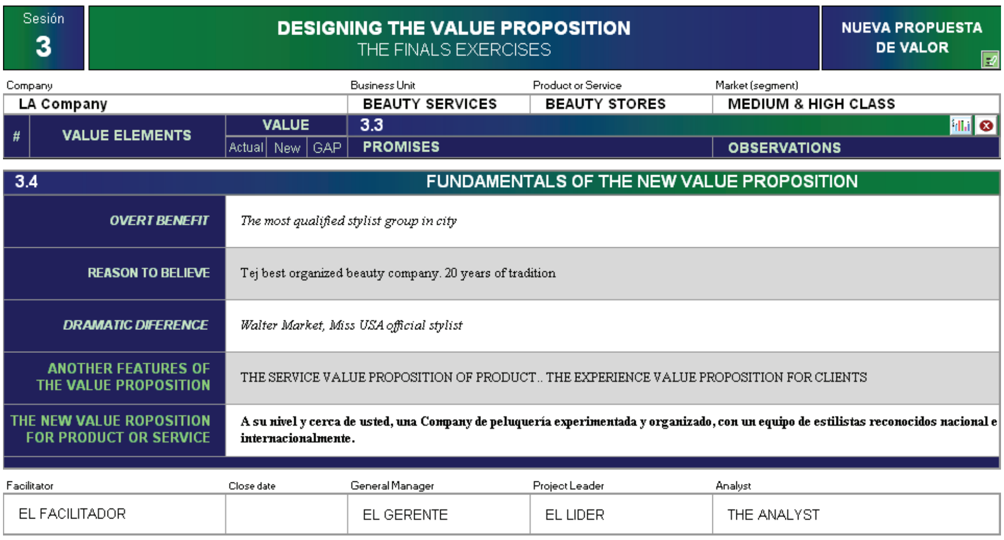
Session 3.1 Desired Situation. Creating an Ocean Blue.



Session 3.2 Chart Analysis for one Value Element



Session 3.4 Promises and Initiatives.

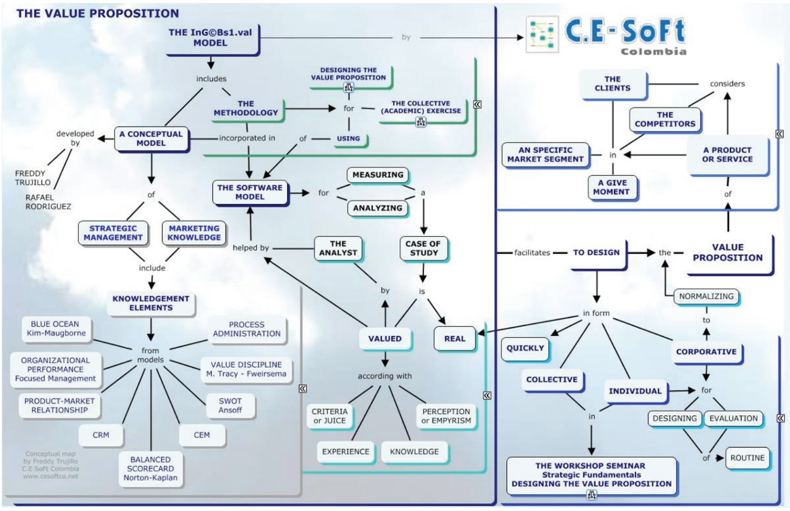


Session 3.4 New Value Proposition

The exercises can be individual or collective. Collective Exercise has an academic, theoretical and practical, approach. The Facilitator has available tools to promote the program and to drive and control the Team Strategic Design Exercise, helped with software. After the introductory session, he or she provides a copy of software to all participants, with data, so they perform the rest of the exercise on an individual basis. The Value Proposition is consolidated based on the individual exercises, which are processed with software, and on the discussion of case with participants.

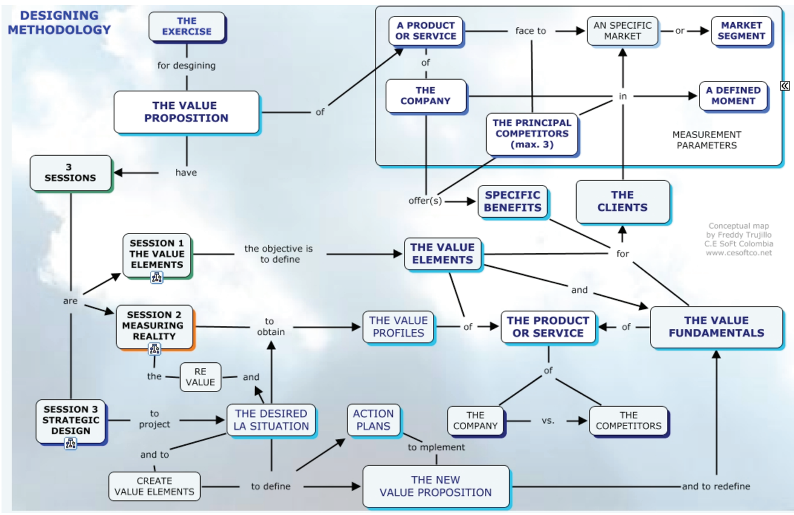
3 The Model In Concept Maps

The InG.Bs1.val academic program is structured in CmapTools (Cañas et al., 2004) and is supported by other resources to facilitate understanding of methodologies and exercises. The CmapTools model can be used to guide the academic program, obtain support documents and to understand and evaluate staffing software. The next concept map describes the model.



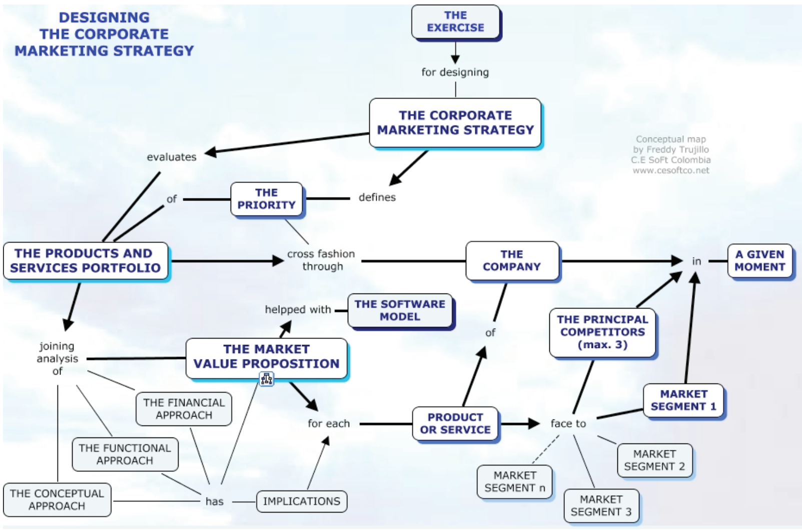
Root Map. THE VALUE PROPOSITION MODEL InG.Bs1.val.

The following concept map illustrates the design of a Value Proposition Exercise.



Design Exercise of Value Proposition for a Product or Service

The exercise, conducted in a linear and cross fashion through the organization, joining to analysis of conceptual, functional and financial implications, serves to define the priorities of the Products and Services Portfolio, and consequently, to design the Corporate Marketing Strategy. The next concept map shows this approach. Nine concept maps are used to assess methodology, step by step, the academic staffing scheme, the demo copy of software and support information of the Model. See http://3cmc.cesoftco.net



Designing the corporate marketing strategy concept map

4 Summary

The strategy requires considering the philosophical, ideological, economic and functional values, as well as the current reality of the organization. An innovative and bold vision can be more easily converted into reality if it's accomplished in a Strategic Approach, based on a particular Client-focused Value Proposition, as well as on an efficient and well-aligned implementation process. InG.Bs1.val is a Management Model incorporated into an office software program that includes concepts of Strategic Marketing and a measurement scheme to analyze a specific situation, to design a new Value Proposition for: a Product or Service, in a given market segment, in a given time, individually and collectively, on the professional, academic and corporate exercises. The academic model uses CmapTools and other resources to facilitate the understanding of methodology and exercises. Supporting documentation to evaluate the model and the exercise, are included with the demo software.

5 Acknowledgements

My thanks to Rafael Rodriguez, who inspired this model when he requested me to create a template in a consulting exercise, participated in the conceptual discussion and in the reviewing process. Thanks also to my son Juan Pablo, who encouraged me to make this presentation, thanks to my daughter Diana, who always has shown to me her affection, trust and encouragement, even in despair moments, and thank you Barbara Bowen, who reviewed translation and texts, adding valuable feedback to this work.

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USING CONCEPT MAP TO FACILITATE WRITING ASSIGNMENT

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Abstract. Writing a term paper may be daunting for students, be it in primary school, secondary school, undergraduate or even postgraduate level. In this study a group of Masters level students were asked to write a paper on the theme "Quality of Life and Vocational & Technical Education". After completing the paper, the students were asked to construct a concept map based on their term paper and do a reflection paper on how they felt using the concept maps. Results show that most of students recognize that using concept maps helps them to organize their ideas and how the ideas flow from paragraph to paragraph. They also realize that if they have done the concept maps before venturing into writing this paper it would also safe them a lot of time. Concept map thus help students of all ages to facilitate writing.

1 Introduction

Constructing concept map is one of the techniques that can be used for organizing and representing knowledge that include concepts, which are usually enclosed in circles or squares, and lines connecting the concepts. Concepts maps are graphics organizers that are structured hierarchically, presented in a two dimension diagrams, and shows relationships between concepts indicated by linking words. (Novak & Gowin, 1984). Many research links concepts maps for instructional purposes. For example, it was proposed for study skills, to improve reading comprehension, or review at the end of course (Winn & Synder, 1996), brainstorming activities (Yin & Shavelson, 2004), teach science related content (Odom & Kelly, 2001; Okebukola; 1990) and assessment tools (Zimmaro & Cowley, 1998).

Traditionally, concepts maps have been used as a tool to engage students in learning content knowledge. However, concepts maps can also be used as a tool to facilitate writing. Previous research indicated that concepts maps has a positive effect on the students' abilities to select concepts that appropriate to respond to a writing prompt, integrate facts into complete thoughts and writing ideas, and apply it in novel situations (Conklin, 2007). Concepts map appear to facilitate learning and how to process information and transform it in to expository writing. Concepts map provide students the freedom to express their knowledge on a given topic and present insights into the way they organize knowledge (Gouli, Gogoulou, & Grigoriadou, 2003) or as a tool to help students and teachers visualize the direction or focus of a research paper (Crane 1998).

Many students, may it be primary school students, secondary school students, undergraduates or post graduate students finds writing an academic paper such as academic paper or essays is not an easy task whatever it may be for. This is because they encounter difficulty in expressing themselves coherently in writing. In order to write a good paper, the author is able must be able to convey to the readers in a clear, coherent, easy to understand, and effectively. Readers should be able to understand the ideas that are brought forward. A well-written paper contains introductory statements that orient the readers to the topics, text structure, and purpose of the text, and that stage for the information that will follow, and concluding or summary statements that offer a wavelike function through the text simultaneously setting up and wrapping up subtopical presentations of information for readers to achieve effective communication (Halliday & Martin, 1993). Thus to write a good paper, one needs to be able to make relationships from a diversity of sources, selects the most crucial facts and details to support their position, omit irrelevant or extraneous facts, and synthesize into a coherent, well-organized argument.

Consequently, a concept map may be use as an aid in helping students structure a well organized paper. Thus, the purpose of this study is to investigate how students perceived concept maps as a tool in facilitating writing in their writing assignment. This is important to see the variety of ways the students used concept maps and how it could facilitate their writing.

2 Methodology

2.1 Sample and procedure

The sample for this study consists of a group of 34 Master's Level students, ages 25 years to 29 years, who are enrolled in the course Curriculum Development in Technical and Vocational Education in the Semester II, 2007/08 session. There are nine male students and twenty five female students.

For this study, the students were required to write a paper with any title but conforming to the theme “quality of life and technical & vocational education”. They were given three weeks to submit the paper. On the day the paper was due, the author instruct the students to construct a concept map based on what they have written and write a reflection paper on what transpires when a concept map is used. The rationale of asking the students to construct concepts maps after they have finished their written assignment is to find out if concept map is useful for the students and if it can be a tool in facilitating them to write better. They were given a week to do this.

The students were also advised that they may revise their paper if they find their paper insufficient or send in the papers without any changes after constructing the concept maps. Students were required to mark letter R (if they revised their paper) and marked letter O (if they were to send in the original papers without any correction) on the back of the submitted paper so that instructors will not be biased when grading the papers. However, in both cases they were required to write a reflection paper based on their experience when using concepts maps.

The students understood that their grades will only being based on the submitted papers and not on their concept map they drew or on their reflection paper. The grades received are compared with the grades on their previous writing assignment. The author then carried out an (document) analysis on the reflection papers which were written by the students.

3 Findings and discussion

The findings from this study provide interesting insights on the students view on how concepts help them in writing the paper. Among the titles chosen for the theme given are related to income and distribution of economy, technical & vocational education and training curriculum, human capital, life long learning, and others. Table 1 shows the frequency and percentages of the titles that the students have chosen based on the theme given.

Table 1: Frequency and percentages of titles chosen based on the theme “Quality of life and Technical & Vocational Education”

Titles related to:	Frequency	Percentage
Income and distribution of economy	10	29.4
TVET curriculum	11	32.4
Human capital	5	14.7
Life long learning	2	5.9
Others	6	17.6
Total	34	100

Although the students were given the choice either to revise or to submit the paper as it is after they have constructed the concept maps, 76.5 %, of the students opt to rewrite their papers and only 23.5 % decide to send in their paper as it is. In both cases, their grades improved from the previous writing assignment. The reason for the improvement is because the students have learnt what is required to do better from their previous assignment. Also, the students who send their paper as it is are students who are strong in writing and who has achieved a fairly good grade from the previous assignments.

Out of the thirty four students only ten students did not submit their reflection paper. Thus only twenty four reflection papers were analyzed. After analyzing the students’ reflection paper, the authors grouped the feedback based on the common themes that the students has written about on their experience when using concepts maps. Feedback of students on concepts maps based on the reflection paper that the students has written when constructing concepts map after writing the paper are shown on Table 3. The top three responses on concepts maps are 17.5 % of students believed that concepts maps are able to help them in relating ideas or connects ideas with each other, 12.3 % of students feel that ideas or contents of papers are easily generated with the use of concept maps, and 10.5 % of students considers concepts map as a visual representation of what is going to be written. Reading through the responses it can be deduced that concept maps can be a tool to facilitate their writing assignment. This is evidenced from their feedback (Table 2) and the fact they have already written the paper and still find using concepts maps useful.

Table 2: Feedback of students on the usage of concept maps in their reflection paper

Response	Frequency	Percentage
1. The contents of the essay is depicted on the map	8	7.0
2. Ideas or contents of the paper are easily generated	14	12.3
3. Able to relate all the contents/idea to each other/connects different ideas	20	17.5
4. Visual representation of what is going to be written	12	10.5
5. Concepts map should be constructed prior to writing	9	7.9
6. Helps to focus on the topic	10	8.8
7. Helps sequencing the flow of writing	7	6.1
8. Concept map should be taught to all students as it help students to construct their own understanding	3	2.6
9. Summarizes the essay	2	1.8
10. Understand what need to written in the essay	6	5.3
11. Able to see what is lacking in the paper	9	7.9
12. Build confidence in learning ability	2	1.8
13. Assist in reviewing and evaluating process	1	0.9
14. Facilitate writing	6	5.3
15. Helps in planning/organize	5	4.4
Total responses	114	100.1*

* Error due to rounding

For example when using concept maps, they understand what is needed to be written in the essay (Response 10), thus enabling them to relate or connect the content/idea to each other and also connect the different ideas together (Response 3) and also helps sequencing the flow of writing (Response 7). They also find that concept maps help them focus on their topic when writing (Response 6).

For some students, concepts map is used as an evaluating tool in assisting them reviewing and evaluating their paper (Response 13). As for the researcher, the concepts maps constructed by students also help the researcher to understand quickly what the student is going to write about, thus making the job of reviewing and evaluating the paper easier. The researcher also can detect if the students are rambling out of topic or just lack of substance in their essay. Overall, comparing the initial paper and the reflective paper done by the students indicate a marked improvement in the coherency and flow of the paper. Students also find the concept map very useful in doing a self review on the papers done (Response 11).

The authors also felt that both global and sequential learners will also benefit from concept maps. This is because for global learners concepts maps will help them to build a big picture before details are added in. For sequential learners they can plan their work in sequence first by connecting the details. Both felt that concept maps is good tool for planning their writing because what they wanted to write about is already shown graphically on the concepts maps. Those who think better with visualization find this is useful too because they can put their ideas in graphical form and write from there. (Response 1). We also felt concept map is also good for the sequential people as now that could also sequence what come next on the paper and so on.

Before writing a paper, one has to have an idea of what to write. They are many ways of generating an idea, and brain storming is one of them. With the help of concept map, they also felt that they could brainstorm ideas better with the aid of concepts maps (Response 2). This is in conjunction with techniques used in brainstorming session such as fishbone diagram, morphology chart, and as such. From these responses, there seem to be a general consensus that concept maps is a useful tool for communicating ideas either in formulating and organizing a writing, evaluating or summarizing.

While writing a term paper may be a daunting task to any student, tools such as the concept map or its derivatives may ease the burden on the student to produce quality paper as required. However good the concept map may be, in the end the substance of the paper will depend on the contents and not the tools that help in organizing and produce it.

4 Summary

Concept mapping is a technique for visualizing the relationships or connections among different concepts. In this study, although the students only constructed the concept maps after they have finished written their paper, they still believed that concept map can be a tool to facilitate students in writing assignments. Students of all levels, may it be at primary school level, secondary school level, undergraduates level or postgraduate level may benefit by constructing concept map prior to actually writing their assignments because it helps them in generating ideas, able to relate the ideas or contents to each other, and also as a visual representation of what is going to be written. It helps students to focus on their topic and helps sequencing the flow of writing. It also acts as a planning and organizing tool for writing. Student of all ages would benefit using concept maps as it is easy to use. Concept map should be taught to all students as it helps students to construct their own understanding.

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USING CONCEPT MAPS TO ENHANCE SYSTEM VIEW NAVIGATION

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Abstract. If one is to understand how a system meets its quality goals they must understand the elements and the relationships among the elements of the system. These relationships span multiple views of the system. View-based documentation of software architectures improves the ability of stakeholders to understand the system and in particular how the system meets its quality goals [Clements]. However, in order to understand the relationships among elements of different types in a system one must provide a mapping across views. Concept maps are a tool for visualizing relationships between different concepts. In this paper we describe the application of concept maps as a solution to the problem of mapping across different views of software, which in the past, have limited the stakeholder's ability to understand the complex relationships that exist in software.

1 Introduction

If one is to understand how a system meets its quality goals they must understand the relationships among the elements of the system. The elements and relationships among them are communicated using different views of the system. Fundamentally these views all represent conceptual models of the same system and collectively are called the architecture of the system. However, due to the number of different stakeholders and the amount of information to convey several conceptual models of the system must co-exist.

Often times understanding of the system being developed is maintained as part of a program team with individual members becoming experts in parts of the system. According to Smolander (2002) this behavior hints at organizational problems and management urges that this architectural knowledge be spread throughout the organization. To mitigate this risk several processes have been created to provide visibility into the system development process. However, documenting systems is not enough because there are issues with documents themselves. Documents tend to become obsolete over time and ripe with inconsistency (Cederling 2000). The solution to identifying element interdependencies and enhancing stakeholder communication has certain requirements. Due to the complexity of software systems the shared understanding must convey large amounts of information efficiently and effectively in a simple manner. Due to the number of problem domains that software engineering is applied to, any solution must be very expressive and must be able to support many problem domains as well. In order to support the broadest set of stakeholders possible the solution selected must be easy to learn with little or no formal training. The solution should support a collaborative environment so that ad-hoc interpretations can be avoided by performing the work in a group environment. Finally, the shared understanding should not be limited to one phase of the software development life cycle but be incorporated as a fundamental part of the process.

This paper describes the use of Concept Maps (Novak 1998) as the basis for a solution to creating such a collaborative environment. Concept maps will provide the basis for a common view to support a shared understanding of the system. In addition, since the concept map provides a shared view of the system the concept map will act as a bridge to map between views of a system thereby allowing different views of the system to be effectively cross referenced.

2 View-Based Approach

View-based approaches to documentation are used to describe software architectures by giving the various stakeholders different views of the system. View-based approaches are therefore effective tools for allowing specific stakeholders to focus on parts of the system for which they have concerns (Clements 2003, IEEE1471). However, view based approaches suffer from a lack of tools and techniques to effectively map between different views of the system. During meetings where different stakeholder groups come together the views used by the stakeholder groups will be translated into a generic form that can be communicated. For example, the system architect will map the UML view of the system into something the customer will understand. This translated view may or may not be technically accurate but is used for illustrative purposes. The problem with these view

[1] The author's affiliation with The MITRE Corporation is provided for identification purposes only, and is not intended to convey or imply MITRE's concurrence with, or support for, the positions, opinions or viewpoints expressed by the author.

translations are that they are 1) inaccurate due to the subjective nature of the translation 2) inconsistent due to ad-hoc translations 3) time consuming to produce 4) inaccurate when translated from a more robust representation and 5) are out of date since work must be done to keep the 'stakeholder' view in line with the working model. All of these problems result in miscommunications, wasted time and effort.

]

Documenting architectures such that different stakeholders can find the information they need and to understand the information once it is found is a difficult task. For example, Figure 1a and Figure 1c illustrates two UML-based views of the Online Collaborative Lesson Planner system that was developed as part of a pilot study in 2007. The lesson planner is used as part of a course for K-8 teachers was sponsored by the Technical Education Research Center (TERC). The Collaborative Lesson Planner is used in the training of student-teachers to become teachers.

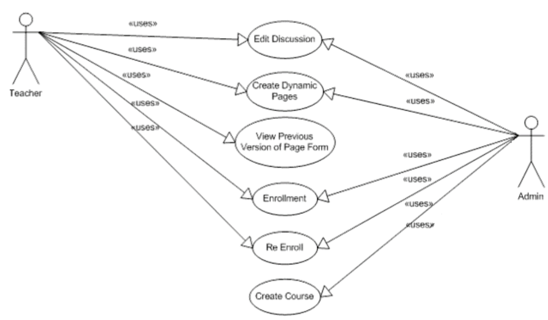
3 Concept Maps

A concept map is a graphical representation of the concepts of a body of knowledge along with their interrelationships in the form of a directed graph (Novak 1981). The map itself consists of a focus question to describe the scope of the map the concepts are represented as nodes and the relationship between the concepts are represented as directed arcs with connecting words. Figure 1b shows a concept map that illustrates the body of knowledge related to the Collaborative Lesson Planner described above. The concept map was created using the process as described by Novak (1998) using input from the Collaborative Lesson Planner Development team in addition to concept maps previously created by the team.

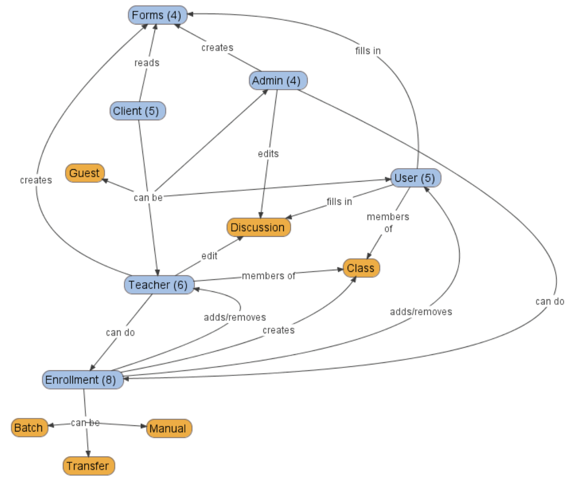
The concept map in Figure 1b differs from the definition offered by (Novak 1998) in the removal of the focus question and the addition of node coloring and degree labeling. The focus question was removed for visual clarity. If one wanted a focus question it could simply be "What does the Lesson Planner Consist Of?" or something similar. The coloring of the Enrollment, Teacher, User, Client, Admin and Forms concepts is used to highlight them as key concepts in the system. Those concepts were selected as key concepts based on the number of relationships that they participate in. This brings us to the degree labeling, the number in parenthesis for each of the blue-colored concepts. The number represents the degree of the node, in other words, the total number of arcs entering and leaving the node. Based on the number of relationships, the concepts Enrollment, Teacher, User, Client, Admin and Forms are ranked in the order of importance. The relevance of the ranking is that during mapping, any part of the implementation that maps to key concepts should be examined for scalability and performance issues since those parts of the implementation will become key parts of the implementation as well. Note, the degree labeling and node coloring are used as a visual aid and can be omitted without changing the idea of the key concepts or rankings.

4 Mapping Activity

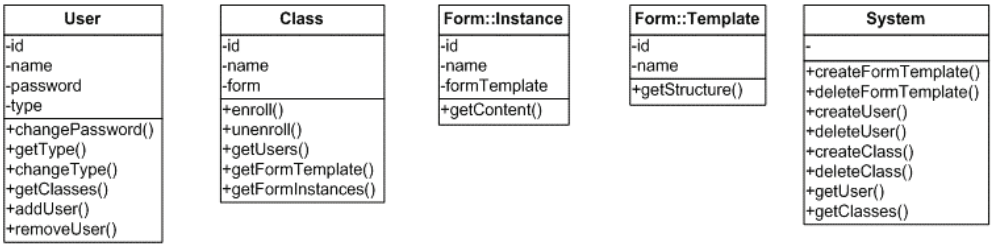
The study selected a use case to class diagram mapping because often times the association of classes in a system involved in the implementation of a use case are not obvious. Mapping between the Collaborative Lesson Planner's use case diagram, concept map and class diagram proved an easy exercise when using a concept map as a bridge. The mapping of the Manual Enrollment use case mapped to the class diagram using the concept map of the system as a bridge is illustrated in Figure 1d. The technique used was a list explicitly describing the relationships between the conceptual models. The list for the Collaborative Lesson Planner's mapping is presented in Figure 1.



Use Case Diagram (a)



Concept Map (b)



Class Diagram (c)

Mapping (d) Use Case	Concept Map	Class Diagram
Manual Enrollment is a specialization of the Enrollment use case.	The proposition "Enrollment can be Manual".	The activity of Manual Enrollment is not identifiable explicitly in the class diagram.
	The proposition "Enrollment creates Classes".	The System class is used to create Class and User objects. User objects represent Users and Teachers.
	The proposition "Enrollment adds/removes Teachers."	Unclear
	The proposition "Enrollment adds/removes users."	Enrollment is performed by calling the enroll method on Class object.

Figure 1 Mapping the Collaborative Lesson Planner's Manual Enrollment Use Case

This mapping technique proved very useful for identifying relationships between the conceptual models of the system and identifying design issues. Evidence for its utility can be seen in the following examples from our experience with the Collaborative Lesson Planner.

First, the concept of User is overloaded. User appears in the concept map as a subordinate to Client but in the class diagrams the class User takes on a more significant role as the base class for all user types. The concept map clearly identified this disconnect from the conceptual model of the system which must be addressed in order to present a consistent conceptual model of the system.

Second, the Enrollment concept has several relationships in the concept map yet enrollment does not appear explicitly in the class diagram of the system at all. Enrollment is hidden in the implementation of several classes: System, User and Class. With such a critical piece of the system hidden it will become difficult for maintenance programmers to fix problems. This will have a direct impact on the maintainability and therefore cost of the system.

Finally, during the pilot study, there was one year lapse between when the first pilot study team ended development and a new study team began development on the same system. Using the concept maps developed by the initial development team, the final development team was able to 1) recreate designs decisions made a year prior 2) communicate the system to new customer stakeholders and 3) continue development with little or no input from the original development team. The pilot team attributed these capabilities to the initial pilot team's use of concept maps. Clearly, these examples show strong support for the use of concept maps as providing a shared conceptual model of the system that can be leveraged in many ways.

5 Conclusions and Future Work

A key goal of this work was to enable a shared understanding between various stakeholders using concept maps for software engineering. Evidence that this goal was obtained was seen in the briefings the pilot study team gave to different stakeholders. The pilot study team was able to bring several stakeholder groups, outside development groups in this case, up to speed on their problem and solution using concept maps as the key discussion driver.

As mentioned previously some of the requirements of any proposed solution are the abilities to present large volumes of information in a compact format and to support many problem domains. During the pilot study, the pilot study teams worked in different problem domains and could represent their architectures in one concept map. Based on that work these two requirements were met. Constructing the artifact in a collaborative environment has been shown to make better designs Additionally, concept maps are effective communication tools as seen in all concept map based pilot study briefings and as such they have been shown to help communicate between different user groups.

Mapping between views proved to be the most difficult aspect of this work. Specifically, the issue of visualizing between conceptual models was the most difficult task. Clearly more work visualizing the actual mapping with more complex systems is needed.

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USING CONCEPT MAPS TO EXPLORE PRE-SERVICE CHEMISTRY TEACHERS' CONCEPTUAL UNDERSTANDINGS ABOUT SCIENTIFIC ıNQUıRY AS A SUBJECT MATTER

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Abstract. This paper describes our experience with using concept maps to explore pre-service chemistry teachers' conceptual understandings and to monitor learning outcomes of a new science method course focused on content knowledge of scientific inquiry as a part of our research project. 27 pre-service chemistry teachers participated in the science method course lasted eleven weeks, three hours weekly. The participants performed some simulated activities, real scientific experiments, and engaged in some assessment activities, and watched a video program which involves strong visual images and simple, accessible scientific examples to bring the steps in scientific investigation into view. As an assessment tool, we used a concept mapping technique called construct-a-map with created linking phrases. Before and after the course, the student teachers were asked to construct a concept map using a list of the concepts provided by the researchers. We used a two-tier analysis as the scoring technique; scoring concept map links quantitatively and their structure qualitatively. The results of the Paired Samples t-Test indicated significant difference between the means of pre- and post-concept scores in favor of post-concepts scores. Quantitative and qualitative analysis of pre- and post-concept maps and the distribution graphics of the map scores indicated that pre-service chemistry teachers' conceptual understandings had a significant progress. In addition, it was observed that structure types of participants' concept maps became more hierarchically organized and differentiated. It is also obvious that the findings from analysis of the pre-service chemistry teachers' concept maps will be beneficial to revise the first version of the science method course, of which progress is still going on.

1 Introduction

In recent years, the issue of how science is taught to individuals, especially to students, has been more important than it used to be before since the ideas about the nature of scientific knowledge radically changed owning to the work of epistemologists. Therefore, the focus on the nature of science and scientific inquiry in science education reforms of many countries in the world is rapidly increasing (Osborne et.al, 2003). However, the number and the quality of the researches about this topic are not enough. In Turkey, we are studying on a research project supported by TÜBİTAK (The Scientific and Technological Research Council of Turkey) in order to develop original teacher development packages and workshops with the final goal of improving elementary and secondary students' understanding of the nature of science considering recent paradigm shifts about science. When this project is completed science method course and teaching materials, the products of the project, will be a resource and model for training both teacher candidates and in-service teachers. During the science method course development process as a part of the project, we used various assessment tools including concept maps.

Knowledge structure is regarded as an important component of understanding in a subject domain, especially in science. The concept map is a tool, based upon the cognitive psychological theory of constructing meaning, developed by Novak and Gowin (1984) as a convenient and concise representation of the learner's conceptual/propositional framework of a domain-specific knowledge. Concept mapping technique can be used to follow the restructuring and the evolution of the cognitive structure by comparing successive concept maps produced by the student at different stages of the teaching-learning process of a given topic (Mintzes et al., 1997). Therefore, in the development process of a new science method course about scientific inquiry, we thought that it would be reasonable to use the concept mapping technique for monitoring the changes in students' cognitions and also as an assessment device.

The objectives of this study were, in the development process of a new science method course focused on teaching scientific inquiry as a subject matter, (a) to explore the use of concept maps in assessing student teachers' declarative knowledge in the context of the scientific knowledge, and (b) to monitor learning outcomes of the science method course as instructional emphases shift from more basic to higher levels of performs.

2 Methodology

As a part of our research project, we have developed a science method course consisted of two sections for the pre-service chemistry teachers attending fifth year in a five-year Teacher Education Program at a university level in Turkey. The first section of the course was devoted to teaching what science is; and how the scientists do science that is to say scientific knowledge and inquiry by providing students real life examples and practices. The second section, not stressed in this paper, considered and reviewed deeply more theoretical background of the nature of science. A concept map overviewed the main and sub-concepts related with the science method course was shown in Figure 1. In this paper we report on our experience about the implementation of only first section of the science method course and present analysis of pre- and post-concept maps of the student teachers.

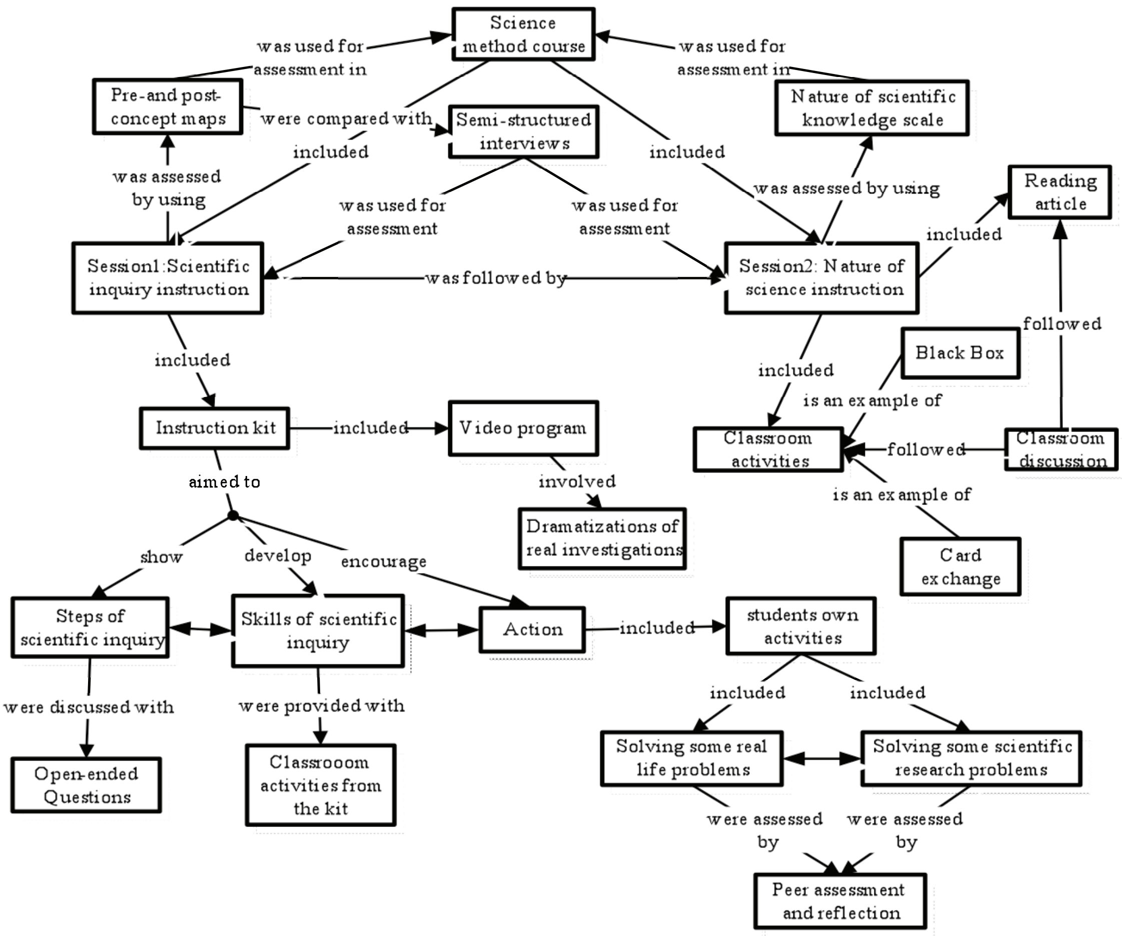

Figure-1. A concept map overviewed the main and sub-concepts related with the science method course

In the first section, we used a commercial kit named *Scientific Inquiry: Steps, Skills and Action* (Friedman and Friedman, 2003). The kit consists of 10 activities, and a video program which involves strong visual images and simple, accessible scientific examples to bring the steps in scientific investigation into view. The video program was translated from English to Turkish and subtitled. Firstly, student teachers watched the program and reviewed the ideas, and participated in small group and whole-class discussions. Then, the students performed some simulated and real scientific experiments by studying in scientist teams and reality teams, and engaged in some assessment activities. According to us, one of the advantages of this approach is that students could see a clear presentation of the steps and ideas involved in scientific inquiry, review these concepts and then use the knowledge in the assessment exercises that we prepared.

Twenty seven pre-service chemistry teachers participated in the first implementation of the course. The course was lasted eleven weeks, three hours weekly. The first three hours of the course were devoted to training participants in the concept mapping technique by introducing them to operational definitions of terms such as concept label, linking relationship, proposition and cross-link. Some maps were constructed on non-scientific subjects. In the course, data were collected by using concept maps, and Turkish version of *The Nature of Scientific Knowledge Scale* in a pre/post format (Taşar, 2006). In addition, the qualitative data were obtained by semi-structured interviews, reflections and peer assessments of student teachers own activities about scientific inquiry. As an assessment tool we used a concept mapping technique, construct-a-map with created linking phrases. This mapping technique characterized as the gold standard of concept maps (Ruiz-Primo et al., 2001). Compared with the fill-in-a-map technique, construct-a-map technique supplies students with more opportunities to determine conceptual understanding; and elicits higher order cognitive processes, such as explaining and planning. However construct-a-map assessments are challenging to score because students' products vary greatly. Researches have proposed various techniques for scoring concept maps (McClure et al., 1999; Kinchin, 2000). We used the scoring technique which Kinchin (2000) suggested a two-tier analysis, scoring concept map links quantitatively and their structure qualitatively.

Before and after the course, the student teachers were asked to construct a concept map using a list of the concepts provided by the researchers but it was said that they could add any concept if they want. 18 concept labels in the list were; *scientific inquiry, observation, hypothesis, prediction, testing, data, analyzing, conclusion, question, result, refining question, communication, literature, scientist, problem, specific hypothesis, practice and existing scientific knowledge*. Since the objective was to point out the eventual changes in the cognitive structure following teaching of the topic, the same terms were given before and after teaching. The maps were drawn up individually during a normal class session.

3 Result and Discussions

Quantitative analysis of pre- and post-concept maps were carried out by scoring 1 point for each correct linkage or relationship, 5 points for each level of hierarchy and 5 to 10 points for cross-links showing correct relation between two concepts in different sections of the hierarchy (Novak & Gowin, 1984). Each concept map was scored by the researchers together. It was determined that the scores obtained from the concept maps are normally distributed (for both pre-test and post-test $p>0.05$) by using Kolmogorov-Smirnov Test in SPSS program. For the purpose of investigating if pre-service chemistry teachers' understandings of scientific inquiry changed, the mean of pre- and post-concept map scores were analyzed by using Paired Samples t-Test. It was found that there was a statistically significant differences between the means of pre- and post-concept map scores in favor of post concept map scores ($t_{(26)}= -7.243$; $p< .05$). The effect size was computed as 1.3 and shows that the treatment was large effect size according to Cohen's categorization (Cohen, 1988). It means that conceptual understandings of the pre-service chemistry teachers about scientific inquiry had an important progress.

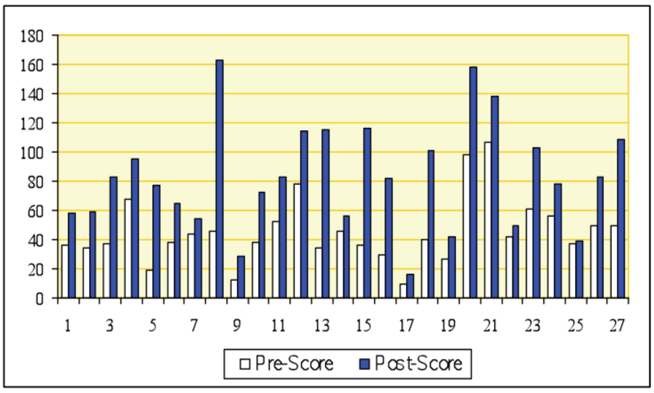

Figure-2. Distribution of the scores

In Figure 2, the distribution graphic of the pre- and post-scores of the students was shown. Analysis of the distribution graphics and the concept maps show that before teaching, 5 of 27 students chose the concept label "*specific hypothesis*" but no one associated it with a suitable concept. After teaching, this concept was used by 25 of 27 students; 12 of these 25 still couldn't link suitable relationship. Analysis also revealed similar results for some concepts such as *refining question and communication.* Figure 3 and 4 show two maps that were constructed by the same student before and after teaching. They are quite different. By comparing the two maps drawn up by each student, changes in the structure of the map were found in more than three quarters of the students. In addition, qualitative analysis showed that structure types of pre-service chemistry teachers' concept maps became more hierarchically organized and differentiated. It is reasonable to think that changes in the maps correspond the similar the changes in the conceptual structure of the student teachers due to participating our science method course. Furthermore, findings of analysis of the data obtained by other assessment tools such as *The Nature of Scientific Knowledge Scale,* semi-structured interviews, reflections and assessment activities were in agreement with those obtained by concept maps.

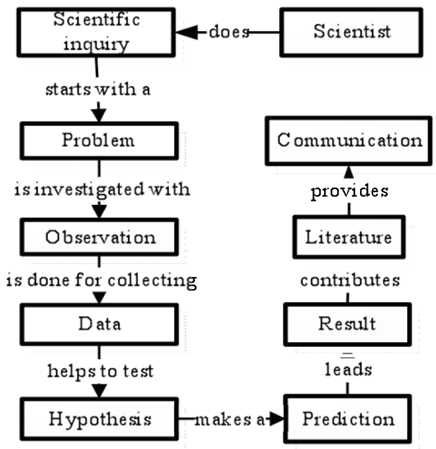

Figure-3. Pre-concept map of one of the participants

Consequently, it is obvious that the findings from analysis of the pre-service chemistry teachers' concept maps will be beneficial to revise the first version of the scientific method course, of which progress is still going on.

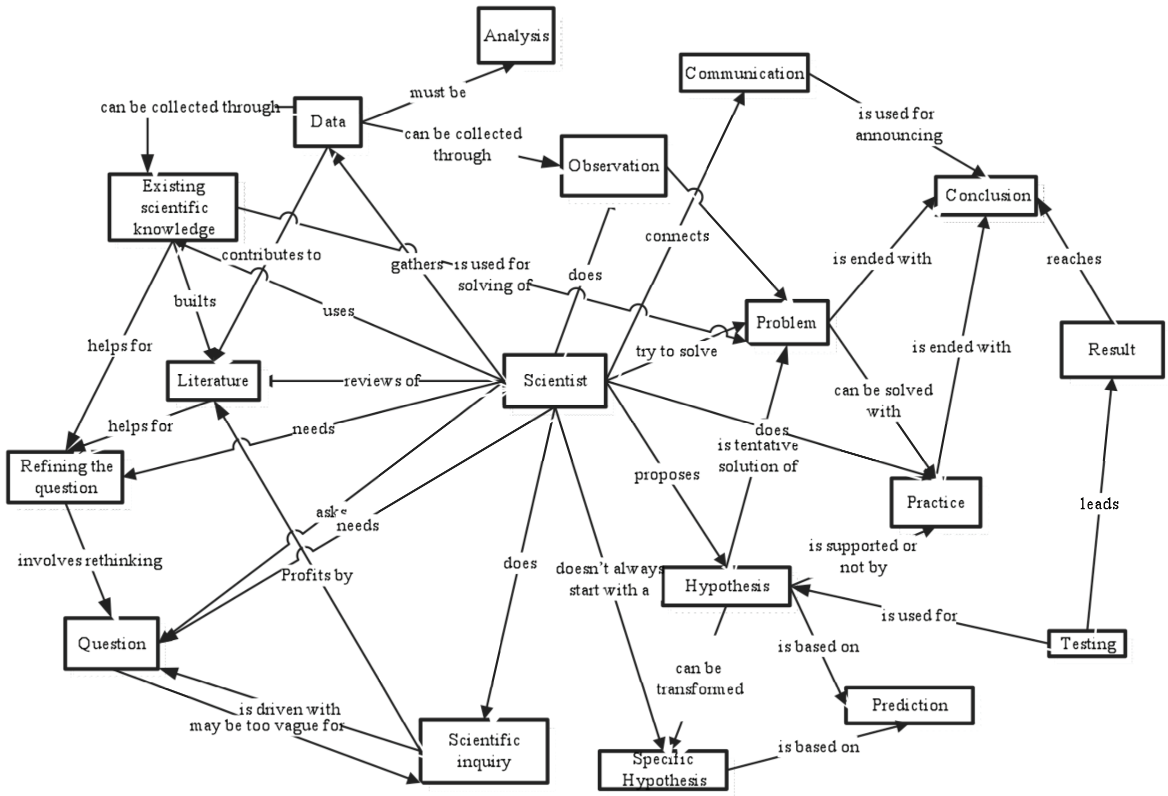

Figure-4. Post-concept map of one of the participants

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Concept Mapping: Connecting Educators
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USING CONCEPT MAPS TO HELP 3 YEAR OLD CHILDREN TO ADAPT TO THE ENVIRONMENT

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Abstract. Piaget (G.C. Davenport, 1994, pp 126-144) believed that intelligence was all about making appropriate adaptations to things around us quickly and efficiently. He stated that babies start making schemas and move on through adaptations, assimilation and accommodations. In order to adapt he said that we need to organize our experiences in some way, as without some mental organization it would be difficult to learn simply from experiences. My task as a teacher/educator is to help children to see, to discover, to understand their close environment and to organize experiences in a meaningful way. In today's society, knowledge and intelligence are fundamental pillars therefore it is highly important for students - even at a very young age - to become experts with the world of knowledge. This work presents an attempt to provide three year old children with a broad view of the relationships and concepts in their surrounding world using concept mapping as a tool and as a mode of independent learning. The results of using concept mapping with the class have proven it to be an effective tool in giving a broad view of the world and to see relationships and inclusivity among concepts. It has helped children to see patterns, make connections and to externalize their ideas in a collaboratively way.

1 Introduction

It is characteristic of children in this age group to organize their thinking around basic mental schemas which will eventually develop into more elaborate ones. They understand basic sequencing in a story or process, such as "beginning*"," middle"* and *"end"*. They are capable of seeing the connection between cause and effect. The idea of belonging to a group or family helps them to make categories. "Same" and "different" are concepts they understand clearly. They are able to solve simple numerical problems. They are always ready to suggest different endings to a situation or story. They will give innumerable solutions to conflicts. These are children who need to express through play and representations. And above all they are highly motivated towards learning in general.

In my school teaching instruction is organized by means of objectives. These objectives are aimed at through contents, processes and attitudes. Contents are concepts, ideas to be taught. These concepts are grouped under an umbrella of topics: The Family, The School, The Body, The Seasons, Farm Animals, Transportation etc., all part of the child's close environment. The different skills are developed through mental and physical processes. Positive attitude towards learning is encouraged constantly and the children slowly and steadily work to meet the objectives.

The methodology used in the school allows the child to develop physically, socially, emotionally and intellectually. Using different resources/materials and making a good use of Information and Communication Technologies devices the child is provided with the appropriate tools to develop cognitively and emotionally. Some of the cognitive tasks used in the classroom are: pondering, classifying, collecting, comparing, contrasting, describing, discovering, identifying, predicting. Association techniques connect ideas with lines or even circles are used for this purpose. Activities implying numeric sequences are also used but these children have never been exposed to concept mapping before.

The important challenge was to create the right conditions for learning to take place. This was accomplished by showing the children a tool which could help them to see and understand the world around them, to recognise and depict relationships among concepts, and to recognise the hierarchy which supported the structure. The aim was to show them the whole picture in a snapshot. The Instrument: The Concept Map.

The research project was started with a Vee diagram, (Gowin, 1981), Figure 1.

2 Methodology: approach to the map

The subjects selected were sixteen children between the ages of three to four. All had started school in 2007; receiving six instructional sessions every day. I considered taking some of these sessions to achieve my final goal. Lessons and strategies were carefully planned, all the stages scaffolded, and time spent for each activity was taken into account plus resources and materials. It was necessary to be aware of all the skills and cognitive tasks with which the children would be involved.

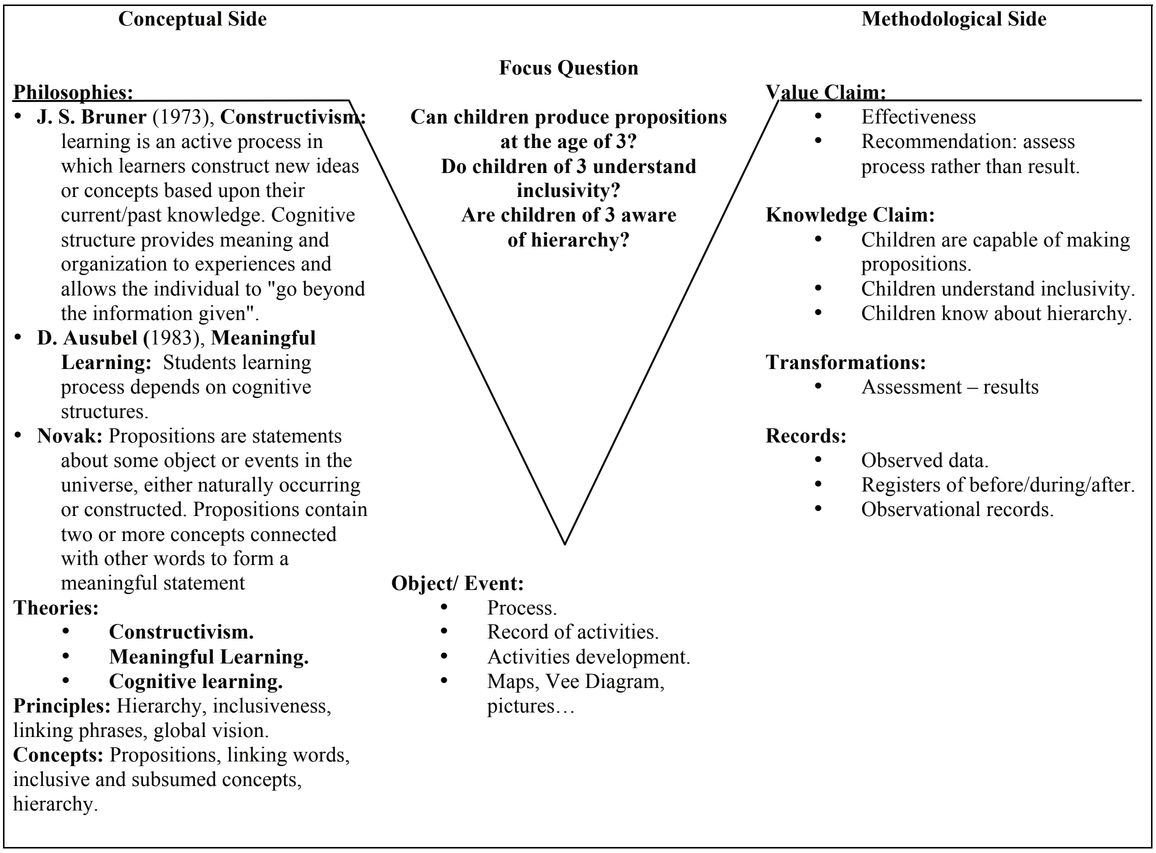


Figure 1. The Vee Diagram showing the research project.

2.1 Step 1

Firstly it was necessary to discover whether the children knew the vocabulary related to all the concepts taught in the classroom. Deloache, Uttal e Pierroutsakos (1998), discuss the symbolic meaning of objects rather than focus on the object itself. With this concept in mind and activity was created where the students had to picture-read flashcards, naming all the concepts seen so far in our lessons. Te children had no difficulty reading all the cards presented.

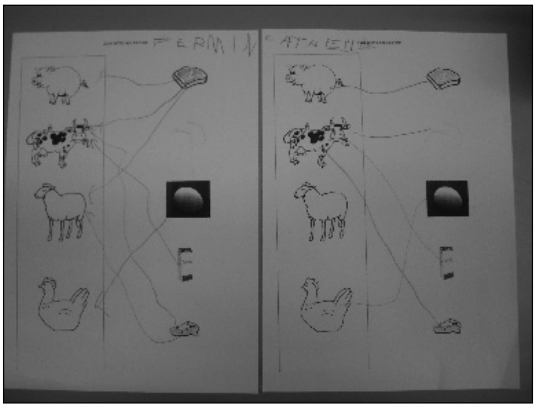
2.2 Step 2

In the next activity the idea of *inclusivity* was checked, knowing that a more inclusive concept is one that, according to the learning task in progress, can be considered a superordinate concept. The children were presented with a pack of flashcards containing: members of a family, some farm animals and some pictures of rooms in a house. The instruction for the task was to group the cards in three piles. The students quickly grouped the pictures as shown in Figure 2. When asked their reasoning for their grouping, they produced some interesting responses: *"It is a family"; "all animals live on the farm"; "we see this in a house"*. The Family, Farm Animals, The House; were the responses in which the children were showing their understanding of inclusion and hierarchy. They knew there was a superordinate level or concept from a hierarchical perspective. Randomly more flashcards were shown with images such as "*an apple*", "*some garments*". To my amazement the students started showing some recognition of the relationship among some of these concepts seen on the cards. They were producing sentences like: "*Mummy wears a hat when it is cold*", or "*we eat tomatoes*", or "*I have a dog*". All along they were making propositions, i.e. sentences containing two or more concepts connected using linking words or phrases to form a meaningful statement. The propositions are the element that makes concept maps different from other similar graphic organizers.

Figure 2. Children's first relationships

2.3 Step 3

By this stage all three focus questions had been answered. The students were showing the cognitive skills involved in Dr. Novak's concept maps. It was then that the idea of arrows was introduced to make connections and show directionality. An activity was prepared where the children had to join with arrows products with their corresponding animals using arrows. A worksheet with two columns was designed. See Figure 3. On one side were the animals and on the other side the products. Children quickly understood the task but the idea of using arrows instead of a line took a while to grasp. Different activities had to be designed to show clearly their understanding of directionality. See Figure 4.



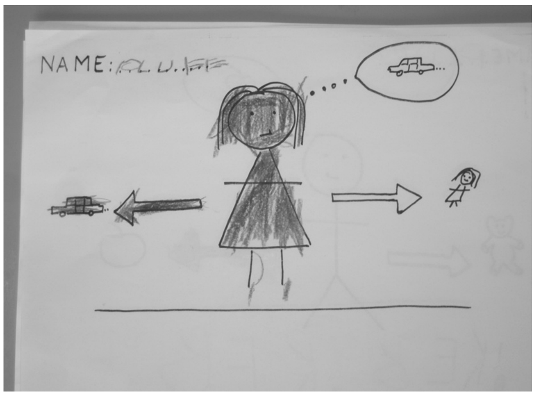


Figure 3. Activity showing inclusion.

Figure 4. Activity showing directionality.

2.4 Step 4

Knowing children were able to: see the relationships among concepts, understood inclusivity, were able to produce propositions and they understood directionality it was time for our first attempt to do a map. In the morning session the idea of maps was discussed, different types of maps were shown to the children and we talked about their use. "*With maps we can find where things are. We can find where the house is, we can see roads, names, little pictures of buildings*". The children were taught that maps could be used for different purposes and that they were going to be shown how to do these. Like a real map, their map was going to have roads and labels and pictures were going to be included.

I prepared a huge piece of white paper along with some arrows made of straws and the flash cards which had been used consistently. A group of only four children were trained to concentrate better on the task but before the session was over some other children had joined in and were also making suggestions. This was a magical moment as the different children were seeing different relationships among the concepts and the arrows were pointing in different directions. They were learning from each other. My instructions were clear and concise, I would flip the cards and they would have to tell me were to place them and how to connect them with the arrows. The first card to appear was the cat, and everyone agreed it had to go on a corner of the paper. The second card was the picture of a mother and it was placed on the opposite corner. The third card was a picture showing an ear, the children decided to put it in between the mother and the cat with arrows point both ways as mothers and cats have ears. The map was forming and little by little the children were not only placing the cards and placing the arrows they were debating their arguments and their reasoning for their decisions. When the picture of Father Christmas appeared there were two different responses. Some children decided it had to be linked with the cold weather, but another child said it had to be connected with the family, their reasoning being that "*Father Christmas comes when it is cold"* and *"Father Christmas brings toys to the children in the family"*. So arrows were placed pointing in quite different directions, towards the family and towards the flashcard that represented cold weather. See Figure 5.

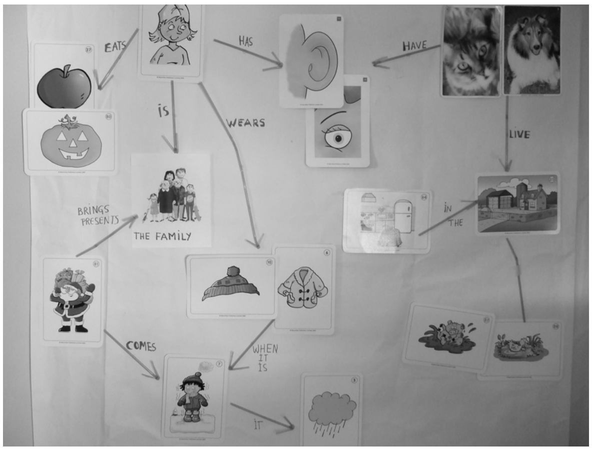


Figure 5. Children's map

Little by little and through guided questions the children constructed the map, they watched carefully how connections were made and they saw the linking words used to connect the concepts.

3 Summary

This research project has shown evidence of children's ability to understand the concept of inclusion, hierarchy and their ability to make propositions. Therefore I see concept maps as a useful instructional tool even in preschool education. The concept map has also proven to be a valuable assessment instrument, while the children were organizing the map they were showing their understanding of the concepts learnt throughout the school year. The collaborative work and the way the children externalized their ideas was another positive aspect of using concept maps, so further research will take place to look into the many possibilities of concept mapping and its use in preschool settings.

4 Acknowledgement

This paper was supported by Fermín Mª González García, Professor at the Public University of Navarra. Special thanks to Rhisiart Tal-e-bot and Christine Ferguson, for their help with the language, and special thanks to the children in my classroom who respond positively to every idea I propose.

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VISUALIZING GRAMMAR

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Abstract. The distinction between casual and academic or formal English is highlighted as teachers and students come to realize the language required for success in school settings necessitates a greater level of commitment to achieve. Academic language development is explored using SDAIE (specially designed academic instruction in English) to facilitate acquisition of grammar and IHMC CmapsTools are used to assist with hybrid and on-line teaching. Emphasis is placed on the combined usage of the instructional strategy and the learning tool.

1 Introduction

Teaching academic writing focuses attention on academic language development. Academic language must be taught especially to second language learners. One of the cornerstones of academic writing is knowledge of grammar rules. As second language learners develop mastery of the various levels, it is usually with an eye toward academic and professional writing. Students entering college with this goal in mind face numerous challenges and grammar is the first hurdle.

Choosing an instructional approach to ensure the development of academic and professional language is critical. Tools such as this enhance the intructor's teaching practices and are important for student success. An instructional model, SDAIE, (Specially Designed Academic Instruction in English) http://www.lbschools.net/Main_Offices/Curriculum/Areas/SDAIE is presented in this paper which integrates language development within the context of academic English, utilizing IHMC CmapTools as a resource to guarantee that new concepts and rules introduced are more easily remembered. http://cmap.ihmc.us

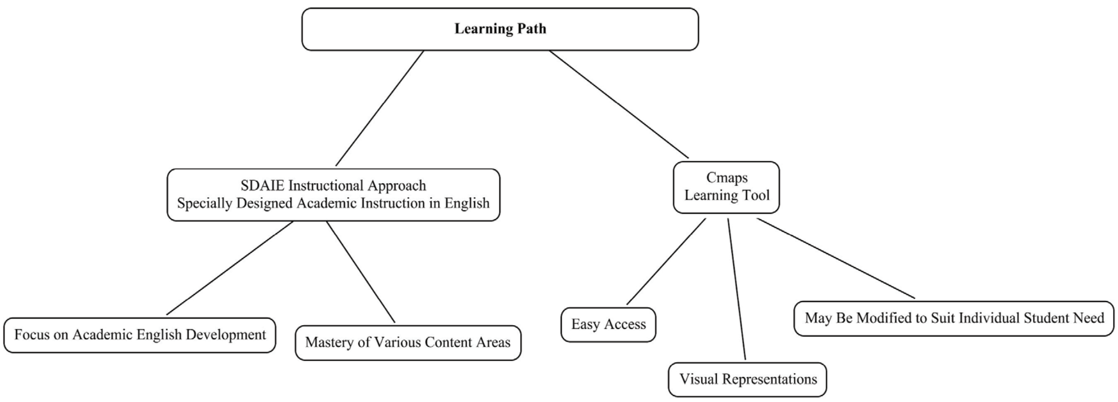

Figure 1. Combining Instructional Strategy and Learning Tool

2 Discussion

Howard Gardner highlighted different learning styles in his research over thirty years ago, and explained how this perspective enabled more students to remain engaged at any given time during a lesson. Varying the presentation increased the likelihood that the various intelligences would be used in mastering new material (Howard Gardner, 2006). As attention to on-line (OL) learning intensifies, his message appears to be more valuable than ever. In addition, as personal and world economies shift, many students find it difficult to purchase textbooks, or given their non-academic workload dedicated to contributing to the family income, complain of not having time to read an entire textbook. Consequently, they rely solely on the availability of readings in the reserve room of the library, which are limited in number. This harried world that tries to learn so much in so little time, poses a challenging problem for today's educator. Therefore, combining the SDAIE instructional model with CmapTools ensures that students engaged in the learning process have easy access to grammar rules during the writing process.

The elements of SDAIE include: the use of graphic organizers, in this case, CmapTools, grouping strategies to facilitate cooperative learning in the virtual or actual classroom, consideration of various learning and teaching styles, and where appropriate adaptation of the text. While being mindful of the language level of the students, attention is also paid to accesssing prior knowledge, and increasing wait time in consideration of reducing the affective filter. Academic language learning is further supported by modeling in the classroom or OL with repetition through constant use of the target vocabulary. Students are taught to become aware of their particular strategies to master material, such that those strategies can be modified by the individual, as the need arises.

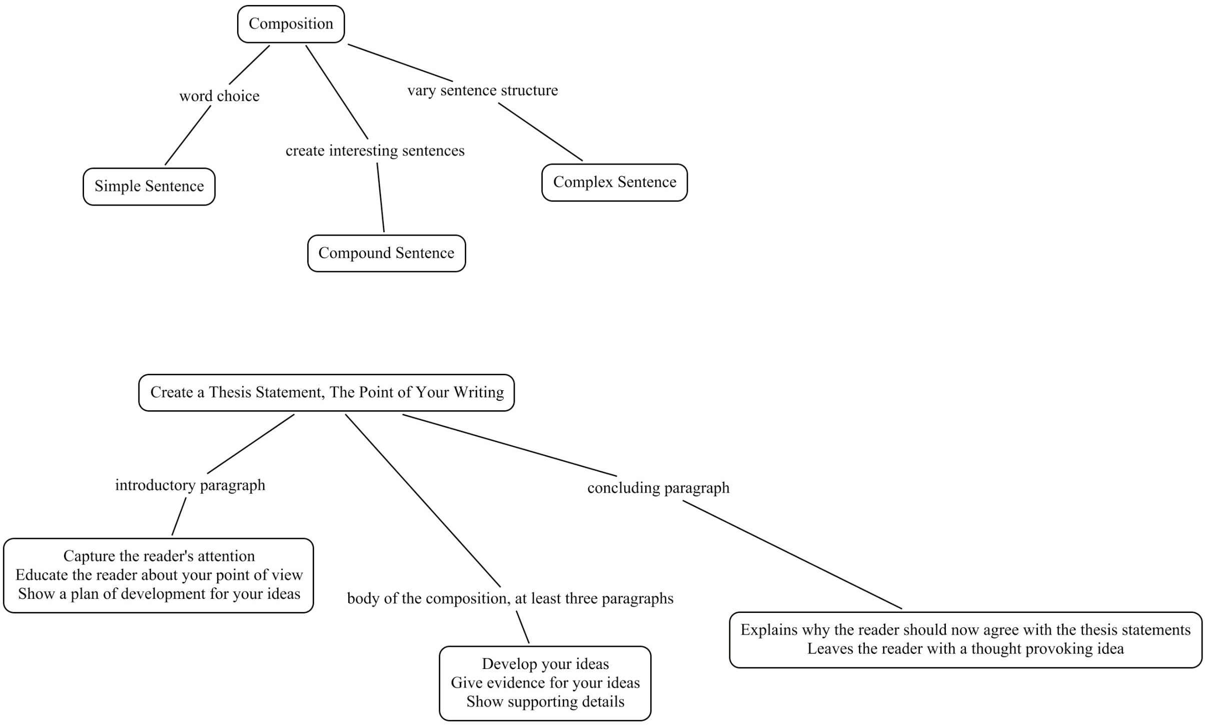

Figure 2. Creating a Composition at a Glance

CmapTools facilitate memorization of the rules required to dominate the language. Within the context of interactive learning experiences, students utilize vocabulary and concepts in the classroom environment to deepen their understanding in a hybrid or OL environment.

Given the cognitive demands of academic language, and the focus on meaningful opportunities to utilize the combined approach of SDAIE and CmapTools in an authentic situation, the students quickly come to realize the benefits of this approach. They become aware of moving from the big picture to specific ideas within a topic. Gaining access to the subject matter in a second language through the use of context embedded language with the help of a handy reference guide such as CmapTools, students learn to use the language as a tool to understand a subject rather that to simply focus on language learning itself.

Within this context, students are exposed to a wider range of the target language and discover that use of the language enables them to access a world of ideas thereby empowering them in the process. Students have the opportunity throughout the learning process to review grammar rules and re-use the new vocabulary taking advantage of the collaboration of SDAIE and CmapTools using themes in teaching to ensure the familiarity that develops enables the students to have greater confidence and therefore a better experience. With this language as meaning making approach, language is kept whole and its rules kept handy. As Freeman and Freeman point out, "…an important part of learning is the process of constructing meaning by determining which parts count" (Freeman and Freeman, page 87, 1993).

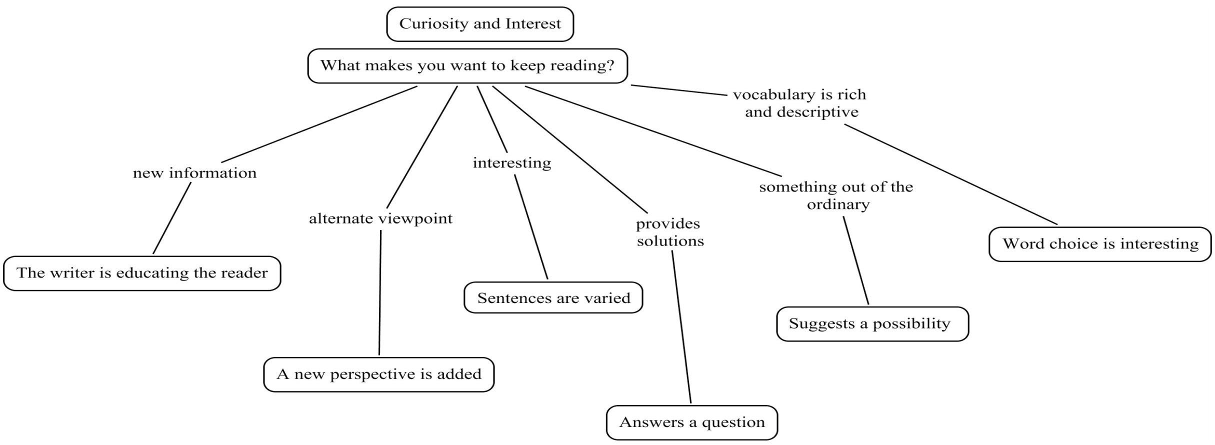

Figure 3. How a Writer Stimulates a Reader's Interest

3 Conclusion

As students use all four aspects of language: listening, speaking, reading and writing, and evolve an understanding, they discover that yes, language is about rules, but it is also a tool to be used to negotiate meaning. With this dual focus on self-efficacy and academic competence, students learn early on that writing is as important as listening, and reading is as important as speaking. Taking charge of the personal learning process through the use of CmapTools is efficient and empowering.

The use of SDAIE strategies ensures that teachers do not oversimplify the subject matter by focusing the English language development exclusively. The use of CmapTools illustrates that there are many roads to the same goal. Using the strategies and tools together allows the teacher to present the curriculum materials in their complexity in a top down fashion so that students see that the parts they know belong to a whole. This makes certain that students are in a position to place themselves within the total picture of the learning experience, giving themselves permission to learn as much as possible.

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