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

San Martín Echeverría, Inés; Albisu García, Sagrario; González García, Fermín. Universidad Pública de Navarra, Spain
Email: ines.sanmartin@unavarra.es, albisu@unavarra.es, fermin@unavarra.es

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 CMap Tools 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).

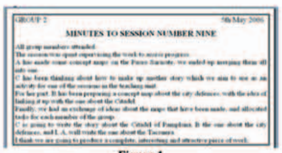
Bearing in mind that these theoretical assumptions can be operationalised with the help of CMapTools, a computer program designed to support collaboration in cooperative knowledge construction and knowledge sharing and thereby facilitate meaningful learning (Albisu, San Marín,González, 2006: Cañas et al., 2003), 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 CMap Tools Software and the construction of "V" diagrams (González,2008).


GROUP 2

MINUTES TO SESSION NUMBER NINE

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 Cmap Tools. Figure 1 shows an example of one of these reports.

2.1 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.

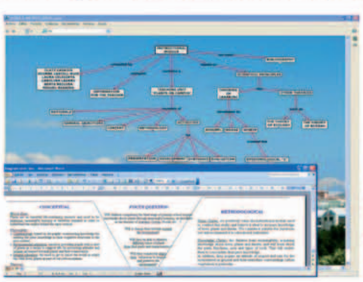


Figure 3

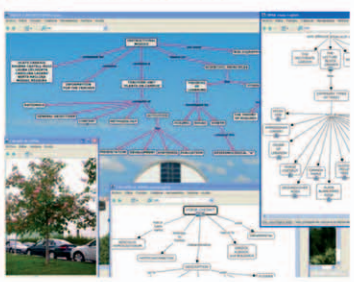


Figure 4

2.2 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 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

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 CMap Tools 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

We are grateful to Iñaki Urtasun for his assistance with the graphics

References

Albisu, S. San Martín,I.,González,F.(2006) . Aplicación de los MMCC y de la V de Gowin en la elaboración de módulos instruccionales en alumnos de magisterio. Proceedings of the Second Internacional Conference on Concept Mapping. Alberto Cañas & Joseph Novak, Editors. Universidad de Costa Rica

González, F. M.(2008). El mapa conceptual y el diagrama V. Recursos para la enseñanza superior en el siglo XXI. Madrid. Narcea.

Guruceaga, A. & González, F. M.(2004): Aprendizaje significativo y educación ambiental: Análisis de los resultados de una práctica fundamentada teóricamente. *Enseñanza de las Ciencias, 22(1), 115-136*

Meichenbaum D. & Biemiller A. (1998): Nurturing Independent Learners Helping Students Take Charge of their Learning. Cambridge, Massachusetts: Brookline Books.

Novak J. D. & Cañas A. J. (2003): Construyendo sobre Nuevas Ideas Constructivistas y la Herramienta CmapTools para Crear un Nuevo Modelo para Educación. Institute for Human and Machine Cognition www.ihmc.us

Lobato Frailes, C. (1998): El trabajo en grupo. Servicio Editorial de la Universidad del País Vasco.

Vigotsky, L.S. (1979): El desarrollo de los procesos psicológicos superiores. Barcelona. Grijalbo.

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 Mendía, 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 CMap Tools (Cañas, 2006) 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 CMap Tools (Cañas, 2006). 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 CMap tools* (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.

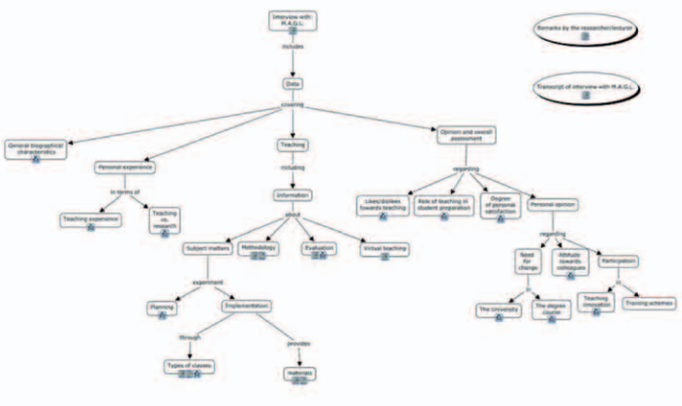


Figure 1. Concept map of the knowledge elicited from the "good practice" lecturer

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.

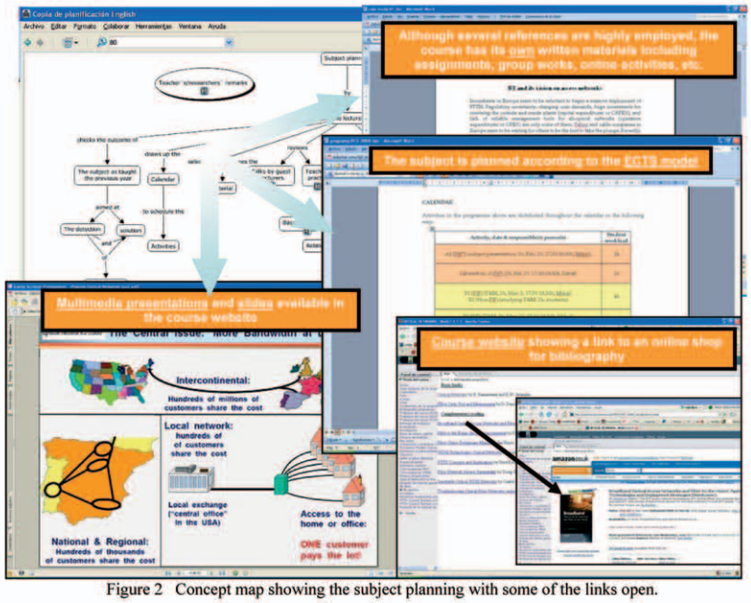
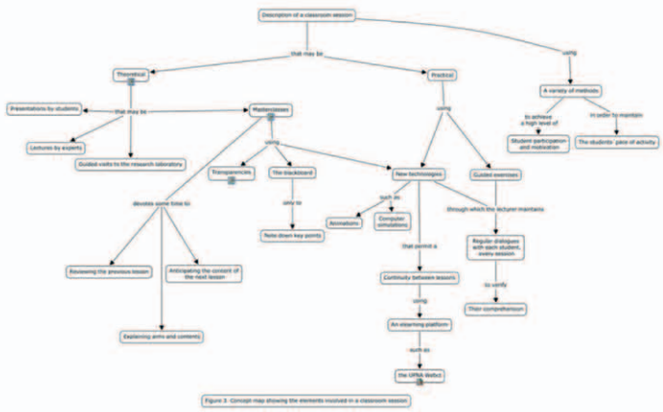


Figure 2 Concept map showing the subject planning with some of the links open.

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.



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 CMap 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.

References

González, F. & Zuasti, J. (2008). The running of the bulls. A practical use of concept mapping to capture expert knowledge.

Novak, J.D. (1998): Learning, creating and using knowledge: Concept maps as facilitative tools in schools and corporations. Mahwah, NJ: Lawrence Erlbaum Associates.

Novak, J.D & Cañas, A.J.: The Theory Underlying Concept Maps and How to Construct Them, Technical Report IHMC CmapTools 2006-01, Florida Institute for Human and Machine Cognition..

Zabalza, M.A. (2004-08). Elicitación y representación del conocimiento de profesores universitarios protagonistas de buenas prácticas docentes: ingeniería del conocimiento para la mejora de la calidad de la docencia universitaria en el marco del proceso de convergencia europeo" Universidad de Santiago de Compostela.

THE RUNNING OF THE BULLS. A PRACTICAL USE OF CONCEPT MAPPING TO CAPTURE EXPERT KNOWLEDGE

González García, Fermín M. Department of Psychology and Pedagogy. Public University of Navarra, Spain
Zuasti Urbano, Jokin. Urtats S.L. Harizti 17 Zuasti de Iza, Navarra, Spain

Email: fermin@unavarra.es , jokinzuasti@yahoo.es

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.

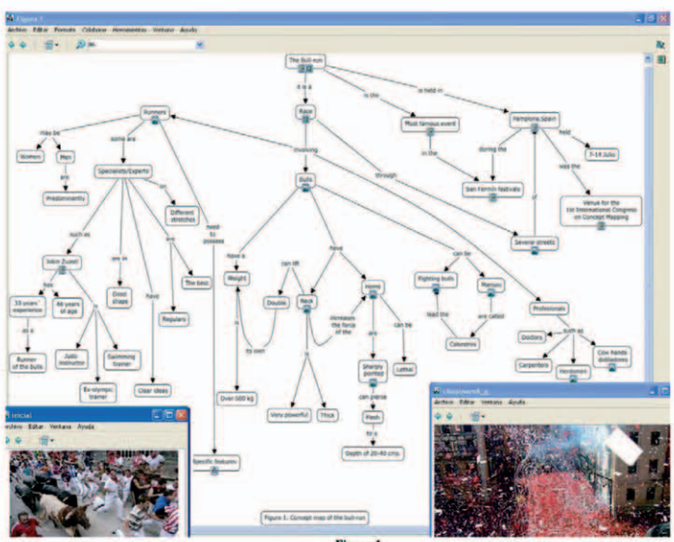


Figure 1.

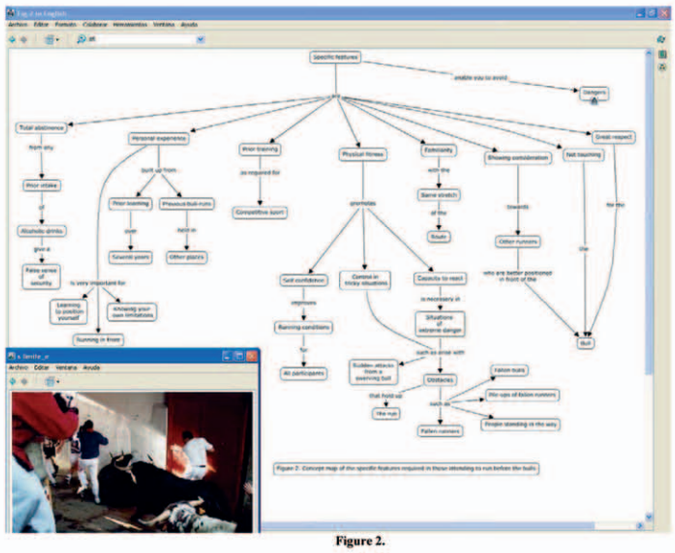


Figure 2.

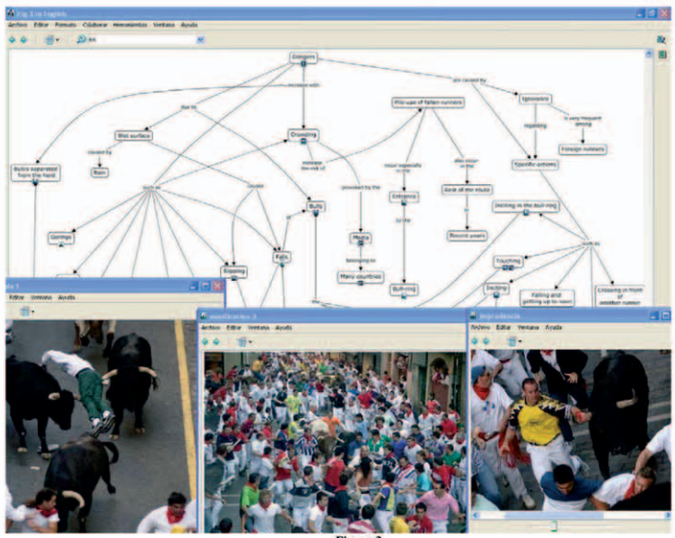


Figure 3.

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.

5 Acknowledgements

To Iñaki Urtasun for the composition of the images and text.

References

Cañas, A. J., Ford, K. M., Coffey, J., Reichherzer, T., Carff, R., Shamma, D., & Breedy, M. (2000). Herramientas para Construir y Compartir Modelos de Conocimiento basados en Mapas Conceptuales. *Revista de Informática Educativa,* 13(2), 145-158.

Coffey, J. W., R. Hoffman, A. J. Cañas & K. M. Ford (2002), *A Concep Map_Based Knowlwge Modeling Approach to Expert Knowledge Sharing,* IKS 2002- The IASTED International Conference on Information and Knowledge Sharing, November Virgin Islands.

Ericsson, K. A.; Charness, N.; Feltovich, P. J. & Hoffman, R.R.(Eds.)(2006). *The Cambridge Handbook of Expertise and Expert Performance*. Cambridge University Press: Cambridge, MA

Novak J. D. (1998*). Conocimiento y Aprendizaje. Los mapas conceptuales como herramientas facilitadoras para escuelas y empresas.* Alianza Editorial: Madrid.

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

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

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

1 Introduction

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

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

In the cooperative learning situation, students work together towards a more meaningful learning outcome for all. The practice of meaningful learning, with all that it entails both for the student and the teacher will also facilitate the incorporation of new information into the student's cognitive structure, the state of which must be verified before the learning process begins. These dynamics will help individual students to realize their full potential. CmapTools software created at the Institute for Human and Machine Cognition (Pensacola, Florida) 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 team work 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.

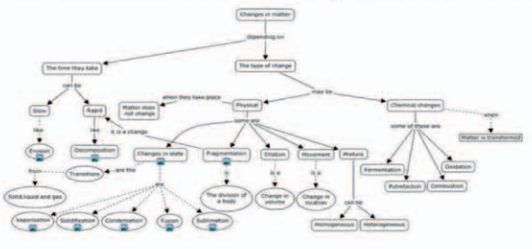


Figure 1. Concept map created by group A

Figure 2. Concept map created by group B

Figure 3. Concept map created by group C

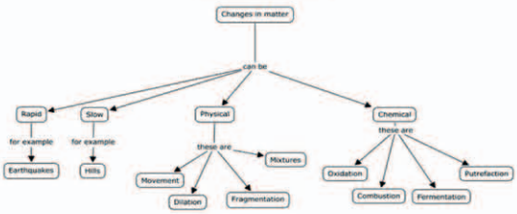


Figure 4. Concept map creado by group E

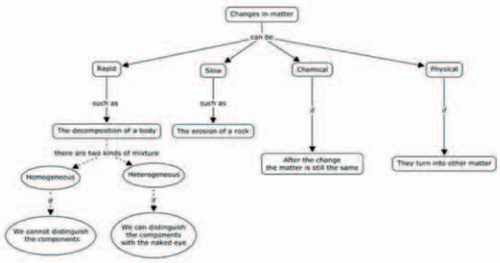


Figure 5. Concept map created by group F

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).

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.

5 Acknowledgements

We are grateful to Iñaki Urtasun for his assistance with the graphics and text.

6 References

Novak J. D. & Cañas A. J. (2003): Construyendo sobre Nuevas Ideas Constructivistas y la Herramienta CmapTools para Crear un Nuevo Modelo para Educación Institute for Human and Machine Cognition www.ihmc.us

Vigotsky, L.S. (1979): El desarrollo de los procesos psicológicos superiores. Barcelona. Grijalbo.

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

Guardian Soto Beatriz Dolores, IPN, bdguardian@ipn.m, Fermín González García ,UPNA fermin@unavarra.es,
Abel Camacho Galván, UNAM

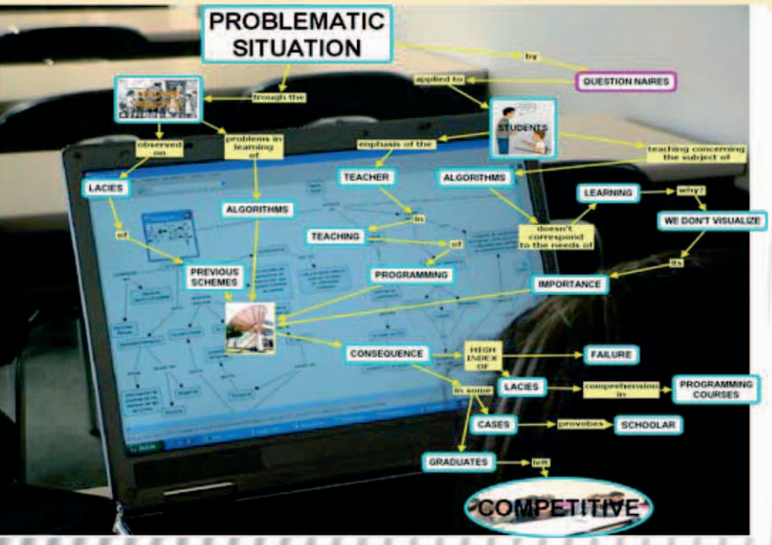
The present work proposes the use of heuristic techniques developed by Novak and Gowin.

The main reason behind this work is the evidence of success of the use of Gowin' V and conceptual maps in several researches done at the University of Cornell, Brazil, Argentina and Spain, in physics, chemistry, and environment sciences. A second reason lies in the difficulties that the students face in some topics of computer programming, as in algorithm design.

PHILOSOPHY: CONSTRUCTIVISMO AND ALGORITMIA

EVENTS: The idea could also imply an improvement in way 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. This last point is a serious problem in Mexico and Latin America.

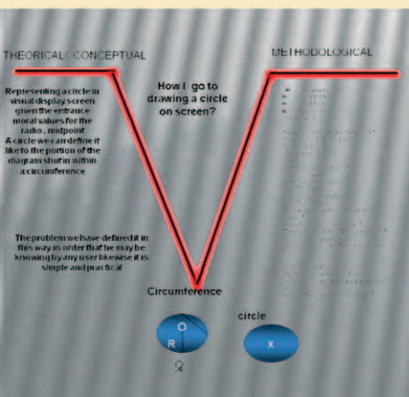


THE APPROPRIATE USE OF PROBLEMS IN THE LABORATORY OF COMPUTATION AS WELL AS IN THE RELATED CLASSROOM OF CLASS REAL RELATED WITH THE THEORIES, AS WELL AS THE EMPHASIS IN INVESTIGATING THE CONCEPTUAL STRUCTURES OF THE STUDENTS. TO SUPPORT THE STUDENT TO IDENTIFY THE BASIC PRINCIPLES THAT BASE THE DISCIPLINE AND ENVELOPE THE DAAC, BASES A LEARNING TO BASE OF REASON. WITH THE MC AND THE V DE GOWIN.

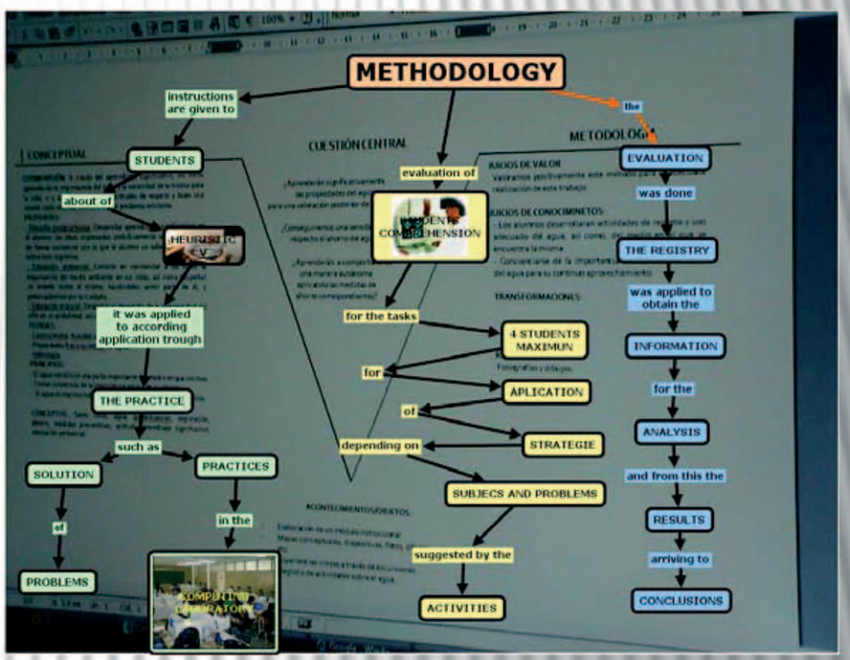
THEORY

These techniques are defined as tools that help the student in the construction of his/her knowledge, and this is done with the constant interaction between theory (thinking) and praxis (to do).

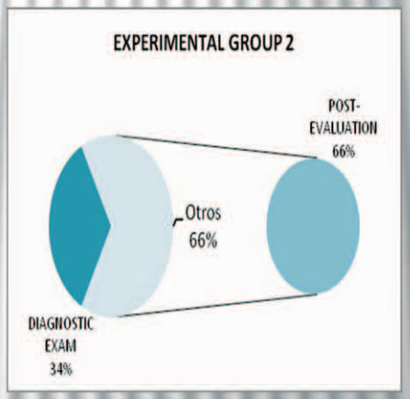
Gowin's V and conceptual maps where proposed by Novak and Gowin as heuristic and metacognitive tools. The main reason behind this work is the evidence of success of the use of Gowin's V and conceptual maps in several researches done at the University of Cornell, Brazil, Argentina and Spain, in physics, 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.



The idea is to employ software, Cmaptools, with the goal of achieving a better and deeper understanding of the material by the students enrolled in computing engineering at Escuela Superior de Ingenieria Mecanica y Electrica, campus Culhuacan. These techniques are defined as tools that help the student in the construction of his knowledge, and this is done with the constant interaction between theory (thinking) and praxis (to do).



RESULTS



SUMMATIONS

Metacognitive strategies in virtual environments are very useful since the results obtained in these topics showed a remarkable advance in comparison to those cases in which these techniques were not considered.

The use of new technologies and learning techniques, like the heuristic V and conceptual maps, entail a new educational model based on the constructivist theory, the one focuses the learning process on the student. This last remark implies that now the student builds his/her knowledge in an independent manner. Of course, this means a remarkable improvement in the academic realm. The proposal was successful in the subjects of analysis of algorithms and graphication. Nevertheless, it only suggests its possible application to other subjects.