

## COLLABORATIVE CONCEPT MAPPING MODELS

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**Abstract.** Starting from various examples of practices of Collaborative Concept Mapping within partnerships from different schools countries and students, we will design some models of collaboration, that will be compared and criticized, in the hope that these would be useful to other teachers to challenge and plan suitable strategies to get engaged in similar experiences. To this task it is important to examine first some theoretical background to show the reasons why this kind of collaboration should be recommended as an educative target.

### 1 Introduction

Our community of practices is aimed at establishing concept-mapping collaboration teams among groups of students from different countries. Differently from other international twinning initiatives (e.g.: eTwinning in the European Lifelong Learning Programme) this community is non-official; it is on care exclusively to teachers' free time; and above all it is based on concept mapping only.

The topics of collaborating teams are mainly curricular ones, about environment, citizenship, history, specific science topics, etc., depending on the preferences of the involved teachers. But nevertheless it is possible for partners to deal of intercultural topics or to debate about educative issues among teachers members of the community.

The choice of Collaborative Concept Mapping (CCM in the onwards) has twice the value: concept mapping firstly facilitates the engagement of teachers of non-language subjects, as L1, History, Maths or Science teachers, although a side-support of a L2 teacher is welcome. Secondly, concept mapping is both a communication medium and a target as a learning tool for metacognition.

If these collaborative practices and technologies want to be of positive impact on the local educative communities, they should be agreed with proper objectives and shared expectations from both the school partners, and should be helped with suited strategies to assure an effective interaction and sharing among students. These are the reasons for we want study in depth the educational objectives and the strategies for effective CCM.

### 2 The context of CCM

*Collaborative Learning* (CL) is a quite different task in *presence-based* education (for groups of students in the same classroom) and in *distance-based education*, where students may collaborate from different countries. First of all, a *face to face promotive interaction* is not possible anyway in the distance based CL; the mother tongue is often different; communication depends on different technologies and different time zones (for instant messaging); culture, behalf and awareness for cosmopolitanism, educative missions, priorities, objectives, curricula, can differ a lot among the partners. All these differences, that often risk to be undervalued, strongly affect the effectiveness of the collaboration task. Moreover, the relevance of such international collaborations, and the related educative results, are not evenly appreciated and promoted by the different involved institutions. These factors are somewhat related the concept of *governance* introduced by Gowin and Novak (1984). Actually, the entourage that surrounds the collaborating team may modify the development and the *sustainability* of the collaboration, because of presence/absence and quality of feedbacks.

We know by experience that children have a strong affection for mates from different countries and we don't need to make big efforts to convince them that the partners have similar characteristics: they have curiosity, a teacher, an objective, that they are working on shared concept maps etc. We have rather to care sometimes that they can appreciate *differences*, because they identify their partners to themselves. Even if they leave to their teacher the most part of the decisional and strategic tasks, they also rely on their teacher to know that the collaborative task is worthy and this is enough to confirm their strong motivation to carry on the collaborative work and to consider their partners as really being members - friends of the same collaboration team. For the older, the teenager students, we experiment a completely different behaviour. They are generally less curious for every reality not belonging to their life experience and strongly selective about the people and

the activities that are acceptable into their *emotive sphere* or that must keep off. It is not enough for them that their teacher believes in the collaboration, because they are highly influenced by the context of other mates, other teachers and parents. If the context is not aware of the meaning of a collaboration, the team becomes informal and not inclusive of the emotive spheres of its members. We should remember that teenagers are more sensitive to the governance factors and that we have to prepare the context, if we want the team working won't proceed as a matter of duties with "strangers" as partners.

### 2.1 Collaborative learning approximating to cooperative learning objectives

Once governance factors have been considered, the sustainability and the effectiveness of collaborative work depend strongly on efforts towards the attainment of other well known requirements of the Cooperative Learning model (Johnson & Johnson et. al., 1994).

We are aware that *interpersonal and small group social skills* training should be strongly implemented from the very beginning of a collaboration, while *individual and group accountability* need to be assured along the developmental process. Therefore, in the current collaborations experiences, we care for direct – daily communication having place, between student and teacher partners, helping them in the construction of suitable communication skills, technologies and methodologies, independently by the contents to be elaborated in the following CCM activity. This latter would be a sterile one without the vital habit to communicate and leave feedbacks among partners.

Finally, *group processing*, i.e. the reflection on the work of students and their interactions, the focuses on achieving the group's goals and ensuring effective working relationships, has been placed to the teacher's care. But as a matter of principles, this job should be conferred to the team members, in the case of older students. The objective of Collaborative Concept Mapping via Web is to approach, as much as possible, the five basic criteria of Cooperative Learning, that are: Positive Interdependence, Individual Accountability, Face-to-Face Promotive Interactions, Use of Collaborative Skills, Team Self-Assessment (Johnson et al. 1994). Absolutely speaking, F2F promotive interactions are impossible in distance collaborative learning but a sort of promotive interaction is made potentially possible through the coexistence of feedbacks and contributes, as knowledge claims, coming from different partners of the team. These "ingredients" can generate or not what we call an "*active collaboration process*": if in a concept map or in a knowledge model there are knowledge claims coming from different members of the learning community that are conflicting, faulty, superfluous, duplicate, incomplete or incomprehensible for someone, we can observe what happens in time. If these faults will provoke some proper feedback, or interactions between the member of a team, we shall affirm that an *active collaboration process* is functioning. Feedback replies are more important than the subsequent editing or adjustments that can have place, also, pushed by the teachers in the unawareness of some members. Feedback-communication is the first warranty that integration between individual views or cognitions is possible. And therefore, this is the condition for the construction of the conscience of being a learning community. So we are continuing with our analogy between the integration process that takes place in progressive differentiation and integrative reconciliation of Ausubel's-Novak's principles and a different integrative process (Novak & Cañas, 2006) that concerns *collective knowledge* (Reigeluth, 1999), both processes being facilitated by concept mapping.

The time lag between the generation of a problem in a dynamic concept map and the generation of a feedback, or the time interval that passes from the feedback and a reply from other members, can be considered as the "clock frequency" that measures the rate of activity of the active collaborating team. An online learning community can have obviously only a reduced rate on respect to face-to-face interacting teams, but we believe that it exists a minimal threshold under which we can declare the process as inactive.

Provided the above conditions are rather complex and not always controllable, the working teams in *our community* cannot be considered as a flat terrain where formal research questions could be easily planned and carried out. They are rather fertile soil where good practices of collaborative concept mapping and amity could be nurtured through the years.

We hope, however, that a greater awareness of the difference between simple *collaboration* and *cooperation* will help us and the future partners, to prepare more effective collaboration teams.

## 2.2 *Special role of concept mapping*

In the constructivist perspective, a concept map is viewed as a process that reflects the accommodating steps in the changing of organization and definition of individual or group cognition about the same knowledge domain. This kind of concept mapping (Cañas et. Al., 2004, Henaó Cálad, 2004) is dynamical in all its aspects and it serves to the learner, to the educator-mediator and to the external reader, in decreasing order of engagement in the dynamical processes-tasks of learning and collaboration.

In details (Novak & Cañas, 2004, 2008) a concept map include concepts, usually inside closed shapes, and relationships indicated by a line and by words on the line connecting two ore more concepts, forming propositions, i.e. meaningful statements o “units of meaning”. But a concept map is more than a network of propositions. It has a context that can be identified in a text, a laboratory activity, or a particular problem that one is trying to understand. The awareness of the context and of the domain framework will help to determine the hierarchical structure of the concept map. A good way to define the context for a concept map is to construct a *Focus Question*, that is, a question that clearly specifies the problem or issue the concept map should help to resolve, and that contains the level of arbitrariness of the c-map.

In its dynamic perspective, a concept map can be viewed as well as an open ended platform where a learner structures his attempts of accommodating his/her previous knowledge and to subsume new knowledge. This integrative process has been described as electively facilitated by concept mapping (Novak & Cañas, 2006). In our opinion this is due to *three fundamental and unique properties of concept mapping*, that are:

- a) the “immediateness” character, that is the possibility offered by the two-dimensional plane to make coexisting and clearly visible declarations that are separated in time sequence and in the logical flow;
- b) the “flexibility” character of concept mapping, i.e. to the possibility of free changing of the concatenations, of the ranks of concepts and to adjusting the type of relations;
- c) to the “disciplining” character, consisting in the requirement of make every proposition meaningful, explicit and unambiguous as a statement, or semantic unit inserted with a precise and explicit role in the framework.

We maintain that the same characters of concept mapping work to facilitate integration between cognitions of different people interacting as well, as can be required in the educative mediation and in collaborative concept mapping. Concept mapping becomes both a privileged medium of interaction, comparison and negotiation of beliefs, meanings, opinions about the same subject, and also an educative target as a learning tool that can make a difference in the education of single learners.

An important additional aspect of concept mapping is about multilingual collaboration. As we have illustrated elsewhere (Tifi & Lombardi, 2006), there is a great advantage in sharing ideas and knowledge claims in L2 if these are coded in concept map language, rather that in plain text, for pupils with very basic skills in L2. Due to the elementary propositional structure of concept maps, CCM facilitates the elicitation and the representation of knowledge, reducing the speech to its essentials, simplifying the negotiation and convergence of views for effective communication and sharing, also if collaborators speak different languages. We have proposed the use of bi-trilingual concept maps with bi-tricolour font-typing to facilitate the passage from L1 to L2 and the achievement of reciprocity and mutual understanding of the contents and contexts. Decoding a L2 concept map to L1 is analogously very easier than translating a linear text.

## 3 **Factors for successful CCM**

Our first experiments on CCM dealt on the basics: twinning of teachers, creating a community, sharing of tools (IHMC CmapTools) and technological know-how, finding a common model for concept mapping, that is the Novak-Cañas model (Novak & Cañas, 2008; Tifi et al. 2008), adapting it in a set of rules for students facing concept maps for the first time, searching for relevant and interesting topics to develop in the teams, thinking about how to coordinate and alternate the contributes of the students in each team.

We have tried and we are trying different strategies for web-based concept mapping collaborative learning, that are targeted to enhance *positive interdependence* and *motivation* among the members-students. These strategies will be deeply and theoretically discussed and generalized in this paragraph.

### 3.1 Sources of motivation

Motivation can be as well a good outcome of the process, generated by a happy choice of strategies (above all the preparatory stage), a clever planning setting and initial agreement sharing of objectives.

#### 3.1.1 Starting from curiosity

First of all we should ask why we want to engage ourselves, as teachers, in a concept mapping - web based - collaborative learning project, given that the conditions for learning - in such an unusual modality of education - are sufficiently hard to fulfil even within the boundaries of a single class, locally. We adopt from the children the answer to this question. In several occasions, we have perceived their positive emotive feedback when they were realizing that they were going to collaborate together with other children, “on the other side of the computer”, and that those overseas children had the same expectations, the same enthusiasm, same longing to collaborate. So the first rule consists of amplify the emotive impact, by complying their eagerness to exchange personal information with their partners. One or more chat meeting or videoconferences can be a suitable way to achieve this objective, that finds its value also in exploiting the instinctive sense of cosmopolitanism of the children.

#### 3.1.2 Choice of the topic

We often choose the topic of collaboration, but a different line of conduct is winning if it should support and guide the children’s interest: within a given general theme or subject, dictated by the class curriculum or by the general purposes of the partnership, we should leave the children free to choose the specific areas of interest that they want to develop. Children are often unexpectedly autonomous in defining a field of leading interest, due to previous experiences, or to some information partially known, maybe for the desire to engage themselves in something new with the sake of surprising their partners.

#### 3.1.3 Documentation resources

For the younger, the documents should be properly chosen by the teachers to permit an autonomous and easy research and reading by the children. We have experiences of children that decided autonomously to meet out of school time, to study documents. For older students, it is advisable to let them search for the resources or browse in a predetermined list of links. Moreover, to foster interest and engagement, it is possible to assign a topic that is of pertinence of the other partner (as an example Italian students may study alterations of Nile valley environment, while Egyptian students in the same team could study analogously the alterations of Po river valley, about which Italians are more informed. This exchange of competencies could enhance the reciprocity and encourage the subsequent stage of peer reviewing. Furthermore, another factor that might motivate collaboration is the availability of multilingual sources, as books or as the U.E. portal: <http://europa.eu>. This is a factor of motivation as it assures that the other partner share exactly the same resources of ours, in the same words.

#### 3.1.4 Quality and timing of interactions

In a collaborative frame, that is for the objective of this paper, it is evident that the collaborating partners working at the same concept map, should decide jointly a knowledge domain and a focus question, and to agree upon criteria and time schedule to alternate and differentiate the contributions of each member and to keep a chronological log of changes.

When the partners have to wait a long time for reading the next contribute of other members of the team, this lead not only to a slow down, but even to a discouragement in that team. This negative factor could be avoided through an agreement of the members of the team to a self-disciplined timetable. For children the respect of scheduled times is entrusted the teachers coordinators.

The quality of collaborative interactions depends on the availability of technological tools as well. A software as IHMC CmapTools includes features that allow students, as well as teachers, to interact and question each other. The easiest way is to use the “Annotation tool”, that is a ‘post-it note’-type of annotation by which to post short advices or comments on other each others concept maps or on the same shared concept map. When a single knowledge claim has more than one of these alike annotation icons, these become confusing. This drawback can be overcome, with a little more click, by attaching a “Discussion Thread” to any knowledge claim or concept map element (concept node, linking phrase, folder). At a higher level of complexity and potentialities there is another collaboration tool, named “Knowledge Soup”. A Knowledge Soup is a repository of shared and independent knowledge claims that are subjected to questioning and negotiation before being picked out and

adapted in the concept maps. A knowledge soup can be considered as a preliminary stage that permits knowledge to become meaningful for all team members, facilitating the integration of heterogeneous knowledge in the concept maps, in the next stage. All these powerful collaboration tools, if correctly managed by the students, may stimulate positive interdependence and promote interactions, with efficacy on motivation.

### 3.1.5 Concept mapping skills

Coding knowledge as propositions in concept map can affect individual motivation towards the collaborative task, depending on the concept mapping skill of every individual member. The syntax of concept mapping can represent sometimes an hard struggle for older students, independently by their metacognitive attitudes and by the meaningfulness of their learning style, because cognitive structure of the adult people can be characterized by high levels of “connectiveness” or by a prevalence of complex sequential structures that aren’t easily reducible to elementary propositions, relatively independent one of each other (Tifi et al., 2008). Not everybody accept the worth of deconstructing in depth and recoding their knowledge in such “format” that follows a set of “strange” rules. This is true especially if these adult students haven’t ever had experience in concept mapping in their previous education. The same problem is very attenuated for children, as they have naturally a language that is closer to the elemental articulation of concept maps. To prevent a possible “discouragement effect” in the “predisposing” cases, we suggest some precautions: a mini-training session can be proposed, accompanied by a video or a presentation of the several steps in the construction of a concept map, where the application of each criterion is well highlighted, and by an exercise of constructing a concept map from a short and familiar text, followed by a proper feedback from the teacher-trainer. A similar training can be also useful to prepare the team members to use the collaboration tools and other basic features of the software.

The preparation of “skeleton concept maps” (Novak & Cañas, 2004) can also help to overcome the initial impact due to conventions of concept mapping. In these “initiated concept maps” the focus questions have been already stated, the root concept (that is the top high concept in the pyramidal structure of the c-map) and some of the first level concepts, have been already placed in the layout, together with some other nodes that need to be labelled, suggesting a possible structure to be continued.

### 3.1.6 The products of collaboration

We know, as educators, that a good process is more important than nice final products and that our best result is when the online learning community wants to keep collaborating in the future. Nevertheless students in the learning community need a precise and concrete target to attain. This target could consist in a reviewed concept map or knowledge model made of a certain number of pre-assigned focus questions and concept maps answering to these questions. Sometimes the lack of such a well defined target (because of the “open-endedness” of sources and of all knowledge) is interpreted as a sign of arbitrariness that may be used to “justify” a sort of permission to get rid of the individual responsibility and of the care for interdependent team processing. The background idea is that the possibility of having a clear objective to pursue, that is perceived not too far from the current attainment, can represent a motivating push.

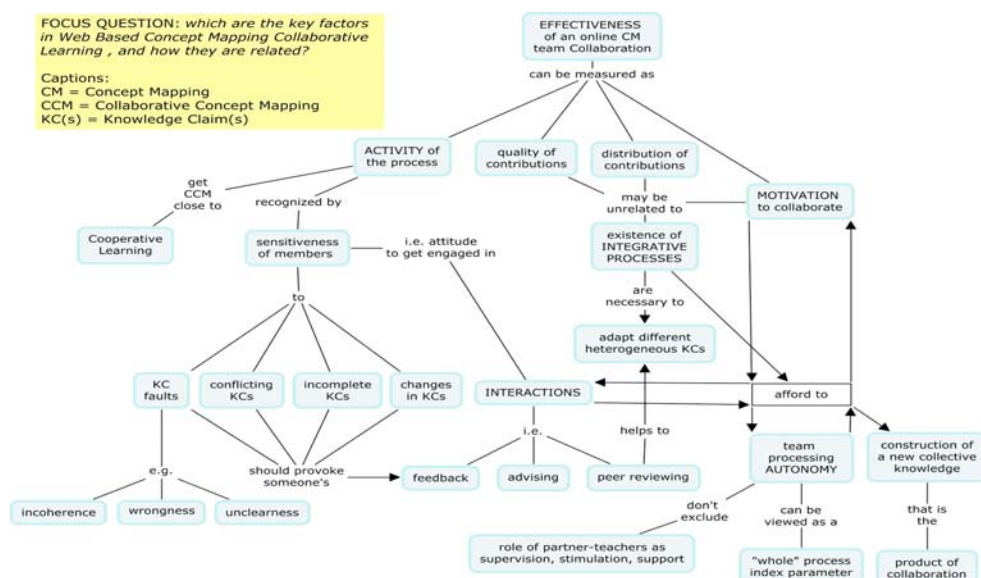


Fig. 1. Key influences in Web based CCM, as elicited in the analysis of motivation related factors. Double arrows indicate a synergy effect.

### 3.2 A survey of strategies and methods

The key aspect of a concept mapping collaborative learning process is represented by the method used to integrate knowledge claims and sharing of productions.

#### 3.2.1 Comparison of independent concept maps

The easiest form of collaboration is when partners work on separated multilingual (for the sake of mutual comparison) concept maps on the same topic (maybe with the same focus question, yet generally biased for local context, environment or culture). Partners are tied up by the sharing of the same task applied to their local realities. Motivation to know the contributes, and to interact with the other partner, comes by children's curiosity and by the teacher's push to make them learn from peers instead of textbooks, and is not demanded by true interdependence. Collaboration among younger children was often set in such way that has its strength points in the simplicity and freedom of timing.

#### 3.2.2 Alternated contributes on shared concept maps

A little more complex type of collaboration uses an alternation of contributes from the several partners on the same shared concept maps, or a mixed strategy of independent development that is followed by addition of contributes and revision –accompanied by restructuring claims - from a different partner.

The first sub-method of “simple alternation” seems more practicable than the mixed one, for younger children, because the mixed one requires an higher level of mastery in the comparison and in the criticism and rearrangement of concept maps and of knowledge claims of each others, in a *non-additive-integrative* process that is more feasible with high school students and adults. Children are more likely concerned in exploring and taking note of the contributes of the other partner and in finding further evidences and knowledge claims to answer the focus question, in a substantially *additive* process. The extent of interdependence is evidently higher in both these forms of collaboration than in the comparative strategy (3.2.1).

#### 3.2.3 Mixed alternated-independent concept mapping and peer reviewing

As we have depicted in 3.2.2, in this model the different partner initiates to construct individual c-maps and then, first to become more complete, these c-maps are examined and reviewed by the partner. The revision consists of putting annotations with claims or suggestions, or of adding new propositions, copying and reorganizing the c-map in a different arrangement. This means that this model of collaboration has as a strength point that is more flexible and less constrained than the one that is based on alternated contributes on c-maps that are shared from the beginning. It has as a weakness as being characterized by scarce interdependence in the first stage of unshared concept mapping.

#### 3.2.4 Shared concepts + peer reviewing

The strategy based on *sharing of concepts* has been used successfully to maximize the interdependence in a CCM collaborative learning team that was created with the purpose of facing a *new curricular topic* (atom) that was previously chosen by the two teacher partners. The two teachers agreed to divide the theme in four sub-themes, described by as many focus questions that formed a continuum in the curriculum. Each subtheme was assigned to a sub-team. The first stage was the *search for the key concepts* in every context, a task that was accomplished collaboratively. Italian (Divini's) and Rumanian (St. O. Josif's) students picked out concepts through the examination of resources in the mother tongue that were selected in advance by the teachers, mainly from the course textbooks belonging to the students, but also from shared resources from the web in English. It is important to notice that *a)* the work of concept eliciting has been continued also in the subsequent work of concept map construction, as students went into the concern; *b)* they were informed of the focus question of each sub-domain of knowledge when they started this job; *c)* contributes-exchanges of relevant concepts from other sub-teams of the same community was welcomed at that stage.

In the second step, the local groups of Italian and Rumanian students in each team copied separately the concepts from the gathering page and pasted them into new empty resource file, where they started to construct new concept maps, being minded of the sub-topic focus question. Remarkably, during this stage the students frequently asked their teachers for supports to understand the hard points of the subject and for suggestions about the organization of knowledge in their maps.

In the latter stage, it was initiated a work of peer reviewing, where the Italian students reviewed the Rumanian concept map in the same subtopic and vice versa, through addition of annotation queries to the

partner. The critical innovation in this project has consisted in the use of shared gathering concepts. This task was appreciated for its simplicity to give interdependence and trigger collaboration from the very beginning.

### 3.2.5 Collaborative reading of texts + Knowledge Soup sharing

The three partners collaboration project “History Maker Molecules”, that we’ll call HHM onwards, constituted an experiment about *collaborative reading of a shared book*, facilitated by concept mapping and Knowledge Soups. The two distant Italian partners and the Spanish one, shared the same book, *Napoleons buttons, 17 Molecules that Changed History*. This book had a high motivating and intriguing power on both teachers and students. Six students from 14 to 16 years old from each partner school have chosen three chapters of the book by means of a poll based on the titles and paragraphs index. Two students of each class have been assigned to each chapter-team based on the priority criterion of their previous preferences, and so forming three teams of six students. Working on the English edition of the book for all, team students started to gather relevant knowledge claims from *portions* of the chapter. This task was accomplished by means of highlighting paper copies of the text. Then the students were instructed to transform such elemental knowledge claims in “mini maps” that were copied and shared as “gathering resources” i.e. as c-maps through CmapTools. This step is not as easy as it seems, because this kind of analytic reading implies *a)* to elicit concepts and relations, *b)* to decide which concepts are subordinated to which and *c)* to choose the way to “quantify” the top-concepts, i.e. how to cluster attributes and to create articulated concepts adaptable to the context. The effort in analytic reading was also the main reason that made this project so interesting for all the involved teachers.

From the gathering c-maps, the next step was to collect knowledge claims in a Knowledge Soup, a task that is automatically accomplished by associating the gathering resource-map to a *Knowledge Soup*. The knowledge claims coming from all the gathering resources of the same chapter, have been easily published in the Knowledge Soup of that chapter. Finally, the students begun to assemble the knowledge claims as propositions in several c-maps for each chapter, obliged by the rule to insert at most four propositions a time in the same map, and then waiting the contribute of another partner, before to add further knowledge claims. This rule was established to prevent asymmetrical developments of the shared concept maps by one of the partners, and it was effective to set up interdependence.

This experience was very rich of advices for us, and as a conclusion, the lesson for future experiences in collaborative reading in L2 (perhaps also in L1) can be synthesized as follows:

1. The units of reading, from the book, should be narrowed to single specific contexts, each of them containing no more than 30 - 40 concepts, prior of being faced collaboratively;
2. the analytical reading of each reduced unit should be accompanied by direct concept mapping by every member and direct publication of knowledge claims in a single shared knowledge soup for that unit.
3. the whole team should deal with one of such units a time, progressing from each unit to the next, until the complete chapter would have been read and transformed in customized individual concept maps. Knowledge Soups should be used for sharing claims and interacting with the partners through discussion threads, questioning advices, and propositions in the concept maps.
4. a skeleton c-map could be used to create an hyperlink-index guide to the browsing of the knowledge model about the book, and, at the same time, it can be further developed from top – down to give a deeper vision of the chapter as a whole ensemble.

The complete documentation of all the experiences is available from the Authors by request and navigable from <http://www.2wmaps.com/Eng.htm>, link “Keyhole”.

## 4 Conclusion

Our research of optimum strategies for distance CCM is not ended yet, and it is worth to remark that suited solutions can also be freely searched for in each team, depending on the requirements of the topic to be faced. The model for CCM cannot be taken for granted anyway, and the collaborators should agree and be aware of it.

Collaborative Learning via Concept Mapping is in our views an open door towards great opportunities: to enhance education of students, to offer positive stimuli for the governance quality of the institutions, and challenges for the teachers engaged in new methodologies and technologies. We strongly believe that collaboration in an international team group helps to improve a second language, to acquire an intercultural sense, to widen the students’ self-perspective and the interest for the others, to overcome the sense of closure due to the repetition of curricula and to the crystallisation of roles. Beyond the opportunities to make our

students protagonists, we wish them to share new communication experiences - collaboration tools and resources through the web. In this sense, differences rise to the role of resources.

Finally, we believe we are reaching our first aim as founders of this community (promoting concept mapping in education), provided we are realizing that some students are creating concept maps for their own studying purposes, from outside of their working team.

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