

**I**N THE EARLY 1990s, THE UNIVERSITY OF West Florida and IBM Latin America investigated establishing telecommunication links among schools. Because the Internet was not readily available in most Latin American countries at the time, the IBM telecommunications network, accessed via local offices, was used initially to link students and schools throughout the region.

The project included public and private schools throughout Latin America, from Chile to Mexico. This arrangement—Project Quorum—was funded by IBM, which provided software development, teacher training programs, and curriculum materials to support collaborative learning across classrooms and countries.

Project Quorum was based on the idea that meaningful learning can be encouraged through the use of concept maps as vehicles for collaborative learning within classrooms (Novak and Gowin, 1984; Novak, 1998) and among schools via international computer networks. However, soon after the project was initiated, we became aware that there was very little software available to support collaboration among students. Therefore, software was developed to allow elementary and secondary school students to produce text and draw and share concept maps on the computer. These concept maps represented children's ideas on some topic, problem, or issue, and the texts and maps were shared over a computer network by accessing the server of the closest IBM office, usually via a local phone call.

As part of the project, a collaborative software system was developed (called Knowledge Soup), which allows students from distant schools to share claims

ENHANCING COLLABORATIVE  
LEARNING BY USING TECHNOLOGY  
WITH CONCEPT MAPS

(propositions) derived from their concept maps. Sharing takes place by accessing the Knowledge Soup, a repository of propositions submitted by students and stored on a computer server. When students access the Knowledge Soup, similar propositions already in the soup are automatically displayed. Students can use these propositions from other students to enhance their individual concept maps. In addition, students can question or criticize propositions submitted by other students, leading to a peer-review environment in which students themselves are responsible for the validity of the propositions in the soup. Thus, for any domain of knowledge, the students, with some help from their peers and their teachers, can create over time a large knowledge soup with almost unlimited, related, valid propositions.

#### MEANINGFUL LEARNING

A primary goal of Project Quorum was the promotion of meaningful learning, which requires learners to relate new knowledge to relevant knowledge they already possess in some substantive, non-trivial way. Memorized information may be stored in a student's long-term memory, but it is not usually integrated with existing relevant knowledge and does not lead to construction of powerful knowledge structures. However, because

ALBERTO J. CAÑAS, KENNETH M. FORD, JOSEPH D. NOVAK, PATRICK HAYES,  
THOMAS R. REICHERZER, AND NIRANJAN SURI

they are accustomed to this type of learning, most students find it easier to memorize facts and definitions rather than to integrate them into their knowledge structures. Meaningful learning requires learners to choose to integrate new information with knowledge they already possess. Because concept mapping requires students to relate known information to unknown information using a structure, concept maps can be a powerful facilitator to meaningful learning (Novak, 1991).

*Students can create a concept map in one classroom over a local server and then join a*

*remote Knowledge Soup with students in other schools*

*by using the Internet.*

displays similar claims from other students in the Knowledge Soup window (lower right in Figure 2). If students do not publish their propositions with other students, the window will display only their own claims. The more they share, however, the more likely that claims from other students will be displayed on the workspace. Students can then analyze other students' claims and decide whether they should add them to their concept maps. As other students contribute similar claims to the Knowledge Soup, these will be added to the student's window. Students need to be connected to the server in real-time for claims to be shared. However, the student can work on the concept map off-line and later share propositions when a connection is established to the server.

### CREATING A KNOWLEDGE SOUP

To work with the Knowledge Soup, teachers and students must first be trained in the use of concept mapping and other parts of the concept mapping (*Cmap*) software. The latest version of the software takes advantage of the Internet's connectivity, is freely available for teachers and students at [cmap.coginst.uwf.edu](http://cmap.coginst.uwf.edu), and makes it easy to guide learners through the process of constructing a concept map. Figure 1 shows an example of a concept map dealing with plants and containing 12 concepts and 13 propositions or knowledge claims.

While a student builds concept maps in the *Cmap* program, the student can join a Knowledge Soup. The system then automatically opens a scratchpad window and displays a list of propositions it derives from the student's concept map, such as "roots absorb water," or "plants have roots." The student can delete propositions from this list or add propositions if the software has failed to identify a sequence of concepts and links in the map that form a proposition. As the student works on the map, the system continues to derive the new propositions and place them in the scratchpad.

Students can share their propositions with other students via the Knowledge Soup server. The software allows the server to be anywhere on the Internet. When the student selects the collaborate option from the file menu, the system searches for available propositions from other participating students' soups and presents a list for the student to select from (possibly by indication of the teacher). Once the Knowledge Soup is joined, students can select propositions from the list in the scratchpad window (top right in Figure 2) and select the "Share" option under the "Collaboration" menu entry. We call this "publishing" the proposition. And, because the student must be prepared to defend the proposition from criticism or questions from other students, we refer to it as a "claim."

When the claim is sent to the server, an icon appears to the left of the claim on the scratchpad window. The server immediately sends back and

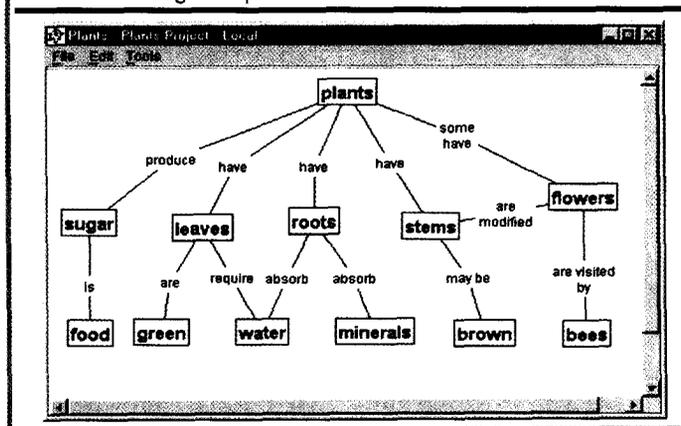
Throughout this process, the teacher can decide whether to keep claims anonymous or have the contributing student identified. At any point in time, students can decide to "unshare" a particular claim they published, removing it from the Knowledge Soup (but not from the scratchpad). If the same claim has not been contributed by another student, it is also removed from the Soup window of students that have contributed similar claims. Students cannot delete claims published by others, but the teacher can remove any claim from the Knowledge Soup.

### THE POWER OF PEER REVIEW

Through the server, students can challenge, criticize, or comment on any claim they disagree with or do not understand or to which they want to add an opinion. Students can create a discussion thread that will be attached to the claim by selecting a claim in the Knowledge Soup window and clicking on the "Attach Discussion Thread" option in the Collaboration menu. Then, after selecting the "View Discussion Thread" menu op-

**FIGURE 1.**

A sample concept map containing 13 claims that can be shared in the Knowledge Soup.



tion, students can write their own comments, criticisms, or questions. The message is sent to the Knowledge Soup server and an icon appears to the left of the claim in the Soup window of the claim's owner and of all other students who are able to see this claim (those who have published a claim similar to the one being commented on).

Through this discussion process, the students (with the aid of the teachers, if needed) determine the validity of the claim. The system itself does not identify claims as valid or invalid. This collaborative process lets students work with each other to elaborate, refine, and improve their own knowledge structures. (Teachers can access the server and participate directly in the Knowledge Soup discussions without having to construct a concept map.)

The *CMap* software is flexible. Students can create a concept map in one classroom over a local server and then join a remote Knowledge Soup with students in other schools and even with students in other countries by using the Internet. Exchanges between students in different countries allow students to highlight and explore cultural differences or differences in fauna, flora, temperatures, and so forth. This multicultural shared learning serves to enhance further the quantity and quality of the knowledge structures built.

Student (and sometimes teacher) misconceptions are potential problems in teaching and learning any subject. Research has shown that misconceptions are not remediated simply by telling the student the correct ideas. Each student must actively and deliberately seek to reconstruct the relevant knowledge in their long-term

memory, where the misconception is embedded (Mintzes et al, 1998). The kind of learning made possible by using concept maps and the *CMap* software is ideal for helping students remediate their misconceptions and build powerful, valid knowledge structures.

### CONTINUED COLLABORATION

The materials developed through Project Quorum have been used in settings other than the classroom. For example, secondary school students have used concept maps to plan fieldwork and to summarize their findings in field studies.

Although Project Quorum is now terminated, many of the schools that participated continue to use the *CMap* software, and improved Internet access encourages this process. Other projects are underway at the University of West Florida to develop further methods for using concept mapping as a representational tool to organize, store, and provide new and more powerful retrieval mechanisms to facilitate learning by students, professionals, and corporate personnel. New and improved versions of the software for concept mapping and collaboration using Knowledge Soups are available for free for not-for-profit educational use at [cmap.coginst.uwf.edu](http://cmap.coginst.uwf.edu). ♦

**Alberto J. Cañas** (e-mail: [acanas@at.uwf.edu](mailto:acanas@at.uwf.edu)) is an associate director, **Kenneth M. Ford** (e-mail: [kford@at.uwf.edu](mailto:kford@at.uwf.edu)) is a director, **Joseph D. Novak** (e-mail: [tdn2@comell.edu](mailto:tdn2@comell.edu)) is a senior research scientist, **Patrick Hayes** (e-mail: [phayes@at.uwf.edu](mailto:phayes@at.uwf.edu)) is a senior research scientist, **Thomas R. Reichherzer** (e-mail: [treichhe@at.uwf.edu](mailto:treichhe@at.uwf.edu)) is a research associate, and **Niranjana Suri** (e-mail: [nsuri@at.uwf.edu](mailto:nsuri@at.uwf.edu)) is a research associate, all at the Institute for Human and Machine Cognition at the University of West Florida, 40 South Alcantz Street, Pensacola, FL 32501.

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FIGURE 2.

Knowledge Soup collaboration software.

