

# Creating e-books in a distributed and collaborative way

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## Abstract

This paper describes how groups of authors may create electronic books about the knowledge area of their interest by means of unsupervised collaborative work. For this task we propose a Web-based groupware system that allows building Web sites that can be considered as electronic books. In these Web sites we can find in a structured way the relevant knowledge about an area or topic. The system allows the creation of e-books in the Web, in an asynchronous and distributed way, and without the need of an editor for managing the task. This is possible through a knowledge crystallisation process supported by virtual communities of experts. Currently, there are several active e-books, which have been created by groups of students at Universidad Autónoma de Madrid. Examples include the operating systems e-book and the uncertain reasoning e-book and these are described.

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## Introduction

Sometimes electronic books or e-books have been understood just as books stored in electronic format (Saez, 2000). However, there are other more ambitious visions. For example, Falquet *et al.* (2001) defined them as: "virtual documents [that] are made of fragments which can be assembled to constitute directly readable real documents or hypertext documents read by navigation". This may be a more general view of e-books.

We have developed a new Web-based groupware tool, called KnowCat, that allows the co-operative generation of virtual documents or e-books. KnowCat stands for "Knowledge Catalyser", and its goal is to enable the crystallisation of collective knowledge as the result of user interactions.

KnowCat intends to encourage the co-operative organisation and creation of e-books in the Web, in an asynchronous and distributed way, and without the need of an editor managing the task. This is possible through a knowledge crystallisation process supported by virtual communities of experts.

There is some supporting evidence that hypertext provides a good model for representing knowledge (Aedo *et al.*, 1997). Thus, the World Wide Web could be a good environment for the e-books.

This paper is organised as follows. First, we describe how the system deals with user interactions for building structured e-books. Next we expose two example cases: an e-book about operating systems, that has been created by students of several operating systems courses, and an e-book about uncertain reasoning, that has been created by students of several graduate Computer Science courses. Finally, we provide some conclusions and comment on some of the open issues in the context of our approach.

## Building structured e-books by unsupervised interactions

To create a new e-book, KnowCat supports the definition of a "site" for the topic in which we are interested. This KnowCat site contains just a root node that has as title the main topic

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of the e-book. The e-book structure will grow as a classification tree composed of nodes. Each node of the e-book structure will represent a topic, a "chapter" of the e-book, and will contain two items:

- (1) A set of mutually alternative descriptions of the topic: a set of addresses of Web documents with such descriptions. These are the fragments that compose the virtual document that we are regarding as an e-book. Descriptions are alternative in the sense that they are competing with each other to be considered as the "best" description of the topic.
- (2) A refinement of the topic: a list of other nodes that can be considered as "subjects" or "refinement topics" of the current topic (that is, further hierarchical divisions of the chapter).

An example screen of the system, where we can see these two items, is shown in Figure 1.

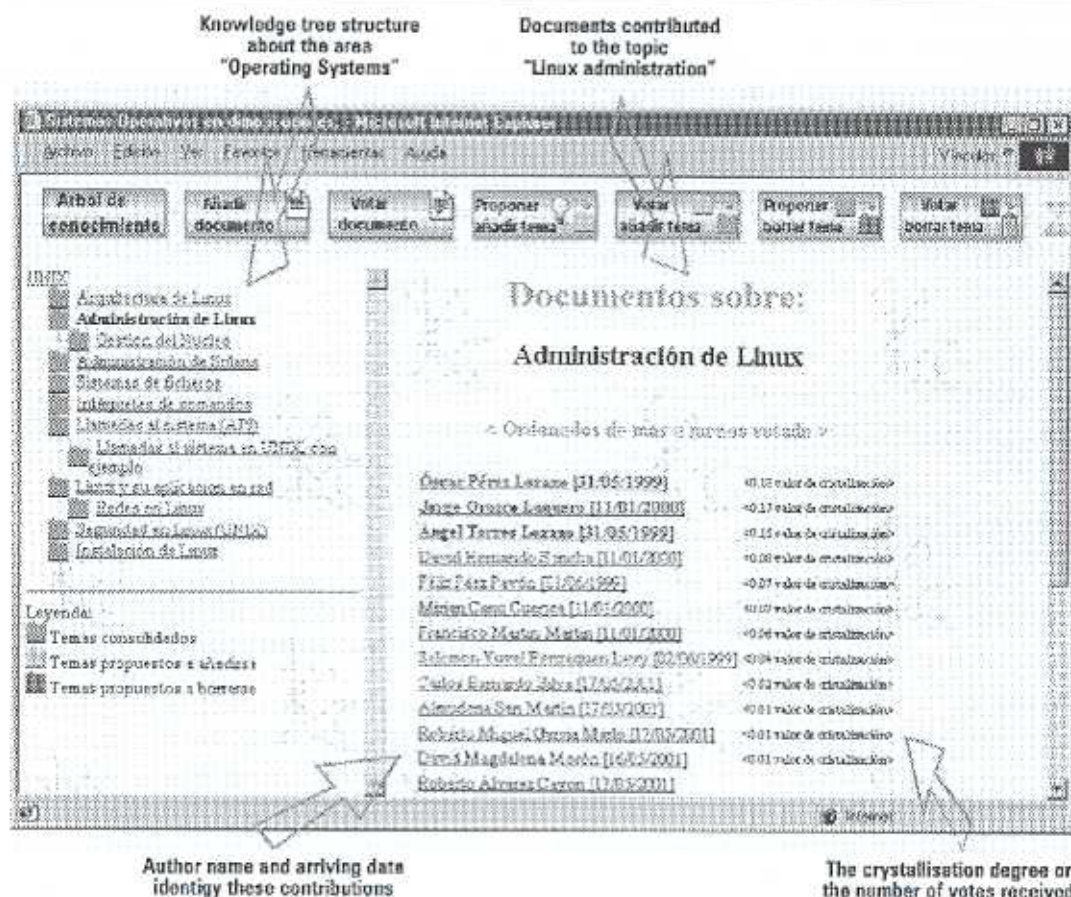
This system screen shows the "refinement" of a selected topic and its contents. The left side of the screen shows the tree structure on the topic "UNIX". The right side shows the fragments that have been added on the topic

"Linux Administration" ("Administración de Linux"). These fragments or documents are identified by their author name and arriving date. They are displayed in order of their crystallisation degree, which is shown on the right of the identification of each document. At any given moment the contents of a topic or chapter are competing with each other for being considered as the "best" description of the topic.

In this "knowledge workspace" users can add contributions, propose changes in the structure of the e-book and collaborate with their opinions about both the contents and the e-book structure. KnowCat also provides other workspaces where users can see and change their personal information, reports may be obtained about system activity, users may subscribe to events or users may communicate with their virtual communities. All the characteristics of KnowCat are easily configurable by means of parameters.

The system deals with knowledge in evolution: both the hierarchical structure of the e-book and the contents (descriptions of each topic) are elements that are produced by the users. Their lifetime in the system

Figure 1 An example screen of the system



depends on the patterns of their usage. Any of these elements will stay longer in the system if it is frequently used and receives favourable opinions from other users. In that case, its "crystallisation degree" will rise, and thus its probability to stay in the e-book. However, if one element of the e-book is not used or does not receive favourable opinions by the users, then it will eventually disappear from the e-book as a consequence of its crystallisation degree going down. This process is called Knowledge Crystallisation (Alamán and Cobos, 1999). Figure 2 shows this knowledge crystallisation process, where the elements of the e-book under this process are documents or descriptions about a topic.

When a new e-book is defined there is a "start-up" problem: possibly there will not be enough people and interactions to make the crystallisation process credible. For this reason, KnowCat proposes a maturation process that involves several phases. Figure 3 shows this evolution.

At the beginning the users work in a "supervised" mode. During this supervised stage there is a steering committee in charge of proposing initial refinements of the root node of the e-book (the initial structure of the book) and voting for them. The definition of the better e-book structure is the most important task in this phase. The members of the steering committee are defined in the moment of creation of the e-book; new members can be added by consensus of the current members.

In this phase, new contents or fragments may be added to the topics of the e-book both by the members of the steering committee and by other users that are considered as collaborators. However, only the members of the steering committee have the complete

capability of voting on the documents, so only their opinions carry weight in the document crystallisation. On some occasions, collaborators may also be given voting rights.

Eventually, if the number of participants and interactions rises sufficiently, the steering committee may decide to advance the e-book to the "active" mode. At this moment there should be a single tree structure for the e-book, decided by consensus. Then the steering committee is dissolved and the subsequent crystallisation of the knowledge is based on virtual communities. However in exceptional cases, a community of experts may decide (by means of a proposal and votes) to return some topics to the supervised mode. The aim of this change could be the need of making radical changes in the e-book structure: active communities can only make small changes in the structure, that is, they can only change topics by adding or deleting topics (chapters or sub-chapters) one at a time.

Virtual communities (Hill *et al.*, 1995) appear as a natural way of handling the e-book construction. In our approach the virtual community is a group of people that are considered as experts in one or more related topics. In this sense we fully agree with the idea that "learning about a topic becomes synonymous with learning to be a member of a community of people who are experts on that topic" (Collins *et al.*, 2001). We think that opinions from experts should have more impact than opinions from novices or occasional users. Novice users are considered as collaborators: they are allowed to contribute with new documents (potential fragments of the e-book). When a document crystallises, the author gets the status of "expert" in the topic where the document is

Figure 2 Knowledge crystallisation process

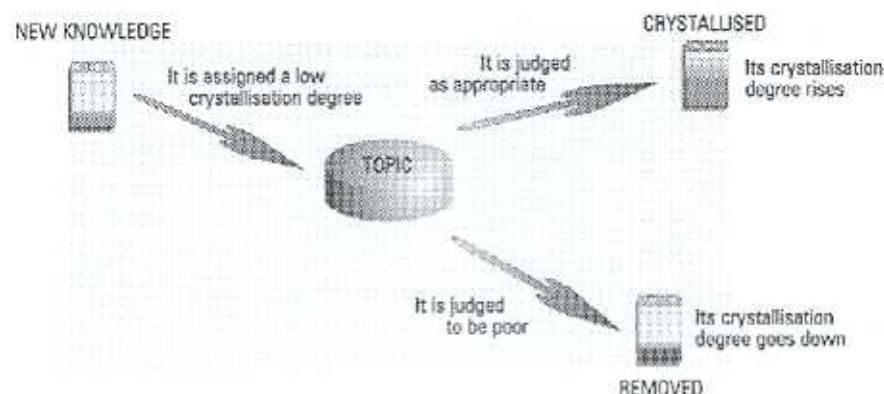
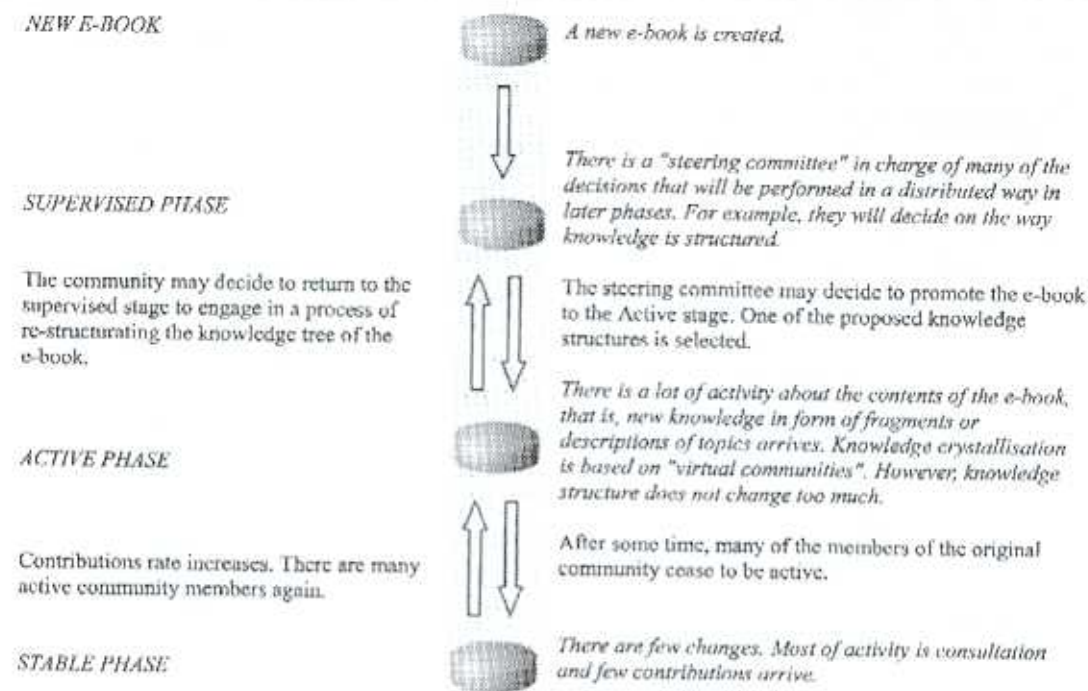


Figure 3 Knowledge evolution of an e-book



located. Only experts have full voting capabilities, and the crystallisation of the contributed documents depends mainly on their opinions. In some sense this process is inspired in the "peer review" procedure currently used in most scientific journals. The relevance of a contribution is judged by a group of experts (the reviewers), and these are considered as experts due to their past (successful) contributions to the area.

Virtual communities of experts are constructed in terms of the e-book structure. For each node of the e-book (topic), the community of experts in this topic is composed of the authors of the crystallised documents on the topic, on the parent of the topic, on any of the children of the topic or on any of the sisters of the topic. There is a virtual community for each node of the tree, and any successful author usually belongs to several related communities.

The mechanism of knowledge crystallisation is based on these virtual communities. When a user contribution in form of a document crystallises, the author receives a certain amount of "votes" that he or she may apply for the crystallisation of other documents (of other authors) in the virtual community where her/his crystallised document is located. Nevertheless, both experts and collaborators may add new descriptions.

The other aspect of knowledge crystallisation is the evolution of the e-book structure. A member of a virtual community may propose to add a new subject to a topic, remove a subject from a topic or move a subject from one topic to another topic. A minimum quorum of positive votes from other members of the community will be necessary for the change to be made.

Finally, an active community may reach the "stable" phase. In this moment many of the community members are no longer active, so different rules should be applied to ensure some continuity of the crystallisation. There are few changes and new contributions, and most of the activity is consultation. However, if activity rises to a minimum again, the node may switch to "active" status, and engage in a new crystallisation phase.

### Case study: an e-book about operating systems

We have tested KnowCat during the last few years with several communities at the Universidad Autónoma de Madrid. Some active e-books have been created, which are available for consultation (<http://www.ii.uam.es/~rcobos/investigacion/knowcat/cng/fKC.htm>). They are currently active and contain knowledge in evolution

that is improving over the years. In this aspect they could be compared to the “courses as seeds” proposed by dePaula *et al.* (2001). The active e-books at our university are:

- “Operating systems” e-book – created by several classes of students enrolled in an operating systems course at the Computer Science Department.
- “Uncertain reasoning” e-book – created by several classes of students of a graduate computer science course about “uncertain reasoning”.
- “Mathematics for children’s training” e-book – created by students enrolled in “Mathematics for children’s training” at the Pedagogy School (Gómez *et al.*, 2001).

In this section we are going to explain in detail the first experience. It has been performed during the last three years with about 200 students participating each year. We started by creating a KnowCat site about “operating systems”, containing 12 topics developed by the course instructor (see Figure 4). The students of “operating systems” were grouped into communities, each related to one of the topics.

Each student had to produce a small paper (fragment or description) on an assigned topic and vote for the three best papers in that same topic. The instructor graded papers independently, and this grading was used to check the adequacy of the voting system to capture the quality of the paper. We wanted to check the hypothesis that when you get enough documents and enough votes from “knowledgeable” peers, the result is a reasonable description of the topic. The student motivation was achieved by grading

the students on the quality of their papers and in the quality of their votes.

At the end of the first year, 174 students collaborated with a document (87 percent of user participation), so the e-book was composed of 174 papers distributed in the 12 assigned topics. One new topic was proposed for inclusion, but this did not meet with unanimous approval. In 11 of the 12 topics the votes of the students converged to a small set of documents. There was a remarkable consensus. For most topics the two most popular documents collected 50 percent of the total votes. Furthermore, in ten out of the 12 topics at least two of the three documents selected as “the three best documents” by the course instructor were also selected by the students. Finally, in seven topics the best paper, in the opinion of the instructor, was selected by the students as one of the three best (see Figure 5).

During the second year, new groups of students used the e-book generated the previous year, with the papers with a low crystallisation degree being removed by the system. In this year the e-book started with 54 papers, each topic having four or five papers.

Also in this second year each student started issuing three votes for the three best papers on an assigned topic; there were only “veteran” papers, that is, papers that arrived to the e-book the previous year. Next they added a new paper on their assigned topic and finally they voted for the three best papers in that same topic. In this case, they could score not only veteran papers but also the new ones through the system voting mechanism. As in the year before, the instructor graded papers for checking the quality of their papers and votes.

This same year they contributed five new topics for the e-book structure, with some students writing about them. At the end of this second year there were 116 new documents. Most of the crystallised documents were “veteran”, and only a small set of new documents got crystallised. This reflected the fact that the documents already crystallised represented “established” knowledge to some degree. However, if some new documents had enough quality, they were also able to crystallise.

During the final year, other groups of students continued with the operating systems e-book. As in the previous year, the system removed the papers with a low

Figure 4 The initial knowledge structure of the operating systems e-book

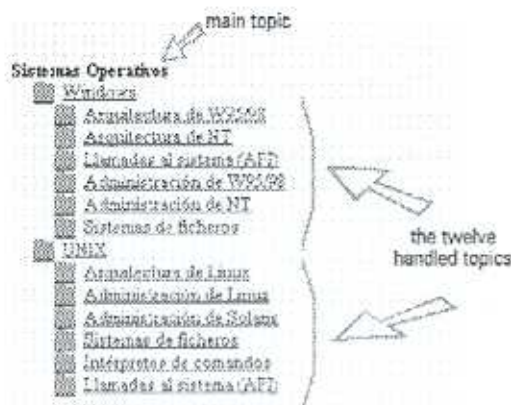




Table I Results obtained through operating systems e-book

From	To	Increase
12 topics have papers the first year	24 topics with papers the last year	200 percent. The number of topics has been doubled
174 documents at the end of the first year	314 documents at the end of the last year	180 percent. The number of documents has almost been doubled.
Tree three levels deep	Tree four levels deep	The depth of the tree has been increased one level
Three papers of each topic collected 75 percent of the total votes at the end of the first year	Three papers of each topic collected 75 percent of the total votes at the end of last year	Equal. The number of relevant paper per topic is stable. But the group of these three papers is not the same from one year to another in 50 percent of the topics

At the end of the year there were 15 topics (14 new topics and the main topic) in the e-book, which were distributed over a tree four levels deep. The course instructor's opinion was that the quality of the structure of e-book was quite appropriate, that is, the e-book was divided into a good hierarchy of chapters. There were 26 papers distributed in these 15 topics.

In the second year, new students had to extend the e-book structure, and to contribute three papers about related topics. That is, a student chose a topic, for example "Methods based on fuzzy sets theory" ("Métodos basados en conjuntos borrosos"), and he or she should write about it or about "Extensional systems" (the parent topic of the first one), or about "Fuzzy sets" (a child topic of the first one). They had to score the three best papers about their selected topics.

During this second year 14 topics were proposed for being added, and ten of them consolidated (crystallised), because their proposals got favourable opinions from the system users. The other four topics did not crystallise and their proposals were removed by the system. During this second year 43 new papers were added. The e-book then comprised 69 papers distributed through 25 topics, about three papers per topic. After the third year, 25 new documents and a new topic were added.

The structure has been improved during these years successfully. The number of topics in the current structure is almost twice the initial number of topics of the structure that was created the first year. Now the e-book tree is five levels deep. In the opinion of the instructor, the resulting tree contains a credible overview of the topics of the e-book, and the crystallised papers show a high

quality. Figure 6 shows the current Uncertain Reasoning e-book structure.

### Conclusions and future work

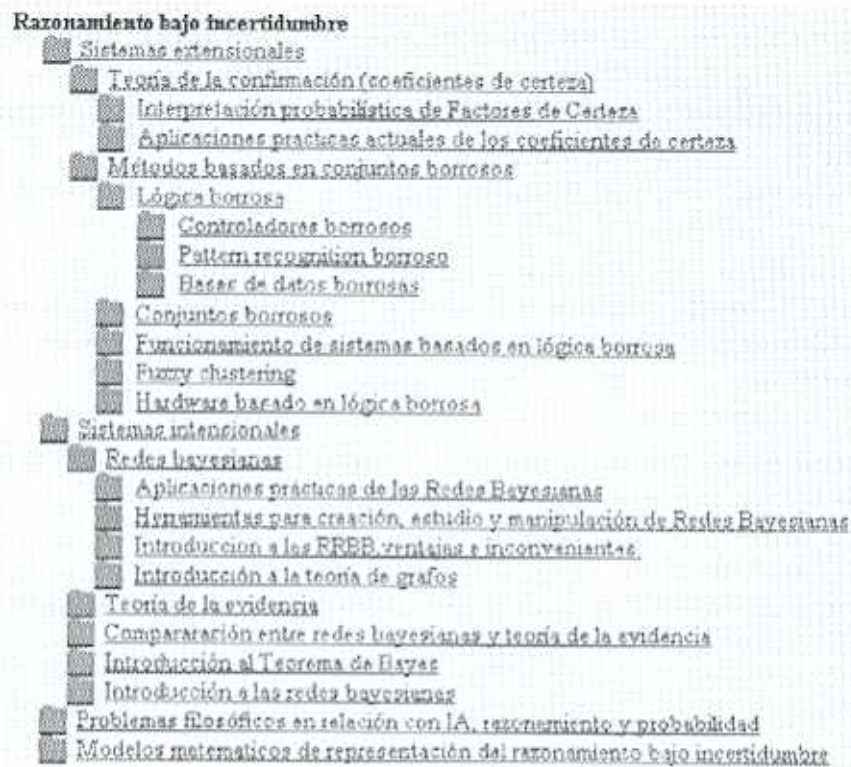
At the moment, KnowCat is a Web-based system that allows us to share, evaluate and structure community knowledge. This is possible through the knowledge crystallisation process, supported by virtual communities of experts.

KnowCat enables the building of e-books where relevant knowledge about the area or topic of the e-book can be found, without the need of an editor managing the task. The system has been tested with several communities of undergraduate and graduate students at Universidad Autonoma de Madrid. The experiments have shown evidence that the system is useful for motivating communities in sharing their knowledge and incrementally constructing an e-book of reasonable quality.

We have identified several open issues in the context of our approach. Currently, when a system user submits a paper about a topic of the e-book, it is identified as an element, and if later he or she submits another paper in the same topic as an improvement of the other, it will be identified as a different element. Thus, we have noticed the need to provide a document version control in charge of checking that the new version respects the content integrity of the first one.

Related to the previous issue is the ownership protection or copyright of documents. A document belongs to its author(s), and there would be some situations where copyright problems could appear. For example, when an author makes a document

Figure 6 Current uncertain reasoning e-book structure



and another author wants to make a version of this document, who would be the owner of the new document? But the problem of ownership recognition is more extensive. Users contribute refinements (one or more topics) to constitute the e-book structure that is considered as an entity, then, who is the owner of this knowledge structure? These are areas which still must be addressed adequately.

## References

- Aedo, I., Díaz, P., Panetsos, F., Carmona, M., Ortega, S. and Huete, E. (1997), "A hypemedia tool for teaching primary school concepts to adults", *IFIP WG 3.3 Working Conference Human Computer Interaction and Educational Tools*, Sozopol, May, pp. 180-8.
- Alamán, X. and Cobos, R. (1999), "KnowCat: a Web application for knowledge organization", *Proceedings of the World-Wide Web and Conceptual Modeling (WWWCM'99)*, Paris, November, in Chen, P.P. et al. (Eds), *Lecture Notes in Computer Science*, 1727, pp. 348-59.
- Collins, T., Mulholland, T. and Watt, S. (2001), "Using genre to support active participation in learning communities", *Proceedings of European Perspectives on Computer-Supported Collaborative Learning (CSCL' 2001)*, Maastricht, March 22-24, pp. 156-64.
- dePaula, R., Fischer, G. and Ostwald, J. (2001), "Courses as seeds: expectations and realities", *Proceedings of European Perspectives on Computer-Supported Collaborative Learning (CSCL' 2001)*, Maastricht, March 22-24, pp. 494-501.
- Falquet, G., Humi, J., Guyot, F. and Nerima, L. (2001), "Learning by creating multipoint of view scientific hyperbooks", *Proceedings of European Perspectives on Computer-Supported Collaborative Learning (CSCL' 2001)*, Maastricht, March 22-24, pp. 222-9.
- Gómez, M., Gutiérrez, A., Cobos, R. and Alamán, X. (2001), "El Aprendizaje Colaborativo con Soporte Informático en el Diseño de Material para Desarrollo del Pensamiento Abstracto en Educación Infantil. Una Experiencia en Didáctica de las Matemáticas", *Tercer Simpósio Internacional de Informática Educativa (SIEE)*, Viseu, Portugal, September 26-28.
- Hill, W., Stead, L., Rosenstein, M. and Furnas, G. (1995), "Recommending and evaluating choices in a virtual community of use", *CHI95*, ACM Press, New York, NY, pp. 194-201.
- Saez, C. (2000), "El libro electrónico", *Scrineum 2*, available at: <http://scrineum.unipv.it/saez.html>