

Object-oriented Collaborative Course Authoring Environment supported by Concept Mapping in MyEnglishTeacher

Alexandra I. Cristea and Toshio Okamoto

Laboratory of AI & Knowledge Computing
Graduate School of Information Systems
The University of Electro-Communications
Choufu, Choufugaoka 1-5-1, Tokyo 182-8585, Japan
alex@ai.is.uec.ac.jp

Abstract

This paper presents an English upgrading course authoring environment for multiple authors collaborating via a distance education system. The course authoring follows a rigorous object-oriented structure, which allows easy search and retrieval functions for both the authoring - and the learning environment counterpart. Moreover, authoring is supported by the concept mapping paradigm, where in our case the concepts are built by the keywords of the individual course building bricks (subjects), and the mapping involves manual and automatic linking of these concepts. The full system consists of both authoring and learning environment and is called MyEnglishTeacher. The focus of the paper is on the authoring environment, on the enforced object-oriented structure and on the concept mapping based course linking supporting function.

Keywords

Collaboration, distance education system, courseware authoring, concept mapping, course linking, adaptability, academic English

Introduction

Although the obstacles and problems in building distance-learning environments were and are still various, distance education is here to stay (Synnes & al. (1999)). Many universities offer course modules, whole courses, or even degrees on-line. Moreover, many companies offer many types of education-oriented material and educational software via the WWW. Generally speaking, educational courseware can be designed from scratch, in an application-oriented way, or built via general purpose authoring tools. Here, one of the new roles of teachers as courseware authors becomes clear. Moreover, teachers nowadays have to either build their own, off-the-shelf Web course (Kaplan (1998)) or to choose among the many on-line course delivery tools, like WebCT, Blackboard, eCollege.com, etc. Many universities have decided to build their own authoring tools for their faculty staff ((Teletop page), Collis (1999)).

Some courseware packages “mimic the style of the typical classroom” (Kaplan (1998)). We, however, don’t see the imitation of the typical classroom as a positive feature. We predict that this imitation tendency will disappear in time (Okamoto & al. (2000)). This paper shows how some of the advantages of distance environments and new technologies can be integrated to enhance teaching, both by in-depth and in-breadth extension.

The main advantages of distance teaching over the web are, as is well known, the *from – and to any place*, at any time attributes. Often, the *free education* aspect also appears, although much of the offered educational software today is not free, and many educational institutions offer (distance) learning programs at a price. Moreover, as the very recent *increases in bandwidth enable more ways of representation*, images on the Internet are commonplace, sound tracks and videos are used with growing frequency, other (multi-) media types evolved (animation, etc.). Based on learner modeling (Paiva & al. (1994)), *adapting teaching strategies* and, generally speaking, (intelligent) user adaptation in ITS (Woods & al. (1996)) are being developed. Another main advantage of the Network is that it favors *collaborative work*, which in turn favors learning (Woods & al. (1996)). Moreover, distance education finds a justification in the *life-long learning* concept. The recent technological changes are influencing our society, and each member of this society must acquire new knowledge all the time.

Here we present a distance education authoring environment based on the concept mapping paradigm, and aimed at upgrading the knowledge of English for academics. This is just a part of the complete CALL system called MyEnglishTeacher [Cristea & al (2000, 2000b)].

The paper is organized as follows. The next section introduces concept mapping and points to the way we use this technique in our system. Section 3 shows the working hypotheses of our authoring system. Section 4 explains the imposed course structure and its rationale, the following section 5 shows a concrete example of this structure and section 6 shows the course views possible for authors, corresponding to the general course structure. Section 7 shows the fundamental course linking ways on which we base our linking technique. Section 8 shows the course linking methods in our environment, based on priority and relatedness connections. Sections 9 and 10 show the two ways we apply concept mapping in our system, by manual and automatic concept insertion by the teacher and system respectively. Section 11 presents a discussion of the goal achievement, while the last section draws some conclusions.

Concept mapping

Concept Mapping is a technique of *graphically representing concepts and their hierarchical interrelationship*, using spatial configurations of nodes and links to communicate about the concepts in a given domain (Beyerbach (1988)). The technique was developed by professor Joseph Novak at the Cornell University in the 1960s. Concepts and sometimes links are labeled. Links can be non- uni- or bi-directional, and they may be categorized (Lanzing (1995)).

The motivation that lead to this new technique is that existing theoretical models of learning do not adequately explain the process of intelligent thinking, so that teaching and learning activities based on these previous models fail to provide both lecturers and students with the necessary attitudinal framework to ensure that meaningful learning takes place (McCabe (1996)). Furthermore, whereas a computer works in a linear fashion, the brain works associatively, as well as linearly (Cave).

This technique finds use as a graphical organizer and assessment tool for education, as a problem-solving and decision-making tool in business, for integration of large bodies of material, for inserting new concepts within an existing structure, for planning remedial activities, for reviewing topics, and many others.

Moreover, an extremely important aspect is the *collaboration through concept maps*; the maps being here a visual representation of knowledge structures and argument forms, similar to semantic networks in artificial intelligence, designed to support collaboration in dispersed learning communities (Gaines & al. (1995)).

Related traditional concept mapping techniques are *Mind Mapping*, introduced in Buzan (1996), that puts at the center a concept and builds around it, *Flowscaping*, introduced in De Bono (1994), which stresses the fact that thinking is a two-stage process: making and using maps, and *Cognitive Mapping* (Ackerman & al. (1993)), which is based on Kelly's personal construct theory, with active links implying causal relations.

Concept mapping is most similar to Mind Mapping. The main difference between the two is that Concept Mapping allows more than one central concept. Both techniques can be also defined by the 4E concept: Expressiveness, Extension, Externalization and Entireness (Kommers (1996)).

Because of the large amount of association involved, this kind of representation tools can lead to creativity enhancement, tending to generate new ideas and associations that have not been thought before (Cave).

Currently, there exist already a multitude of free, shareware or commercial software tools dedicated to concept mapping, such as Inspiration Software, Axon Idea Processor, CMap, etc. (Lanzing, 1995).

In our research, we set out to use the concept mapping concept, technique and mechanism for our course data representation linking, for both *manual concept linking* and *automatic, adaptive courseware linking*. This type of mapping allows multiple links, link labeling, directional links and multiple central concepts. The main difference between our concept mapping usage and the existing tools is our orientation: teachers use our tool in the generation of the courses, and not during the learning itself. However, we will show that such a usage is also quite valuable. Moreover, our mapping is computer assisted mapping, the system generating possible candidates for the links, and the teacher choosing among them, as we will show later on. The manual courseware linking is done by teachers and course authors, and it implies teacher collaboration in a distance environment, via concept linking and collaborative course authoring. For the automatic courseware linking, the system has to autonomously build its own links and to find connections within the courseware material, and ask the teacher only for checks and confirmations. This is a very important aspect of our system, as we want to reduce as much as possible the working overhead of the human teacher/ courseware designer.

One feature, which we borrow from cognitive mapping, is the goal orientation: the course authors should always have the students' learning goal in mind, and construct their (part of the) course accordingly. However, each teacher may build his/ her course according to his/her own teaching strategies. The goal achievement can be verified via various tests. Therefore, we can consider, in a simplified manner, that the test passing is our primary, global goal.

In this way, collaboration in a remote authoring environment is made possible, without adding too much to the teacher-user overhead. We based these methodologies on some hypotheses about course authors, which will be shown in the following.

Hypotheses about course authors

We have started from a few simple hypotheses about the authors who will use our course development system, based on observations and interviews with a number of teachers.

- There will be many course authors, representing different teaching strategies, with different amounts of time to spend in designing the course, different attention to details .
- The ultimate goal is to find the optimal learning path in this heterogeneous net course, so authoring has to be done having the student goals in mind.
- The system helps teachers in adding extra-semantics to their own courses, but acts merely as a guide.

Imposed course structure

If the brain is to be related to information most efficiently, the information must be structured in such a way as to "slot-in" as easily as possible. It follows that, if the brain works primarily with key concepts in an interlinked and integrated manner, then so should our notes and word relations be structured in a similar manner (Buzan (1996)).

Cave (www page) suggests, based on the Buzan (1996) book, that one should concentrate on what is in the material, before plodding on into a "learning catastrophe". One should consider such items as results, summaries, conclusions, indents, glossaries, etc. Moreover, it would be a good idea to have access at such information as preview, inview (forward leaps over unclear areas) and review.

Independently from the above research, we have chosen to impose some similar structural restrictions from the authoring tool and defined some building bricks for our *object-oriented* courseware, with the main goal to allow *easy retrieval and easy adaptation*. Figure 1 shows how the authoring environment enforces these building blocks as obligatory input fields; details follow in the subsections.

Cave (www page) and Buzan (1996) showed that the effect of such a structure is not only a fast retrieval of information, but also *a better organization of the material to enhance student learning*. Therefore, we have intuitively chosen a path that leads to an improved pedagogical strategy. Next, we describe the building blocks (objects) of our courses.

Texts

The smallest block / object (course building brick) is a TEXT. Each text also has (beside of the actual main text body), the following obligatory attributes: a short title, keywords, explanation, patterns to learn, conclusion, and finally, exercises. Titles and keywords are used for search and retrieval (as is natural), but we also use the explanation and conclusion files for the same purpose.

Moreover, any video/audio recording course material has to have a corresponding text (dialog, etc.). In this way, the search of any non-text resource can be performed via a text-based search.

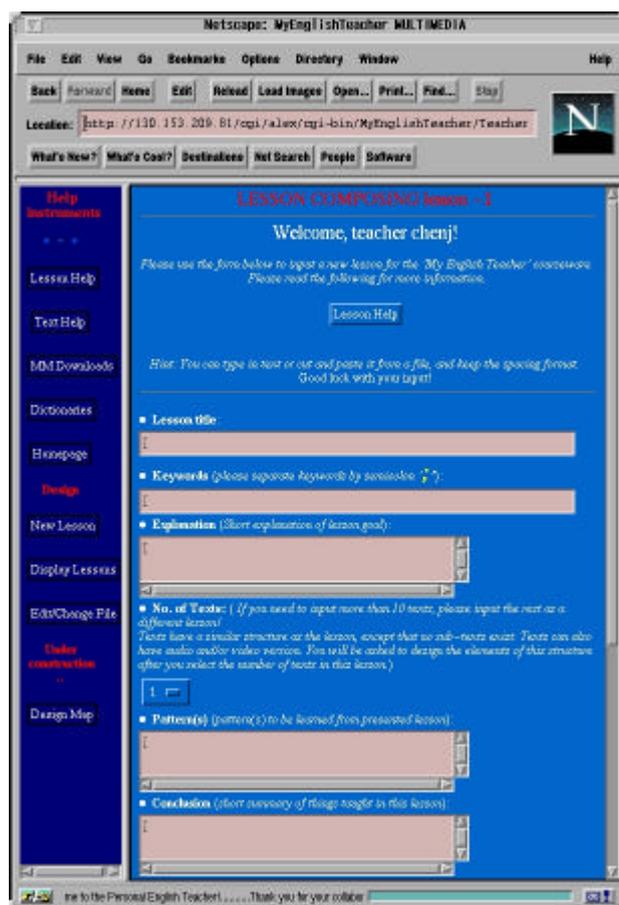


Figure 1. Lesson Input interface

Lessons

One or more texts (with video or not) build a LESSON object. Each lesson also has (beside of texts, etc.) the following attributes: title, keywords, explanation, conclusion, combined exercises (generated automatically or not). This structure is very similar to the text object structure.

Next, a text or lesson will be called a 'SUBJECT'.

Exercises (Tests)

Each EXERCISE also has (beside of main text, etc.), the following attributes: a short title, keywords, explanation, patterns to test, and conclusion. Exercises are connected to either a text or a lesson initially.

This structure of the exercises allows connecting exercises to other corresponding texts and lessons, automatically, via relatedness computations (beside the connections that are input by the course designers, new connections can emerge, see section 10.1, 10.2). Exercises and tests can be compulsory or not, as will be discussed later on (section 8).

All the above restrictions are also reflected by the system feedback, as can be seen in figure 3.

Course structure example

The information exchange from tutor to system means, as explained in section 4, input of lessons, texts, links, but also asking for help in editing, etc. The data from the tutor is stored in a structured way, as can be seen in figures 1, 2, 3. Input can be of audio, video, graphical or text nature (figure 2). The first three types must have also a text version attached. This text version is called a lesson, which has an automatically generated index.

Each lesson object (e.g., lesson 119-2 in figure 2) is subdivided into exercises, conclusion, keywords, title, explanation, pattern to learn, and one or more text objects. The text objects are subdivided into exercise, keywords, pattern, title and actual main text body. A similar structure can be also observed in figure 3, where a teacher is observing a view of the created course.

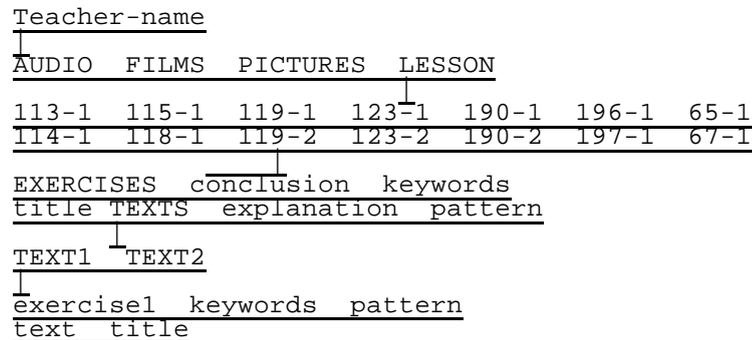


Figure 2. Data structure

Courseware Views for Authors

Once a map has about 50 subjects, which represent a number of concepts, with all the appropriate links, it is practically impossible to get a sensible display in a single map (Ackerman & al. (1993)). To help manage such a complexity, we have designed views of the courseware, showing different sub-sections of it. For an easy overview and gradual processing in labeling and linking, we use views of the existing courseware to help authors get an overview, as follows.

- “views” of whole graph, with reduced information (also called “bird views” by De Bra (1999), figure 8)
- one concept and its “star”-links (all concepts currently linked to it) (“fish views” in De Bra (1999))
- non-linked concepts: “floating”-concepts (figure 6).

Figure 3 shows a reduced fish view of related courses, which have been generated by one author only (lesson display of *type - mine*).

Basic Course Linking Ways

Teachers can, generally speaking, bind their own courses to the existing ones in the following main ways:

1. [START]->>old course->>[END] : The teacher binds his/her course only to the beginning and end of the learning trajectory, making therefore a whole, **equivalent new course**.
 \->new ->/
2. [START]->>old course->>[END] : The teacher adds only an **equivalent start of the course**, and uses the same ending.
 \->new ->/
3. [START]->>old course->>[END] : The teacher adds only an **equivalent end of the course**, and uses the same beginning.
 \->new ->/
4. [START]->>old course->>[END] : The teacher adds only an **equivalent part of the course**, and uses the same beginning and end.
 \->new ->/
5. [START]->>old course->>[END] : The teacher uses a **combination of the above**.
 \->new ->/ \->new ->/ \->new ->/

The system doesn't put the newly authored course on line (for the students to see) till:

- this is *confirmed* by the author
- the course is *complete*; i.e., for each subject, there is an input and an output, with the marginal case being item 1 above.

Figure 4 shows an example of adding a new subject in the middle of an existing course supported by the system functions, as described in point 4. Figure 3 below was explained previously and shows a courseware view (section 6).



Figure 3. Example of lesson list.

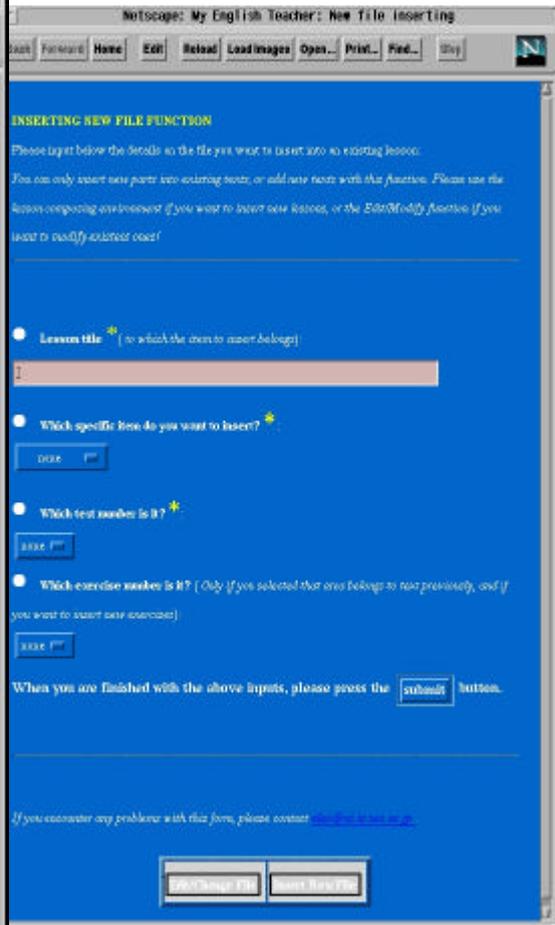


Figure 4. Inserting a new part into an old lesson

Course linking in MyEnglishTeacher

A textbook should never be read from the first to the last page (Cave). Moreover, a course made by several authors can have many inconsistencies, repetitions, omissions, etc. These can have a negative influence on the learning process, although the resulting material is rich in information. Therefore it is necessary to have system support both for the authoring, and for the learning function. Here we concentrate on the authoring aspects. Checking of redundancies, etc., is made with the help of concept mapping (section 9, 10). This section presents how new authors can use the existing courses, by interlinking them with their own courses. The basic course linking ways were presented in section 7.

Our system has two main possible connection types: *priority connections* and *relatedness connections*.

The Priority Connections represent the normal flow of the lesson, as input by the teacher.

Relatedness Connections are weighted connections between subjects, for which no specific learning order is required, but which are related. These relations are useful, e.g., during student testing: if one of the subjects is considered known, the other related one should not be tested, etc. These weights are set by the teacher, or are computed automatically by the system, as we will explain in sections 9, 10. After the initial settings of the teacher, the system will automatically add more links via keyword matching, from explicit keyword files and keyword search within subjects.

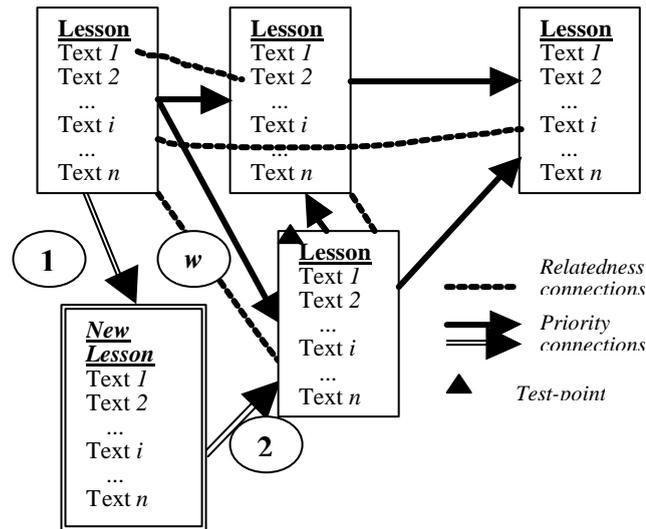


Figure 5. The subject linking (course graph)

The main difference between the priority connections and the relatedness connections is that the first ones are directional, weightless connections, whereas the latter are non-directional, weighted connections.

The teacher / multimedia courseware author can decide, for each subject, if it is more meaningful to connect individual texts or entire lessons. The way a new lesson is inserted, by connecting at least to the previous and the following lesson in the lesson priority flow, is shown in figure 5 (steps 1, 2). Priority connections with no respective relatedness connections can exist (figure 5). This happens when, e.g., common course design knowledge dictates the priority, but the lessons learning contents are quite different. These kinds of priorities are optimal student-learning-strategy-related connections, not similar-contents connections.

These priorities help the system to place the current subject in the global subject map. This result can be shown to the teacher or not, depending on the options under which the system is running. The final graph is used for the student, and it can be shown to the student upon request, serving as a map guide.

Moreover, the teacher should mark TEST-POINTS, also called compulsory exercises (figure 5), at which it is necessary to pass a test in order to proceed (these tests can be at any subject level). This idea is derived from the game-theory, where a player cannot proceed to the next level, unless s/he has passed some test (collected some items, etc.). Obligatory test points cannot be bypassed, even if they are on different branches (see previous section); at the joining point, the student has to pass (a combination test of) all the test points that are entering the respective joint.

Manual Concept mapping: theory and example

Concept mapping can be applied in two ways in order to improve the connectivity and information content of the subject linking.

1) One of them is represented by the *teacher inputting more transversal links* via concept mapping techniques, as follows: The system offers a keyword list and a title list (figure 6), and the teacher can select concepts, and link them in a graphical editing window. In this way, brainstorming and free generation of related concepts can be helped and guided to function within the existing courseware. Therefore, the system supports the teacher in adding transversal (relatedness) connections, as opposed to linear (priority) connections (figure 7).

2) The other way of using concept mapping is to have the *system automatically link concepts*, and then present the map(s) to the teacher, for inspection. The teacher can then add, delete links and, more important, can *label* links. When labeling links, the teacher can introduce also labeling directions, as shown in the example figure 8. Concepts, represented by subjects, are depicted in ovals; labels, introduced by the teacher, are shown in callouts in figure 8.

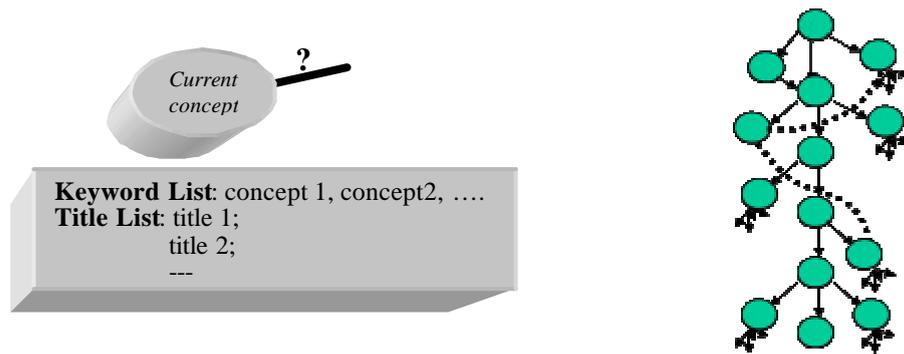


Figure 6. Selection of related concepts

Figure 7. Intuitive image of linear connections (arrows) versus transversal connections (dotted lines)

These labels are going to be used for the student display. In this way, the system can offer more related material, as well as better-explained related material. For instance, for the example in figure 8, if the current subject is {listening practice}, the system can offer (among others) the following type of advice to the student:

You can go from here to:

- **Subcategory: simple words "I listening to words", or to**
- **"Audio material ", etc.**

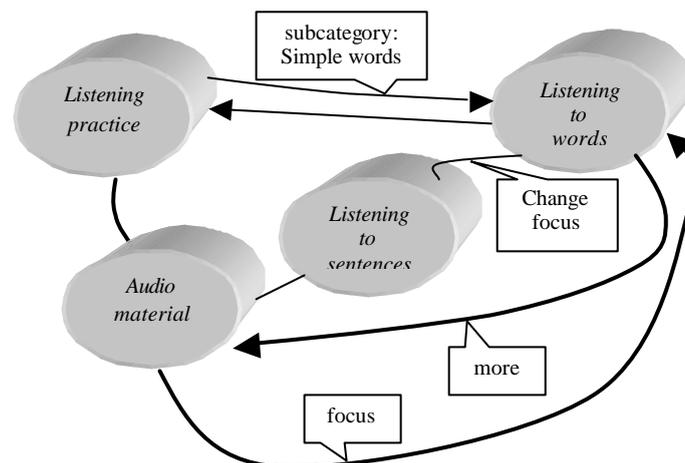


Figure 8. Labeling example.

In this way, the system advice semantics is increased, under the direct supervision of the course author. The teacher is only responsible to link his/her own course to the existing courses created by him/her or some of the other courseware designers, s/he cannot link other teacher's subjects. As could be seen above, the teacher is free to link and label whatever subjects s/he desires, s/he is under no compulsion to link all texts offered by the system. In order to have an easy overview during labeling and linking and to allow gradual processing, "views" of the whole graph are presented to the teacher, one-at-a-time. For instance, the teacher can take one concept at a time, with its "star"-links (all other concepts currently linked to the central concept). Non-linked concepts can be represented as "floating"-concepts, so the teacher can add the links s/he considers appropriate (figure 6). Other possible views were explained in section 6.

The above examples also show how concept mapping can be used by groups to develop a conceptual framework, which can guide evaluation or planning activities (Trochim) regarding the existing courseware, and, on a larger scale, *course authors' group collaboration*.

Automatic Concept mapping

The system can automatically bind subjects via a weight given by the relatedness connections. Moreover, a different kind of connection (importance coefficient) is generated automatically between each subject and the

test point corresponding to the level to which the subject belongs. In the following, we will show the quantitative computation formulas for the two connection types.

Subject material's relatedness weight computation

As shown previously, the priority connections between lessons have no weight attached, but the relatedness connections have weights. These weights change interactively, as they reflect 'how related' two subjects are.

Weights' values are initialized as strong (equation 1), if resulting from the teacher's selection, and they are weaker, if the system deduced them. The weights are changed according to the behavior of the students within the 'MyEnglishTeacher' environment (equation 2).

$$\begin{aligned}
 w_{A,B} &= \{ 1: \text{teacher's selection}; 0.5: \text{system's generation}; 0: \text{rest}; \} & (1) \\
 w_{A,B}(t+tconst) &= a * w_{A,B}(t) + f_1(\text{no. of times connection A,B activated}) + \\
 &+ f_2(\text{no. of times connection A,B was accepted, when proposed in relation to unknown subject}) + \\
 &+ f_3(\text{no. of times connection A,B was accepted, when proposed in relation to query}) + \\
 &+ f_4(\text{no. of times tests related to connection A,B were solved satisfactorily or not}); & (2)
 \end{aligned}$$

where: a in $(0,1)$: forgetting rate; $f_1 \sim f_4$: linear functions;
 $w_{A,B} > 0$: weight between subjects A and B;
 t : time; $tconst$: period for weight update.

It is easy to see from these equations that related subjects will form cluster-type groups. However, inside groups, the weights express the relative relatedness of the components (more details in Cristea & al., 2000b).

Subject material's importance coefficient computation

The importance of each subject is computed as a direct relation value between the weight of the current text and the final test result of the compulsory test (test-point) of the current stage. If, during the navigation activity of different users, the study of a certain subject is of importance for the outcome of the current stage test, then the importance coefficient of the respective subject is increased. If, on the contrary, the respective subject turns out to be superfluous, the relative importance to the test is decreased (for more information, please consult Cristea & al. (2000)). The importance coefficient is represented with I and is computed as follows (A is the current subject, and B is the test to which it is related, $f_5 \sim f_7$ are some linear functions).

Note: all subjects are considered related to the compulsory tests of the current stage. Keyword matches increase this relatedness. The importance of all course items is at the beginning the same and takes the value of 100%.

$$\begin{aligned}
 I_{A,B}(0) &= 100\% & (3) \\
 I_{A,B}(t+tconst) &= a I_{A,B}(t) * f_5(\text{time spent on text A}) * \\
 &* f_6(\text{optional tests of the current level were solved satisfactorily or not}) * \\
 &* f_7(\text{compulsory tests of the current level were solved satisfactorily or not}); & (4)
 \end{aligned}$$

Here it is to be also noted that the importance factor between a subject and a test is different from the relatedness factor, which is computed similarly to the relatedness weights. The reason is that, as tests have a structure similar to the subject structure, it is relatively easy to compute keyword matches between tests and subjects. These relatedness values evolve differently, however. This type of calculation allows establishing equivalence of different subjects, or even paths, by combining the relatedness value with the importance coefficient.

As the automatic mapping is user model dependent, it belongs less to the authoring environment, and more to the student environment, therefore we are not going to go into more details here. Examples of automatic linking can be found in Cristea & al. (2000). The reason we mentioned automatic mapping here is that it implies automatic concept mapping.

In the following, we will discuss how concept mapping techniques and object-oriented structuring has brought us closer to our goal of enhancing collaboration in distance course authoring environments, and ultimately, to make use of the advantages of distance education and new technology to improve the learning via a remote environment.

Discussion of goal achievement

The reason why “pictures are worth a thousand words” is that they make use of a massive range of cortical skills: form, line, dimension, texture, visual rhythm and especially *imagination* (Buzan (1996)). Images are therefore often more evocative than words, more precise and potent in triggering a wide range of associations, thereby enhancing creative thinking and memory. Key items are hierarchies and categories, and wholeness (“Gestalt”) (Cave). Mapping can be seen as a kind of brainstorming, generating new ideas and helping setting them in a context. However, brainstorming attempts to encourage highly divergent, “lateral” ideas, whereas mapping, by its structure, provides opportunity for convergent, goal oriented thinking, fitting ideas together (Mind Maps FAQ page).

One of our goals was to incorporate all these advantages of concept mapping in helping teachers create useful courses and build logical learning paths for the student-users of our environment.

Computers can be useful in mind- or knowledge-mapping for automatic map generation, map editing, data storage and retrieval, text input and organization of data. Moreover, computers can offer other major advantages, such as easy re-structuring, highlighting, comments, presentability, export facility (Mind Maps FAQ page). We have used the computer environment to enable stepwise improvement of the existing courseware via adding and editing functions.

Mind- or knowledge mapping comes in handy for placing each new idea in the right place, regardless of the order of the presentation (Mind Maps FAQ page), represented in our courseware linking by the priority connections. Therefore teachers can ignore such factors as course order, when designing the relatedness connections in our system and concentrate on semantics issues.

Moreover, knowledge mapping encourages the reduction of each subject to one or more essential words (keywords), which is already supported in our courseware authoring through the imposed object-oriented course structure. As we require explicit keywords, thinking in keywords is made easier in the concept mapping steps. Moreover, the system generates via searches other keywords, which might be of interest for the teacher author.

Concept- and mind mapping allow indicating the relative importance of each concept, and figuring out the links among the key ideas more easily; moreover, they allow to see complex relationships among ideas, such as self-perpetuating systems with feedback loops, rather than forcing you to fit non-linear relationships into linear formats. Also, they allow spotting of contradictions, paradoxes and gaps in the material (Mind Maps FAQ page). So we can conclude that concept mapping allows the visualization of concepts and knowledge that is already embedded in the system, as well as the connection of new concepts to the already existing knowledge. Moreover, concept mapping allows organizing ideas in a logical but not rigid structure that allows future information or viewpoints to be included (Hale).

In our present paper, we have shown how we can enhance the usability and flexibility of a course authoring system for English upgrading, by basing our authoring function on an object-oriented, structured approach, and on the concept mapping paradigm. By using both direct input of course flow from the teacher, and the concept mapping technique for relatedness links, it is possible to allow both traditional, linear course building, and then bind these linear courses in many transversal ways, to allow flexible navigation for the student.

Our system allows a combination between mind mapping in the preliminary stage, when binding a central concept to existing ones, and concept mapping, because of multiple linking, link labeling, multiple resulting central concepts, etc. Moreover, even the preliminary stage is not pure mind mapping, but guided mind mapping, helped by automatic search procedures. The advantage over the pure mapping is that the teacher can notice, in this way, the absence of an important concept in his/her own course, or in other teachers' courses, and add that concept. Therefore, this assisted kind of mind mapping can lead to discoveries and failure detection.

We have shown in a different paper (Cristea & al. (2000)) that this kind of courseware can lead, from the students' point of view, to a five-star learning environment. The current paper shows how the authoring environment functionality can be enhanced, and the stress can be laid on *collaboration, re-usage of pre-existing course material, gradual verification and improvement* of the courses created by each author, as well as the *creation of new learning paths corresponding to a variety of teaching strategies*.

We have kept our course authoring on purpose more or less out of context, to be able to establish some general enhancing ideas for (text-based) course authoring.

As weak points of our approach, we can mention the risk of an increased user overhead for teachers – although, on one hand, this risk is minimized by making the linking of extra courses optional, and on the other hand, this risk is balanced by the advantage of being guided by automatic suggestions for concept mapping, instead of losing one's way in a huge amount of courses.

Another problem, which also appears, is how heterogeneous the individual courses can be? In other words, how heterogeneous their authors can be? Previous researches have shown that “conceptualization is best when it includes a wide variety of relevant people” (Trochim). We intend to study this matter further on, to find out if it is valid for our courseware generation. We expect that a clustering of the courseware will result, grouping the authors and their products around significant teaching strategies. Moreover, we also expect to obtain a different clustering of the courseware around significant topics. A way of obtaining this clustering of the material is shown in Kayama & al. (2000).

Conclusion

As Fischer (1999) noted, the new millennium will be marked by the changing of mindsets: the teacher evolving from “sage on the stage” to “guide on the side”, the student switching from a dependent, passive role, to a self-directed, discovery-oriented role and by life-long learning. We have to be prepared for these changes, and intelligent, media-oriented distance learning environments are the answer we foresee.

We have shown in this paper the building blocks of an adaptive WWW authoring system. These structures can have a wider application area than presented here, but are not entirely domain independent. This authoring environment is part of a system for English upgrading, called MyEnglishTeacher (Cristea & al. (2000b)). Our courseware structure is aimed mainly at representing a field in which, with the help of texts, videos and audio presentations, the whole material can be presented. Therefore, we can easily imagine that it could be used, beside the current usage of academic English teaching, as a system of teaching French or Japanese, for instance, but would probably have to be extended, if it would have to fit a Math or Physics course. We have also explained how concept mapping can be used in a slightly different way than was originally intended for, i.e., not during the learning process, but during the course authoring process. We have also presented both automatic and manual concept mapping adjusted for our system, and have given some functioning examples.

As our course is not self-contained, and is just an upgrading course, one of the main problems relies in the fact that the background knowledge is not completely covered by the course, so is difficult to model. I.e., our graphs will give us only partial answers regarding the lacking knowledge, so this problem has to be treated separately. More rigorous tests of those issues presented here are necessary and will be possible as soon as we gather enough course material to allow a meaningful evaluation.

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