Palette
Pedagogically sustained Adaptive Learning through the Exploitation of Tacit and Explicit Knowledge

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Pedagogically sustained Adaptive LEarning Through the exploitation of Tacit and Explicit knowledge

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Summary

This deliverable describes the prototype version of **CoPe_it!**, a web-based tool that supports argumentative collaboration towards learning. The prototype is in a demonstrable form, and can be used and tested through the web (http://copeit.cti.gr/). We present here the rationality behind its development, its generic features and functionalities, its technical specifications, and its deliberate limitations. We also provide a brief discussion on related approaches that validates our motivation and reveals interesting issues to be considered in the future. We conclude with a set of steps to be followed during the evolution of **CoPe_it!** in the next six months in the context of Palette.

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1 Executive Summary

A central task in the context of WP4: Mediation Services is the development of a web-based tool supporting argumentative collaboration towards learning. This deliverable describes the prototype version of the above tool which is now in a demonstrable form. As noted in the project's DoW, this prototype *"will be tested in real Communities of Practice (CoPs) with real data, will serve the early collection of feedback from multiple partners and contexts, and will aid the fine tuning of the services to be provided in WP4 with the ones to be provided in WP2 and WP3"*. A close collaboration with WP5 is also foreseen to address interoperability and integration of mediation tools through 'web services'.

CoPe_it! is the name decided to be given to the above tool, accompanied by the motto "**to cope better, solve it with a CoP**". The above reflect clearly our vision about the role of this tool in the project and declare the desired functionality of our approach: people will better address an issue or deal with a problem if they put it in the context of a CoP and constructively collaborate with their peers towards its solution.

The prototype of **CoPe_it!** is available at: http://copeit.cti.gr/. Beyond offering an entry point for users to experiment with the tool, the above website contains information about its objectives, features and functionalities. Related selected publications (http://copeit.cti.gr/articles.aspx) can be also found there. The tool's website will be updated throughout the project, clearly demonstrating the tool's evolution in the context of Palette.

In brief, **CoPe_it!** is a web-based tool that attempts to assist and augment collaboration being held among members of CoPs by facilitating the creation, sharing, leveraging and utilization of the relevant knowledge. The system follows an argumentative reasoning approach, which complies with collaborative principles and practices. As noted by many influential thinkers, argumentation is central to learning (Paul, 1989; Perkins, 1986; Resnick, 1987). In a variety of contexts, **argumentation is an essential element for effective learning**, in that it brings people to develop their points of view and refine their knowledge. In an effective collaborative argumentation environment, participants focus on the same issues, and learn to negotiate conflicting opinions, until they accept or share the answer, solution (Veerman et al., 1998). Sharing information and creating common knowledge in argumentative discourse also contributes to trust development and enhances collaborative behaviour (Chesñevar et al., 2000). Moreover, argumentation facilitates learning as it increases the coherence of organisational mental models by assuring their rationality, logical consistency, and by eliminating any internal contradictions (Rescher, 1970). Similarly, as it operationalises trust and power relations (Bachmann 2001), argumentation has been proved to be an efficient coordination mechanism (Malone and Crowston, 1990). For the above reasons, the employment of ICT that supports argumentation-based collaboration and knowledge management ("argumentation as explanation" (van Eemeren et al., 1996)) in the contexts under consideration is crucial.

Taking into account the objectives of launching **CoPe_it!** at this early stage of the project, we kept its features and functionalities quite generic and deliberately limited. We expect them to evolve significantly after the thorough use and evaluation of the tool by diverse CoPs. Such experimentation may result, for instance, to a much richer set of discourse items and related acts, additional reasoning mechanisms, alternative collaborative workspaces and knowledge

maps, and identification of additional user roles. More specifically, the purpose of this early prototype is:

- to facilitate and expedite brainstorming among WP4 members on the analytical design of mediation services. Features and functionalities to be considered concern specific issues such as collaboration spaces, visualization and interaction, reasoning algorithms, special customizations needed for different CoPs or different types of discourses, participant roles vs. system users;
- to be used by selected CoPs (or CoP members) to provide early feedback to the WP4 team. The feedback from CoPs is expected to be expressed not only in the form of general opinions on usability, friendliness, and technical suggestions, but most interestingly, in the form of well-documented and demonstrative examples that correspond to representative mediation support scenarios.

We expect that the feedback from WP4 partners, the availability of integrated scenarios and the related brainstorming discussions will start immediately after this first release of **CoPe_it!** (feedback from CoPs is now estimated to be available later than initially planned).

Finally, a note on the relationship of this deliverable with the others foreseen in WP4 (as described in DoW): the advanced version of **CoPe_it!** will constitute D.MED.02 (due in M18), while the specifications of the mediation services resulted from the abovementioned brainstorming and analytical design process will be incorporated in D.MED.05 (due in M12).

2 Features and Functionalities

Discourses being held in CoPs are considered as social processes and, as such, they result in the formation of groups whose knowledge is clustered around specific views of the problem. Following an integrated approach, **CoPe_it!** provides CoPs' members engaged in such discourses with the appropriate means to collaborate towards the solution of diverse issues. In addition to providing a platform for group reflection and capturing of organizational memory, our approach augments teamwork in terms of knowledge elicitation, sharing and construction, thus enhancing the quality of the overall process, building a collective memory of a CoP and augmenting learning. This is due to its structured language for discussion and its mechanism for the evaluation of alternatives. Taking into account the input provided by the individual members of a CoP, **CoPe_it!** constructs an illustrative discourse-based knowledge graph that is composed of the ideas expressed so far accompanied by supporting documents. Moreover, through the integrated reasoning mechanisms, discussants are informed about the status of each discourse item asserted so far and may reflect further on them according to their beliefs and interests on the outcome of the discussion. In addition, our approach aids group sense-making and mutual understanding through the collaborative identification and evaluation of diverse opinions. Furthermore, **CoPe_it!** provides a shared web-based workspace for storing and retrieving the messages and documents of the participants. The knowledge base of the system maintains all the above items (messages and documents), which may be considered, appropriately processed and transformed, or even reused in future discussions.

In summary, **CoPe_it!** enables the following:

- Easy expression and sharing of a CoP's knowledge;

- Structured visualization of the above knowledge expressed during argumentative discourses; Organization of a CoP's knowledge through an illustrative discourse-based knowledge tree-like graph;
- Augmentation of group reflection and leveraging of knowledge creation through argumentation;
- Efficient building of organizational memory, which can be reused in future collaboration instances;
- Integration of argumentation-based reasoning mechanisms for the evaluation of the proposed courses of action;

Moreover, the tool supports multi-level user management and it can be accessed through major web browsers.

As far as its architecture is concerned, the current **CoPe_it!** prototype comprises two discrete modules that enable user management and argumentative collaboration support. This component-oriented approach has a series of advantages, the most important being the following:

- Easier future conversion to 'web services' and enabling interoperability with other components (modules, tools, etc.) or external services (other than those foreseen in WP4, developed either in the context of Palette or coming from other projects and initiatives);
- Enabling the ontology definition and encapsulation in each module separately.

In the following, we present the features and functionalities of the two basic **CoPe_it!** modules, namely Argumentative Collaboration Support and User Management.

2.1 Argumentative Collaboration Support

The **CoPe_it!** Argumentative Collaboration Support module handles issues related to the reasoning mechanisms, as well as to the conducting and visualization of the discussions carried out. More specifically, argumentation support features and functionalities comprise:

Discussion management. Authorized users can create new discussions or close (terminate) existing ones (Appendix - Figure 2). By closing a discussion, all user actions with respect to a discourse are prohibited. The closing date and the administrator of a specific discussion are determined during its creation. There is at least one discussion administrator having privileges on user accounts for the particular discussion.

Join ongoing discussions. Users of a group can participate in an ongoing discussion carried out in their own CoP. When participating, users can add or update an alternative to a given issue or a position speaking in favour or against a discourse item. Positions or alternatives are posted after the filling-in of an appropriate form. Each time a user posts a discourse item, **CoPe_it!** re-evaluates the whole discussion and indicates a solution (the most 'well-argumented' so far, according to an internal argumentation mechanism).

View closed discussion. Closed discussions are past discussions that cannot be altered (view-only mode); they can be shown to all groups' users.

Visualize the entire discussion: Users are able to see the entire discussion as it is being shaped by all participating members. There is no restriction on what users can see with respect to a discussion. Within a discussion, any user is able to see discourse items posted by other users. Currently, **CoPe_it!** supports a hierarchical view of argumentative discussions (Appendix - Figure 3).

Post discourse items (issues / alternatives / positions) to discussions. Once a user has joined an ongoing discussion, he is able to participate by submitting alternatives and positions (in favour or against an alternative or another position that has been already asserted). A point-and-click paradigm has been adopted. Any submission may be accompanied by supporting material such as attached files, URLs, and comments (see Appendix - Figure 4).

Display of information. The subject of a posted discourse item is by default visible to users. Users may extend the information given for each item by configuring their display. Users may also request the display of additional metadata about the items posted, such as the author and the submission date. Also, by clicking on any item in the discussion, details such as metadata about the selected item and relevant supporting material can be retrieved (see Appendix - Figure 5).

Users groups / Online users. Users are able to view which users belong to their group. Also, they can view which users of their group are currently online.

2.2 User Management

The **CoPe_it!** User Management module handles all issues regarding control and administration of the user accounts. In order for users to participate in argumentative discussions, a user account is required. In such a way, each user can uniquely be identified. A group-based access control mechanism determines the rights each individual user has with respect to discussions. More specifically, the module supports the following:

User registration. During registration, users need to specify a number of fields such as desired login name, password and the CoP to which they belong. Currently, registration requests are received and reviewed by authorized administrators.

User notification. Once user applications get approved by administrators, **CoPe_it!** automatically notifies those users about their successful registration by email containing details on how to access and login to **CoPe_it!**.

Update user data. Registered users are able at any time to modify their account data.

User registration applications. Authorized users (e.g. administrators of individual discussions) can review available user requests and accept or reject them.

Password reminder service. Passwords can be emailed to users, in case they have forgotten their password.

Administration of user accounts. Authorized users may change user data or grant and revoke access rights to discussions (see Appendix - Figure 1).

2.3 On deliberate limitations and foreseen features

In this section, we provide an initial but not exhaustive list of functionality features, deliberately not available in **CoPe_it!** prototype, in order to assist subsequent brainstorming among WP4 partners towards the analytical design process of the tool.

Collaboration space. Currently, a single collaboration space is supported, containing only the discourse items of the underlying collaboration. We foresee the need of multiple collaboration spaces, each one having different characteristics to cover needs such as the recording of sparse thoughts and arguments of participants, the hosting of original free-text dialogs, the collection of original resources needed in the context of a specific session of collaboration, creation of new knowledge by elaborating original resources, etc. The need of having such collaboration spaces interconnected is also mentioned. Special collaboration spaces may also needed for contexts that require decision making through voting or another well-prescribed reasoning process.

Rounds. A discourse is currently conducted in a single round. We foresee the need of having discourses conducted in more than one rounds, each probably leading to different conclusions. Also, the same discussion may be initially carried out by different and distinct groups, while the conclusions of the respective discourses may need to be later joined in a sophisticated way (collaboration towards strategic decision making carried out at a large scale, e.g. a nation-wide dialogue about educational issues, needs to be carried out through such discrete stages).

Participant Roles vs. system users. Participant roles in a discourse are currently covered by different types of system users that may access the tool's resources and trigger diverse functions associated to its functionalities. We foresee the need of a clear and sophisticated distinction between these 'system users' (associated with systems permissions to access, read, write, modify etc.) and CoP participant roles that evolve upon time and may (or may not) be associated with one or more 'system users'. For instance, in real discourses there may be a need for a person to have two different roles in the same discussion, or a role may be shared by two or more persons. Also, a role may be valid for a certain period of time (associated to one user and then changed to another). Finally, we may need to have virtual roles for users that implicitly participate in a discourse or representative roles for users assisting in some way others.

Sensitive information protection. Protection of private data (e.g. who said something) may be needed in some cases and triggered either by the user himself or by another user having a different role.

Support for decision making. The current argumentation-based reasoning mechanism is simple (based on the number of active positions in favor and against an alternative). We foresee the integration of a set of alternative reasoning mechanisms to cover the needs of diverse CoPs and decision making contexts. These mechanisms may take into account parameters such as opinion weights, preferences, constraints, and be based on broadly accepted processes such as voting. The relation between the context of a specific collaboration and the appropriate reasoning mechanism to be applied needs also to be considered and made transparent to the participants.

Discourse items and acts are currently limited and certainly need to be expanded to cover needs of diverse CoPs and collaboration contexts. Additional items could be 'preferences',

'constraints', 'ideas', 'axioms', etc., while additional discourse acts could be 'request for additional (explanatory) information', 'join (or separate) argument', 'change my opinion', etc.

Terminology used in the tool (concerning user and participant roles, discourse items and acts, etc.) has also to be carefully reconsidered.

Intrinsic characteristics of collaboration towards learning. Real CoPs' contexts are characterized by a series of personal, habitual, emotional, social, and business-specific characteristics that promote or prohibit collaboration towards learning. These should be clearly identified and analyzed in order for the tool to accommodate them properly.

2.4 Other remarks

Some noticeable technical and functional problems which will be further addressed in the next releases of the tool are listed below:

Compatibility with major web browsers. MS Internet Explorer displays accurately all visual cues relevant to a discussion. When using Firefox or Safari, different visualization of colors, tree collapses, alignments, context menus and popup windows may appear. These are known and will be fixed in the future and they do *not* affect the tool's functionality.

Transaction management and history of post actions. An advanced transaction management with capabilities of rollback of any post action is one of the next implementation targets.

User management. Currently a hierarchical user management model is supported, as well as creations of user groups and assignments of administrators for each group. As already mentioned we aim to offer an advanced, CoP-oriented user and role management system.

Awareness support. Awareness services, such as progress awareness, participation awareness, modality and social awareness are not currently included in the prototype. They will be integrated as described in DoW, through task T4.4.

2.5 Implementation issues

CoPe_it! has been developed on state-of-the-art technologies such as XML and MS Visual Studio .NET Framework V2. **CoPe_it!** is based on a multi-tier architecture that ensures the openness and extensibility of the system. These tiers are:

- The storage tier provides persistent storage for data and information. The storage layer in which discussions and relevance information are stored and manipulated consists of a workspace of discussion files in XML format together with a database schema in the Relational Database Management System (RDBMS) Microsoft SQL Server 2000.
- The middleware tier provides the application logic that includes all domain specific ontologies and constraints. This tier has been implemented as dynamic linked libraries (dll) using the C# and VB.NET programming languages.
- The presentation tier handles the visualization of discussions.

3 Related work

This section provides a brief presentation and evaluation of approaches related to **CoPe_it!**, aiming at further validating our motivation and revealing important issues to be considered in the future.

Designing software systems that can adequately address users' needs to express, share, interpret and reason about knowledge during a discourse has been a major research and development activity for more than twenty years (de Moor and Aakhus, 2006). Designing, building, and experimenting with ICT systems for the development of specialized argumentation and decision rationale support systems has resulted to a series of computer supported argument visualization approaches (Kirschner *et al.,* 2003). Technologies supporting argumentative collaboration include, among others, mailing lists, forums, group decision-support systems, as well as co-authoring, and negotiation support systems. Increasing interest also develops in implementing web-based tools supporting argumentative collaboration. These usually provide the means for discussion structuring and user administration, while the more sophisticated ones allow for sharing of documents, on-line calendars, embedded e-mail and chat tools, etc. The above approaches support argumentative collaboration at various extends and have been tested through diverse user groups and contexts. Furthermore, all aim at exploring argumentation as a means to establish common ground between diverse stakeholders, to understand positions on issues, to surface assumptions and criteria, and to collectively construct consensus on whatever grounds can be found (Jonassen and Carr, 2000). In the rest of this section, we present an overview of existing software supporting argumentation that has been applied in different organizational and educational contexts. The primary aim of this overview is to highlight existing argumentation tools features and functionalities and, to comment on their strengths and weaknesses in aiding argumentative collaboration towards learning.

Argumentation based on the exchange and evaluation of interacting arguments which support opinions and assertions has been extensively applied for collaborative decision support systems or for negotiation support in organizational contexts. *gIbis* (Conklin and Begeman, 1987) for instance, a pioneer argumentation structuring tool that has exhibited major impact to a series of others, was developed for the capturing of a design process rationale. This is a hypertext groupware tool that allows its users to create issues, take positions on these issues, and make arguments pro and contra these. *Sibyl* (Lee, 1990), an extension of *gIbis*, is a tool for managing group decision rationale. This tool also provides services for the management of dependency, uncertainty, viewpoints and precedents and can be viewed as a knowledge-based system. *QuestMap* (Conklin, 1996), is another approach based on gIBIS main principles that resembles to a "whiteboard" where all messages, documents and reference material for a project and their relationships are graphically displayed during meetings. *QuestMap* captures the key issues and ideas during meetings and creates shared understanding in a knowledge team. All the messages, documents, and reference material for a project are placed on the "whiteboard", and the relationships between them are graphically displayed. Users end up with a "map" that shows the history of an online conversation that led to key decisions and plans. *Compendium* (Selvin and Sierhuis, 1999) is a graphical hypertext system which can be used to gather a semantic group memory when used in a meeting scenario. *Compendium* provides a participatory user interface to conceptual modelling frameworks and diverse other applications required by the user community.

Other approaches, focusing on the representation of knowledge include *Euclid* (Smolensky *et al*., 1987), a tool that provides a graphical representation language for generic argumentation. In a similar context, *Sepia* (Streitz et al., 1989), a knowledge-based authoring and idea-processing tool, supports creating and revising hyper-documents that views authoring as a design process. *Janus* (Fischer *et al*., 1989) is based on acts of critiquing existing knowledge in order to foster the understanding of knowledge design. *QOC - Questions*, *Options* and *Criteria* (MacLean *et al*., 1991) is another model to represent the rationale of reasoning in a decision making process in that it provides the means to represent and integrate rationale of varying degrees of stability, at the different stages of a design process. *Belvedere* (Suthers et al., 1995) is used for constructing and reflecting on diagrams of one's ideas, such as evidence maps and concept maps. It represents different logical and rhetorical relations within a debate and supports problem-based collaborative learning scenarios through the use of a graphical language. *Hermes* (Karacapilidis and Papadias, 2000), a tool supporting distributed, asynchronous collaboration by integrating features based on concepts from well-established areas such as Decision Theory, Non-Monotonic Reasoning, Constraint Satisfaction and Truth Maintenance, aims at augmenting classical decision making approaches by supporting argumentative discourse among decision makers.

Within argumentation theory, systems supporting the visualization of argumentation have played a considerable educational role by supporting the teaching of critical thinking and reasoning skills. For instance, *Araucaria* (Reed and Rowe, 2001) provides an interface for the decomposition of text into argumentation premises and conclusions. It supports the contextual analysis of a written text and provides a tree view of the premises and conclusions. This software has been designed to handle advanced argumentation and theoretical concepts, which reflect stereotypical patterns of reasoning. These features, combined with its platform independence and ease of use, make *Araucaria* an interesting argumentation tool. The *Reason!Able* argumentation tool (van Gelder, 2002) provides a well structured and user-friendly environment for reasoning. Through the use of an argumentation tree, a problem can be analyzed or decomposed to its logically related parts, whereas missing elements can also be identified. Furthermore, *Reason!Able* provides the means for an elegant structuring of the tree diagram, as different weights can be assigned to the arguments, illustrated with different colours. Another educational software providing assistance in the creation and sharing of visual images of ideas is the *MindDraw* (see http://info.cwru.edu/minddraw/index.html), a descendant of *Spidermap*. This software tool enables users to produce ‘cause maps’ or maps of webs of causal relationships, thus supporting and encouraging self-reflection, inquiry and critical thought. It is a special purpose, simple, point-and-click drawing tool that allows the creation, analysis, and pictorial representation of ideas. *MindDraw* is a thinker’s tool that is useful for students and learners of all ages, from primary school through graduate training and professional practice. *Athena Standard* and *Athena Negotiator* (Rolf and Magnusson, 2002) are two more examples of argument mapping software. *Athena Standard* is designed to support reasoning and argumentation, while *Athena Negotiator* is designed to facilitate analysis of decisions and two-party negotiations. It is directed at tertiary education, ranging from first year to postgraduate students or for elementary use by professionals. The above two systems are efficient argumentation structuring tools, but do not employ knowledge management features.

The above approaches have been thoroughly considered during the development of **CoPe_it!** and aided the conceptualization, shaping and implementation of the currently integrated features and functionalities. For instance, the discourse graph of **CoPe_it!** is gIBIS-like,

while its reasoning mechanisms have exploited features of the abovementioned argumentation tools. As also derives from the above, the majority of existing argumentative collaboration systems mainly focus on the expression and visualization of arguments. In this way, they assist participants to organize their thoughts and present them to their peers. However, their features and functionalities are limited (e.g. paying almost no attention to knowledge management issues), they are basically tested only in academic environments (i.e. not broadly used), they are not interconnected with other tools, and they do not efficiently integrate the technological, social and pedagogical dimensions of collaboration. As acknowledged in (de Moor and Aakhus, 2006), traditional argumentation software approaches are no longer sufficient to support contemporary communication and collaboration needs. **CoPe_it!** aims at filling this gap, by providing the list of features and functionalities described in detail in Section 2.

4 Future steps

Future steps to be followed in the next 6 months for the evolution of the **CoPe_it!** prototype towards the advanced tool to be delivered as D.MED.02 are listed below. In any case, these steps will be fine tuned in the near future, according to the outcomes of the related WPs (from the first six months).

- WP4 partners (EPFL, UNIFR, INRIA, CTI, UT, EM-Lyon, GATE-CNRS) to have a **look-and-feel experience** with the **CoPe_it!** prototype and produce 'toy' cases at copeit.cti.gr repository.
- WP4 partners to **create realistic and as complete as possible examples of use**. Partners may involve their own teams, but they should certainly establish a close collaboration with the CoPs specified in the project (the prototype should be demonstrated to them; experimentation issues will be also considered).
- WP4 partners to **model the activities of associated CoPs** (activities related to decision making, knowledge management, etc.), taking also into account the interviews recorded in WP1.
- WP4 partners to participate in focused discussions (through the above forum) on the **mediation support scenarios** produced in Task 4.1.
- WP4 partners to participate in focused discussions (through http://palette.cti.gr/forums.asp?ForumId=1) for the **detailed design of foreseen features and functionalities** of the final tool (see Section 2.3). Several threads (topics) will be raised, each one focusing on a feature (being it already integrated in the prototype or to be added in the future). Additional features (other than ones listed in Section 2.3) may be proposed. Related discussions will be also conducted in face-to-face meetings, in particular between members of the development teams of WP4. The outcomes of the above discussions will be periodically forwarded to the associated CoPs for evaluation and approval.
- WP4 partners to provide **feedback on bugs**, mistakes, and minor improvements at a dedicated thread in the above forum.

- WP4 technological partners (EPFL, INRIA, CTI) to collaborate with WP5 partners for the design of the tool's conversion to a **'web service'** (granularity issues have to be decided upon the evolution of the project). In addition, for the interoperability and integration of the Information and Knowledge Management Services of Palette.
- WP4 partners to **consider the outcomes of WP1** in order to further elaborate and refine the list of current and future features and functionalities of **CoPe_it!**. Also, to provide feedback in the form of well-documented and demonstrative examples that correspond to the mediation support scenarios produced in Task 4.1 (possibly collaborating with selected WP1 partners or selected CoPs or CoPs' members).

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Appendix

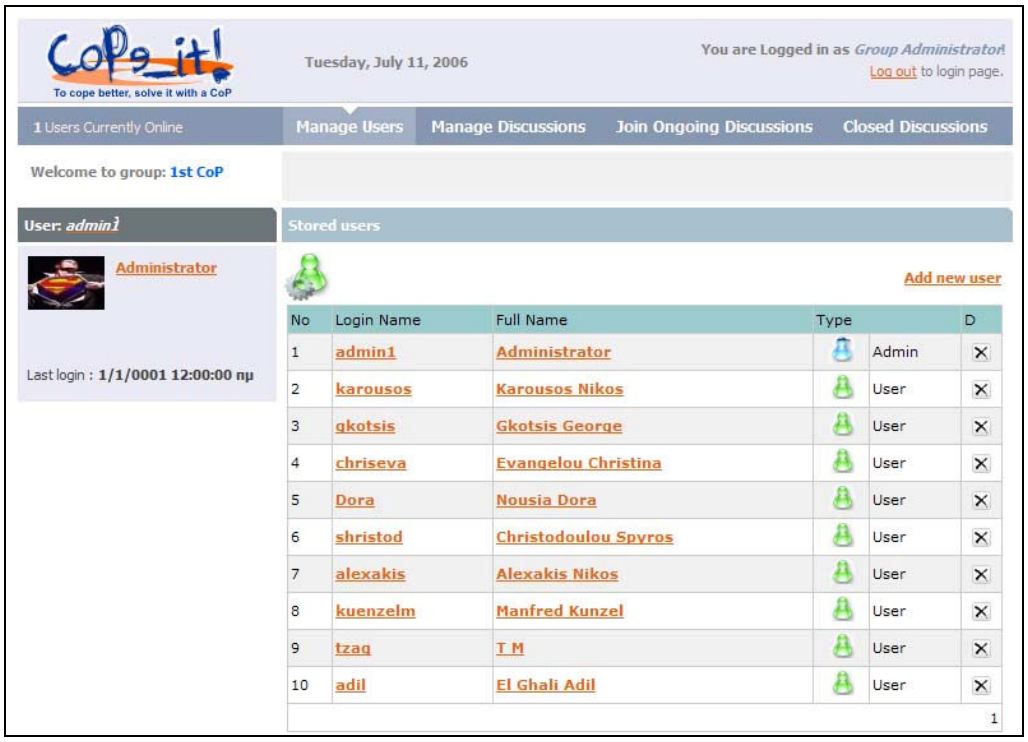

Figure 1. The **CoPe_it!** user administration panel.

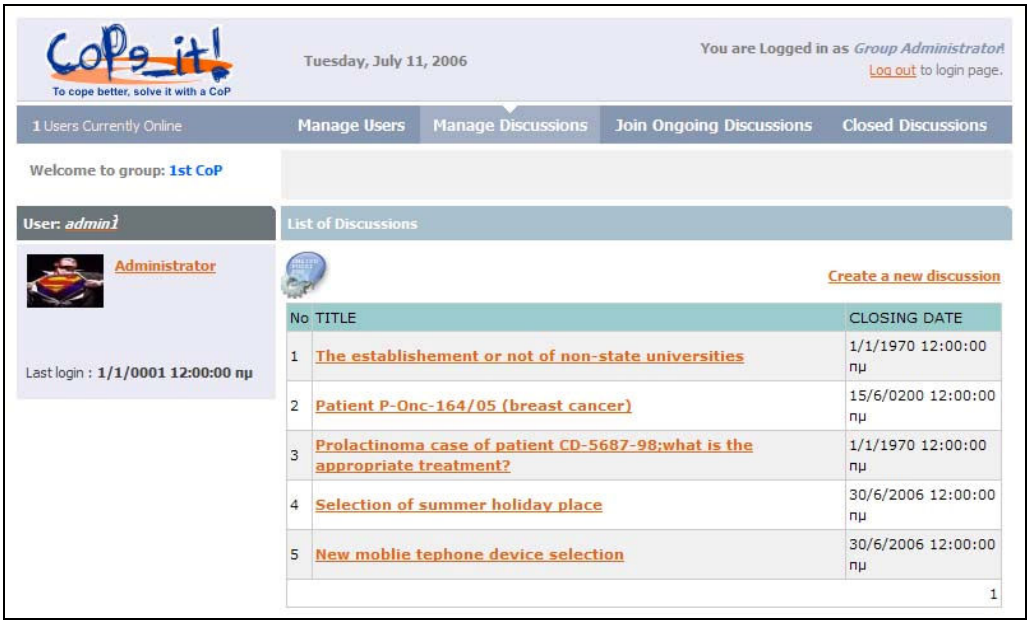

Figure 2. The **CoPe_it!** discussion administration panel.

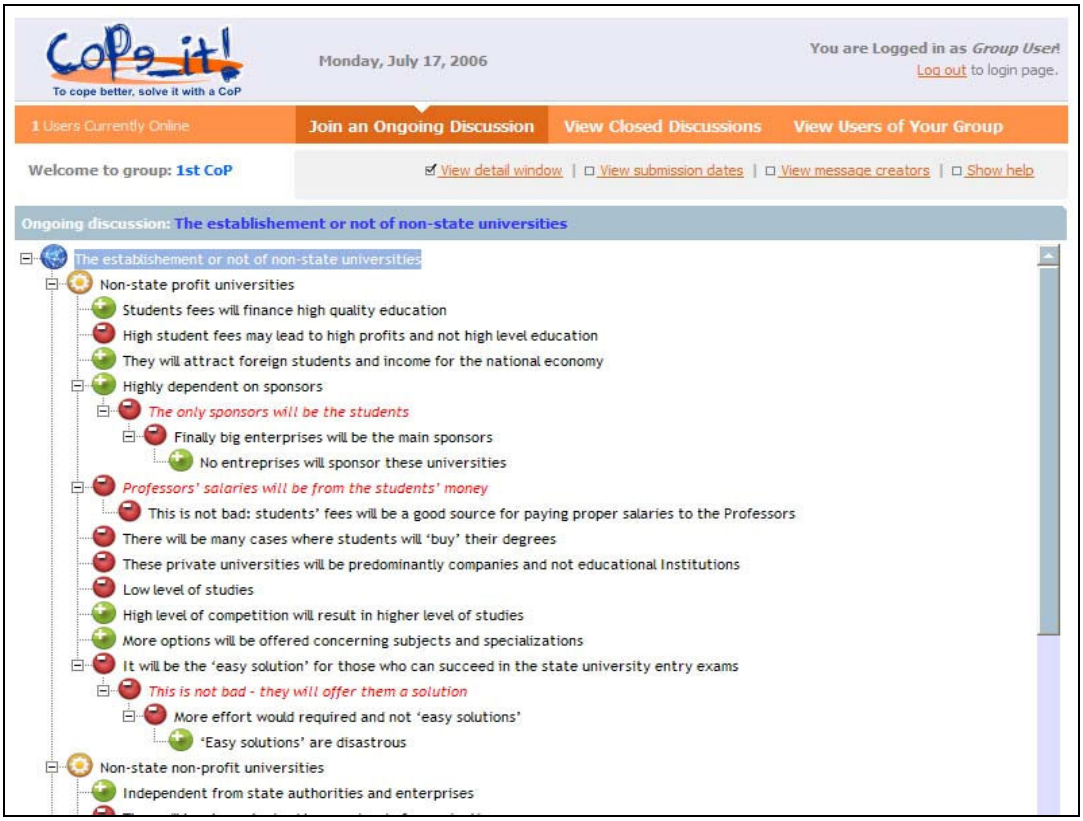

Figure 3. Visualization of an ongoing discussion.

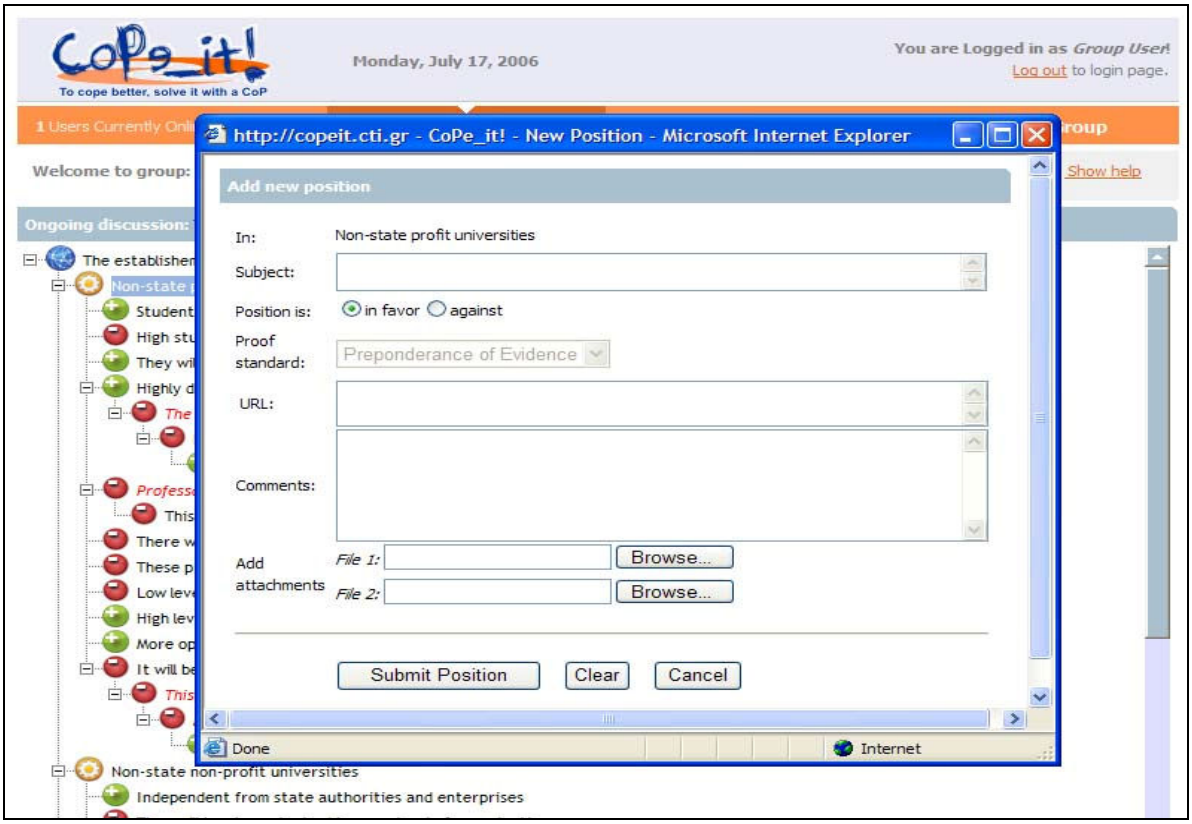

Figure 4. Submitting a new position to an alternative.

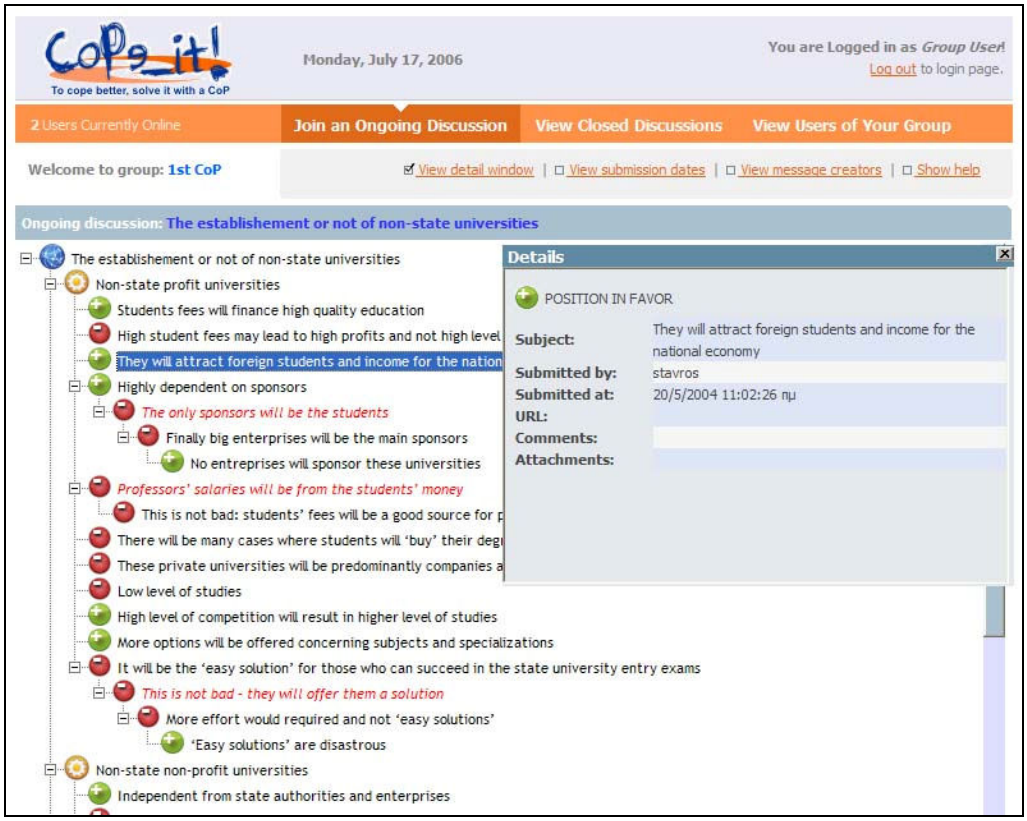

Figure 5. Viewing details of a position.