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ABSTRACT

The trend in business today is undoubtedly toward flatter, more efficient team-based international organizations. The executives in these organizations must make decisions rapidly and must often coordinate their decisions and actions with those of their fellow executives scattered all over the globe. Limited time and financial resources have created the fast-growing need to be able to do this efficiently through a computer-supported system. United States business schools, the training grounds for many of these executives, are attempting to address this new challenge.

This paper presents an innovation in teaching that is on the cutting edge of business education. CATT, a groupware-based system for business case discussions, breaks through existing geographic, technological and mental barriers. It simulates the actual high stress environment executives face by allowing for on-going international discussions aimed at formulating a plan of action in a given business situation. Structured argumentation provides the framework for the description of all the facts and nuances of the case and the discussion as well as the later evaluation of student performance. The multi-media input and the feedback of both fellow students and instructors guide the discussion toward its ultimate conclusion, keeping in mind the specifics of the situation as well as experience gained from past case discussions.

This paper outlines the present barriers to effective case discussions, the key design objectives of CATT, the system's major characteristics and the future directions of this field of research.

> The word education means, literally, the process of leading out. Thus we are talking of the way in which all your faculties and capacities should be encouraged to expand and unfold themselves.
>
> Alfred North Whitehead in *Essays in Science and Philosophy* (1947)

1. INTRODUCTION

The vision of the team-based organization of the future shows branches scattered all over the globe that are working together on the same projects. This vision is fast becoming a reality. It is made feasible in part due to the development of a new genre of tools often called groupware or organizational computing systems (Applegate et al. 1991). Such systems[1] are becoming increasingly more common in offices, manufacturing shop-floors, laboratories, and homes. The trend towards team-based organizational forms has been created by the increased competition on a global scale, which demands instant responses to rapidly-changing environments. However, financial and time constraints make the traditional method of physically moving all the participants to the same spot at the same time unrealistic.

Business education in the United States has so far responded to the well defined trend of global, team-based organizations by setting three goals: internationalization of the curriculum, teaching the managing of applications of information technology, and incorporation of industry input. In the current business school environment, however, three factors have prevented the development of close links between the output of the educational process and organizational demands that are needed to meet these challenging objectives (Miles 1985). These factors are:

- *Geographic Isolation*: Students in the United States are isolated geographically and culturally, with a significant proportion of the learning experience being related to the American context only. While a plethora of exchange programs exists, the number of students going abroad is still limited.[2] Even in their case, the percentage of international exposure versus the total time spent remains relatively low. In addition, the foreign experience is often isolated and not usually incorporated into the mainstream of education. Students not participating in these programs benefit little. Finally, although a relatively large number of foreign students attend US programs, interaction with American students is not as great as would be expected and is primarily limited to the US environment. This situation may benefit the foreign students but does little to familiarize US students with the realities of doing business in a global marketplace.

- *Technology isolation*: Over the last few years, there has been a substantial increase in the use of information technology in universities all over the country, and computers are now being used throughout the educational process. However, a significant proportion of time is spent using the computer as a high-tech typewriter or a calculator rather than as an integrated tool to support the myriad and complex activities of the knowledge worker of a fast approaching tomorrow.[3]

- *Perspective Isolation*: Business school students are often accused of living in an ivory tower and having limited knowledge about industry. The occasional speeches, work experiences or internships they are exposed to offer glimpses that are most often left hanging and are not integrated into the learning experience. As a result, students learn little about the true trends and needs of the business world from these isolated contacts. Finally, the traditional organization of a business school reflects the functional organization of industry and prevents students from acquiring the holistic approach to solving problems that will be needed in the real world.

These three isolation factors contribute to the gap between the education provided by business schools and the growing need in the corporate world for executives capable of dealing with the new, complex challenges of the very near future. Changes can be made now to accommodate this need in business schools. Our vision of the future is that of students interacting with each other across representational, spatial, temporal, and cultural boundaries. We see the development of virtual classrooms spanning countries and cutting across the traditional boundaries of the physical classroom.[4]

We have chosen the case method as the target for the innovative use of information technology (IT) in education. We have focused on this particular teaching method because it offers the best probability of success in addressing the above mentioned isolation factors. The process of case discussions will in the long run be prototypical of the processes of real business discussions, and these are increasingly computer supported, asynchronous, and distributed. Thus our research can be leveraged when systems to support actual business discussions have to be designed and built. Hence, in this paper we present the research approach (see Figure 1) and key issues involved in developing a computerized argumentation based teaching tool (CATT) to support the case discussion process in business schools.

In brief, CATT is a fully configurable, extendable, object-oriented groupware prototype that is currently being used as a test bed for developing systems to support business education in general and the case method in specific. CATT is conceptually different in design from other systems being built to support business education in that it is built around the concept of asynchronous, distributed, multi-party interaction.

CATT incorporates multi-user, direct-manipulation graphical interfaces. It has tools which help participants to create, modify and manage the argumentation networks that are built up among a group of students and the instructor during the course of a case discussion. Several other tools for the instructor and students are currently being tested including a query language for argumentation networks, a group mood meter, a voting tool, a questionnaire and a survey tool.

The rest of this paper is organized as follows: In section 2, we will highlight the key characteristics of and the major barriers to the conduct of a successful case discussion. Section 3 reviews the design goals that went into the creation of CATT. Section 4 presents an overview of the implementation of CATT. Section 5 details the tools and functionality available under the current prototype and presents an example of the use of CATT. Section 6 sketches some of the experiments we plan to conduct with CATT as well as the conclusions and directions for future research.

2. KEY CHARACTERISTICS OF AND BARRIERS TO SUCCESSFUL CASE DISCUSSIONS

In this section, we present some of the key barriers to conducting case discussions. Understanding these barriers is critical to the design of computer based systems such CATT because they are often subtle and are intricately inter-related.

2.1 The Case Discussion Method: An Overview

The underlying philosophy of the case method of teaching has been spelled out in detail by Christensen and Hansen (1981) in their landmark work. According to them the four key characteristics of the case method of teaching are:

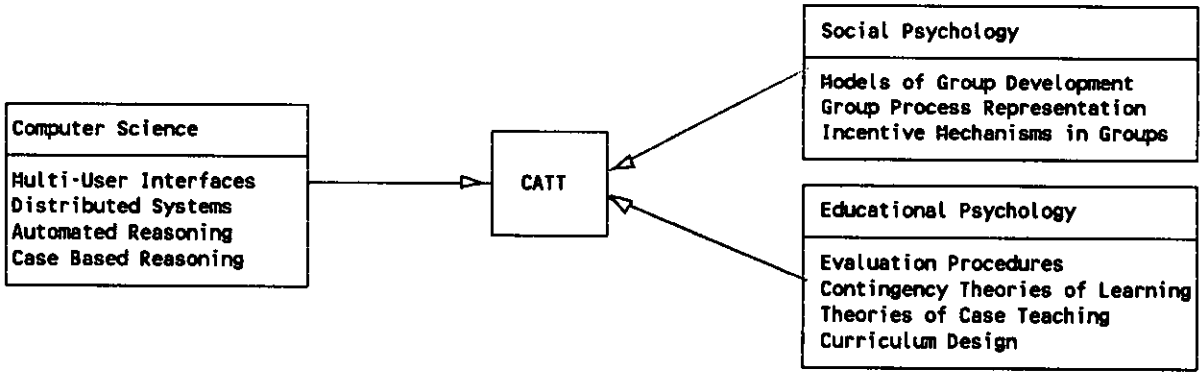

Figure 1. Multi-Disciplinary Research Approach to the Design of CATT

- *The primacy of situational analysis*: For both administrators and students of administration, the primary consideration is "the law of the situation." Analyzing a specific situation forces a student to deal with the "as is" not the "might be." Specifically, a case discussion debates the issues involved in answering the following questions:
  - What, in your opinion, is the most fundamental, crucial or urgent issues and problems before the company? Why do you think so?
  - What, accordingly, if anything, should anyone do? Who should take action? When should the action be taken? How should the action be taken? Why do you think so?
  - How will you communicate your ideas to the top management of the company?
- *Active student involvement*: The section functions as a learning group with all participants benefiting from the arguments of others. The case method of teaching emphasizes learning by the student over teaching by the instructor. Students also learn from their pre-class discussions in peer groups as well as in post-class analysis sessions. In the case method, the onus is on the student to gather the relevant information and present coherent positions and arguments about the situation being discussed. As Thomas Clough described the situation in the "Teaching by the Case Method Seminar" at the Harvard Business School,

  > A skilled teacher recognizes that all significant learning can come only from the creative efforts of the learner. That's another way of saying learning is personal. You cannot learn for anybody.... Essentially the student must be the one to raise the significant problem for you to help him find the answer.

- *A non-traditional instructor role*: Conducting case discussions requires good non-traditional skills, experience, and judgement on the part of the instructor. A critical responsibility of instructors is the leadership of the case discussion *process*. They take responsibility for classroom leadership and serve as sounding boards for the class but need not enter actively into the class discussion.[5] The effective instructor, for example, expands the entire section's opportunities for learning by asking the appropriate question of a specific student at the best time during the discussion. Instructor direction, not domination, is a key to effective case discussions. This directional style is fostered by two main factors. First, the instructor provides the students with a path of inquiry – a conceptual framework for understanding the complexities of the problem being studied. Second, the instructor develops a teaching plan that considers both what is to be taught and how the discussion may unfold.
- *A balance of substantiative and process teaching objectives*: The case method fosters the development of an administrative point of view and brings home the need for relating analysis and action. This is accomplished by examining and understanding any administrative situation from a multidimensional point of view. The student develops a sense for appropriate boundaries and simultaneously becomes sensitive to the inter-relationships that exist between all organizational functions and processes.

2.2 Barriers to the Successful Conduct of Case Discussions

Having laid out the key characteristics of the case discussion process, we now proceed to examine in detail each of the following five barriers to the conduct of a successful case discussion.

2.2.1 The Multi-Participant, Same-Place, Same-Time, Nature of Case Discussion. Case discussion is intrinsically a participatory process in which several participants are simultaneously present.[6] In case discussions, participation is the key ingredient for success. The spirit of the methodology mandates people reacting to each other and learning through the synergies of conversation. A useful discussion is one in which issues are laid out, several differing positions and perspectives are taken, arguments are put forward, and a plan of action is synthesized.

However, due to the current spatial (participants have to be co-located) and temporal (participants have to be present at all times) constraints on case discussions, the interaction patterns are limited to sequences of single-party dyadic interactions.[7] The face-to-face nature of the case discussion process itself often inhibits participation and learning for the following reasons.

- Students do not participate because of social desirability factors (e.g., they will not ask simple questions for fear of being mocked by peers.) While instructors insist that students state their positions or conclusions, they do not want to nail each other down. Students need to compete with each other in presenting issues, positions, and arguments, and simultaneously cooperate with each other in building up an entire logically structured case discussion.[8]

- Although several studies (e.g., Rao 1990) show that the comprehension of listeners is proportional to the amount of feedback they receive, feedback in the case discussion process is limited to the single same-place, synchronous, face-to-face channel available for communication.

- Very often this multi-participant learning process occurs over time (Stice 1976) and learning contexts (Svinicki and Dixon 1978). Students learn as much from their discussions in their peer group meetings before and after class as they do during the lesson. Given the temporal nature of learning and knowledge assimilation, an evaluation scheme that explicitly incorporates the temporal dimensions is required, but is unfortunately absent in the current situation.

- The range of possible variations in the group process is very limited. For example, interaction among dynamically created subgroups is very cumbersome in a traditional classroom setting. It should be possible to group participants in organizational forms such as markets, bureaucracies, or clans. Free role playing and role scripting provide methods by which participants can be exposed to varying perspectives. However, it is not possible under the current setting to have groups of people organized by, say, educational background to take the role of the marketing manager, the computer programmer and the personnel manager, go away, discuss the case on an "off-line" basis and then return to the main discussion.

2.2.2 A Linear Approach to Representing the Case and the Case Discussion Process. The current process of case discussion is based on a liner, uni-medium (paper) representation of the contents of the case. This knowledge representation for cases is unnatural for three reasons: it imposes unitary sequences of thoughts upon the participants, it imposes a single-discussion thread pattern on the process of case discussion, and the representational constraints on the case get mapped on to constraints about the nature of the discussion process.

Hypertext and structured non-linear representations, when used as the basis for computer-based writing tools, have been shown to be remarkably effective as a basis for document representation. In particular, hypertext-based argumentative writing (Hashim 1990b) can serve as a representational basis, for both cases and case discussions.

2.2.3 The Fissures Caused by the Functional and Qualitative versus Quantitative Learning Approaches. The curricula of business schools have historically reflected the traditional structure of organizations (Miles 1985). At a time when cross-functional approaches are being increasingly emphasized, business school case studies are still being handled as simple "product positioning" cases or "plant location" cases.[9] Cases vary in type from illustrations of theoretical principles or applications of theory to emphasis on the mechanics of activities such as double-entry bookkeeping. Given this rich diversity in the nature and content of cases, integration of the discussion based on just one of these elements alone is often insufficient to gain a holistic picture of the situation.

In the case discussion process, linkages often have to be made with previous case discussions. Some form of "organizational memory" (Huber 1990) to ensure discussion continuity (possibly across people, and even courses) is thus required. Support for the well trained student – marrying analytic discipline with personal creativity across functional and curriculum boundaries – to create a vision of what the undertaking is all about is required if computer based support for case discussions is going to be successful.

2.2.4 Imprecisely Stated and Quantified Procedures for Student Evaluation. The case discussion process relies on group interaction to produce knowledge. Hence, students need to be evaluated on both the content of their interaction as well as the nature of the interaction processes in which they participate. Given that participants can play several different roles and make contributions along several dimensions, the current evaluation systems are inadequate. Instructors need to be able to give direct or indirect signals that student analysis is moving in the right direction. Any way of expressing satisfaction or dissatisfaction is better than no response at all. Students need to know "what we have done well, what we have done poorly" on a continuous basis rather than at just the end of the course.

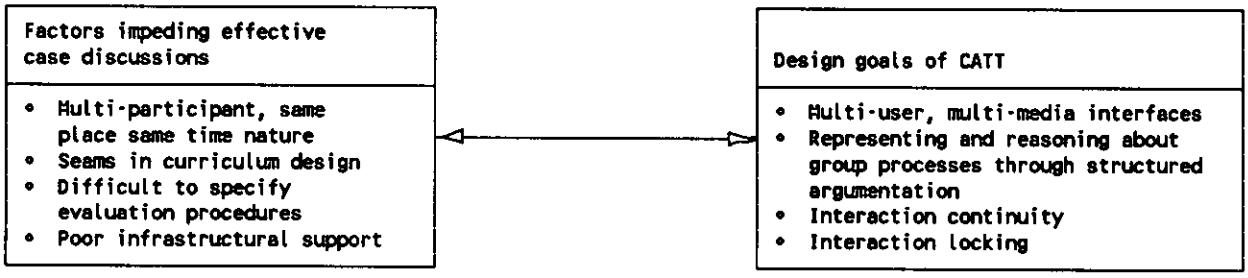

Figure 2. The Characteristics of CATT

In addition, it would be ideal if instructors could evaluate the fundamental viewpoints and perspectives developed and leave it up to a grader/auditor to check out the fine details of the arguments. Currently, support that would allow a variety of evaluation schemes (such as the sweep of interest versus depth of participation) and a variety of evaluators (such as functional area experts from industry versus academicians from research institutions) in critiquing the discussion is missing. It is our viewpoint that a computer based system – like CATT – can support the statement and execution of evaluation procedures by incorporating evaluation methodologies developed in educational psychology.

2.2.5 Poor Infra-Structural Support. Currently a great deal of time is wasted in the preparation for the case discussion. Students spend too much time wading through the mass of exhibits, figures, and text in order to structure the material in a coherent form. Almost every case becomes highly dog-eared, highlighted and marked with arrows before the participants get a clear idea of the contents of the case. This is natural since the organization of case material is non-linear with numerous inter-connections and cross-references.

Poor infra-structural support leads to the inefficient use of classroom time. For example, if people have simple questions, these could be posted on an electronic bulletin board and class time could be saved. Instructor control is very important and one of the most important skills in a case discussion is dynamically keeping track of significant issues in a coherent fashion. Instructors now do this by developing a discussion plan on the blackboard. However, they very often have to write and erase a blackboard numerous times before they can develop the entire road-map. The physical constraints of classrooms, blackboards, flip-charts and other conventional teaching aids are often overwhelming.

3. KEY DESIGN GOALS FOR CATT

In the previous section, we described the barriers to the conduct of a successful case discussion. We now present an investigation into the four key design goals that emerged from these: multi-user interfaces, the dialectic representation and reasoning about group interaction processes, interaction continuity, and interaction locking (see Figure 2).

3.1 Multi-User, Multi-Media Interfaces

Since our goal is to facilitate the case discussion process among a group of people, multi-user interfaces and groupware applications have to be developed. Multi-user interfaces are qualitatively different from those designed for single user interfaces. In multi-user interfaces to groupware systems, the key issues are the equality of interaction between individuals and focus of attention for an individual. The relaxed What You See Is What I See (WYSIWIS) model[10] (Stefik et al. 1987), developed for COLAB, has been successfully used to address the goals of equality and a stable focus of attention. Relaxed WYSIWIS is successful in facilitating consistent user-to-user interaction because the focal point of the group context is not enforced. Rather, it emerges in a non-intrusive fashion as a result of participation.

In multi-user interfaces, the presence of multiple discussion threads (students could be active in more than one discussion and these discussions could be about different cases) and foci of attention (several inter-connected activities exist) make floor control issues complicated. For example, indicating commentary and drawing attention have a totally different interpretation in a situation in which a case discussion occurs over several days and across several continents. Metaphors, such as the video-cruiser and the "peek over the shoulder" developed at the University of Toronto (Mantei 1991), for such forms of interaction as well as activities such as highlighting, annotation, commentating and note-taking need to be incorporated into systems like CATT.

In contrast with printed text on plain paper, case discussions can be presented using computerized graphic displays, video-taped interviews and voice recordings for a full use of available media. For example, if the case describes a conversation between a sales representative and his manager, then the conversation itself could be stored as a multi-media object in the system and used in

its native media-rich form. Alternatively, if an exhibit referred to an annual report, the report itself could be retrieved as a multi-media document. In a computer-based system to represent distributed, asynchronous case discussions, a multi-media representation of cases and human computer interfaces becomes critical as the medium of communication intimately influences the interpretation of the message (McLuhan 1964).[11] Further, a significant amount of non-verbal social negotiation takes place in all communication (Mantei 1991) necessitating the use of a multi-media interface for CATT.

3.2 Representation and Reasoning About Group Processes and Development of Dialogical Rules

The inter-relationships between the roles and group interaction processes in case discussions can be well represented by dialectics in general and structured argumentation in particular. Dialectics and structured argumentation (Mason and Mitroff 1981) comprise the processes of making information and the underlying assumptions explicit, raising questions and issues toward which different positions can be taken, gathering evidence and building arguments for and against each position, and attempting to arrive at a final conclusion and plan of action.[12] Since various people have their own ideologies and agendas, the use of structured argumentation, as a knowledge representation basis for CATT, can bring about a common and shared view of the case and build bridges between the differences among the participants. The use of dialectics thus involves

- the elicitation of point and counter-point in the form of questions and/or issues, positions, and pro and con arguments.
- the documentation of the process of issue raising and response.
- the continuous, incremental, and aggregated analysis of the case.
- keeping track and cross-referencing previous issues and their resolution (if any) for possible applicability (either directly or by analogy) to future situations.
- reasoning about the content and process of group interactions at both the event level and the task level.

The best known example of the use of the structured argumentation approach in a computer based system is ibis (Yakemovic 1990) – a hypertext implementation of the IBIS model (Rittle 1972). IBIS, a non-linear structured argumentation method, helps in capturing the discourse in a network of dialectic components – nodes (issue, positions, arguments, etc.) – and dialectic relationships – links (responds-to, supports, objects-to, etc.). The control of the discourse is represented by the type of the nodes and links included in the network schema (see Figure 3 for an example of the IBIS network schema). The schema represents the logical structure (the syntax or logical rules) of the discourse.

What this structure does not provide are ways for controlling the practical aspects for initiating the case discussions, passing the floor, setting time limits, and evaluation of arguments. What is needed are some procedural rules to control the practical aspects of the discussion. These are rules similar to Robert's rules of order in a parliament. An example of such rules are the procedural rules governing the debate (Dehlinger and Protzen 1972). Another approach is to use a dialogue logic (dialogical) model of structured argumentation made of two parts: usage rules (syntactic, or logical rules) and regulating (procedural) rules (e.g., Lorenzen 1987). These rules, by restricting and inducing control of the discussion, govern the process by which participants in the case discussion process, interact with each other in building up an argumentation network. Thus, in a groupware system to support the case discussion process it is these rules which determine the efficiency of discussion and the evaluation of student participants. In CATT, these rules determine

- the protocol and rules by which participants enter and exit the discussion.
- floor control patterns (which is analogous to selecting one student to answer a question when many others with hands raised are asking for recognition), and patterns of argumentation sequences such as sideline development.[13]
- the selection of a participant to start the discussion.
- the kinds of questions that can be used by the instructor.
- when, how, and where the instructor interjects the discussion with comments, directives, and questions.

Dialogical rules can be decomposed into two parts: regulating rules and usage rules. These rules determine how a discussion grows in a logical fashion (content) and as an interactive sequence of interactions (process). Regulating rules determine how interaction protocols will be observed and thus help organize, control, limit, and direct the discussion. An example of a regulating rule is who gets the floor. The usage rules limit the scope of logical growth of the network by specifying the allowed syntactical or grammatical language for conducting the discourse. An example of a usage rule is what is allowed in terms of the content of an argument node in a IBIS network. It is a combination of regulating and usage rules that determines the methods for reaching a conclusion to a specific issue that arises and also for the entire discussion.

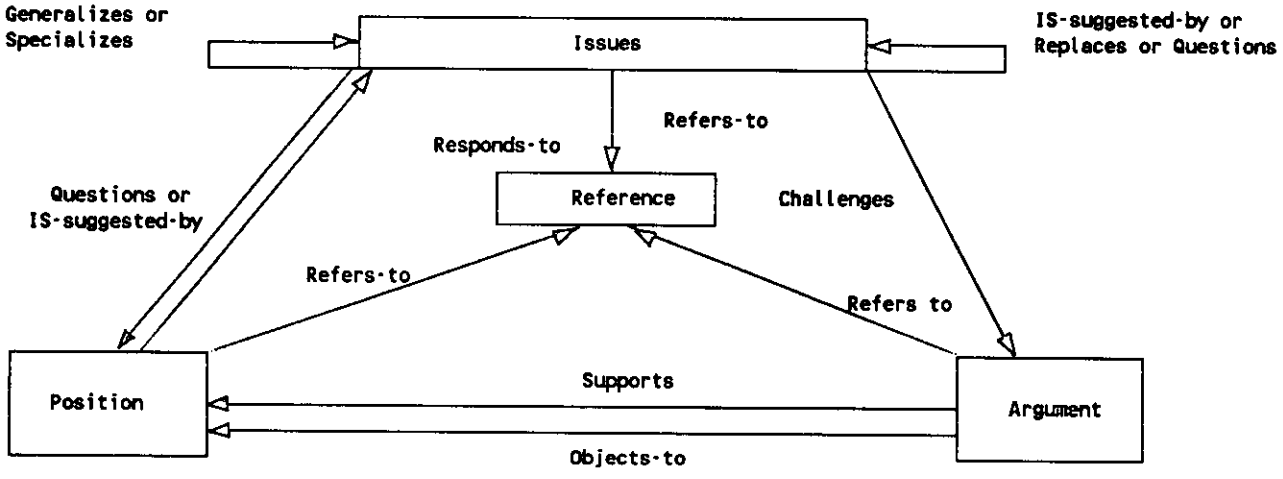

Figure 3. Schema fo an IBIS Network

One of the sets of dialogical rules we are currently examining proposes the uses of "rounds of argumentation" similar to a court of law. Rounds are time-stamped sequential nodes in the discussion graph built by incorporating the constraint that students cannot take part in two successive rounds. This is similar to the courtroom situation in which the prosecution and the defense take turns in presenting the issues, positions, and arguments.

In case discussions, the use of precedent in resolving issues is common. Since both the process and content of interactions are stored in a structured form, it becomes possible to use them as precedents or analogies in dealing with ongoing situations. Storing interactions as episodic events allows the creation of an "organizational memory" and consistency in case discussions. The use of the simultaneous satisfaction of a set of semantic, structural, and pragmatic constraints (Thagard et al. 1990) to retrieve analogies is a result that can be directly mapped to the problem of finding precedents - provided interaction information capture takes place in a structured form.

3.3 Interaction Continuity

We see the case discussion process as building many islands of discussions, all linked to the master representation of the case. In the case discussion process, a need to provide interaction history in terms of both process and content exists. Inter-connected dialectic networks and complex inter-connections within the network will be commonplace when CATT is used. An extensive logical cross-referencing schema is needed to help people build on thoughts and replay earlier cases.

The widely prevailing phenomenon of task and context switching, without the right kind of continuity at the interaction level, affects the ability of the members of a case discussion to maintain a smooth and steady interaction among themselves. In order to reduce the barriers to the successful conduct of a case discussion, CATT must provide continuity to group processes along four dimensions: current discussion thread versus related discussion thread; individual work modes versus cooperative work modes; computer supported work (word processing) versus non-computer supported work (writing with a pen on paper); and synchronous communication (telephones) versus asynchronous communication (E-mail). TeamWorkStation is an example of a groupware system that uses the concept of the overlay of individual workspace images in a virtual shared workspace and the creation of a shared drawing surface to reduce the seams and discontinuity in group tasks just described (Ishii 1990).

3.4 Interaction Locking

Interactions in a case discussion are typically reciprocally coupled. The group nature of interaction requires CATT to provide the customized and simultaneous access to shared information. This philosophy of "interaction locking" is diametrically opposed to the approach provided by the traditional DBMS-based systems to support educational processes. The aim of the DBMS approach to information locking is to create the impression that users are working on a single isolated task. The underlying design philosophy is that each user should work independently of the team and remain unaware of the actions of the other individuals, some of whom might even be working on the same task.

The second major problem of using the DBMS approach to interaction locking is the focus of interaction locking. While DBMSs provide multiple access to shared objects by multiple users, they do not offer users the ability to synchronously interact within themselves. In CATT this requirement is critical, as conflicting requests and ill-defined events indicate that people need to communicate

with, rather than hide from, each other. Like the techniques used in improvisation groups, interaction locking in CATT should rely on the ability to support and encourage spontaneity. Interaction locking at the data level by having mechanisms for transaction serializability, and read and write locks on a database record at the physical level (the traditional scenario) is insufficient. What is required is the facilitation of interaction locking at the user interface level, by having weak locking mechanisms such as telepointers (a cursor that appears on more than one display and that can be moved by different users.)

4. CATT: FUNCTIONALITY AND DESIGN DETAILS

CATT is an extensible, object-oriented prototype being developed in Smalltalk to support business case discussions.[14] The design paradigm of CATT is based on object-oriented programming to provide easier extendibility and component re-use and declarative languages for user level system description. The system architecture is based on identifying the common denominators that exist in a variety of case discussion contexts. Hence, CATT consists of common services that are fixed and task specific services that can be configured.

The design model for CATT is that of a loosely coupled collection of objects. Figure 4 depicts a design model of CATT. The collection of CATT objects includes a "services" object, which resides on the server and is responsible for the control and essential services that CATT provides (version management, file and history management, communications support, tool management, definition management, model management, and dialogue management).

It is the services object that incorporates the mechanism for sharing tools and for automatically updating views as shared entities are changed by tools. The services object also provides status information about the current configuration of the tools and definitions, information about the end user applications in progress, and so forth. The services object is structured in terms of layers of services with well defined interfaces making it possible to change any level without interfering with the others.

Other CATT objects (all of which are treated as clients) are categorized into tools, definitions, and entities. Tools are objects used to manipulate other objects. Entities are the basic objects manipulated by the tools and refer to the objects that the case discussion participants act upon (e.g., an argumentation network or a summary report about the status of the discussion). Users interact with the system through the use entity objects such as structured messages and issue nets. Entities that are created, manipulated, and exchanged by the tools are categorized into several levels across various application areas. This hierarchy consists of cases, discussions, and topics. Definition objects provide the semantics for the entities (hence, entities and definitions have a one-to-one correspondence). Definition objects are declaratively represented so that the interpretation and modification of these objects is as simple as possible. The system has a levelling behavior because the definition object for one tool could be the entity object for another tool.

Tools, definitions, and entities make no assumptions about the internal behavior of other objects. The functionality of CATT can be extended by plugging in new tools, definitions, and entities while the functionality of the system can be tailored by the user using the definition specification language. In order to provide users with configurability, CATT allows users to define tools and definitions in their own specialized terms. Every tool is designed so that a user can manipulate the objects the tool manipulates either in a default fashion or through the use of a customized definition. In the latter case, the system builds the internal data structure from the end user.

To convey an overview of the concepts in our prototype design we examine a sample use of the system. We have a tool (T-IBIS) which can be used to conduct a structured discourse among the participants of a case discussion. T-IBIS allows discussion participants to browse, query, and modify the contents of a case discussion. T-IBIS is responsible only for providing the interface to the entity object that represents the discussion and to the definition object that controls the pattern of the discourse. The definition object, T-IBIS-DEFN, associated with T-IBIS will specify the semantics for a discussion. These, in our example, include a representation for the structured discussion in terms of a directed acyclic graph (DAG). The definition object thus specifies the types of nodes, the types of links, and the rules which represent the set of legal relationships between pairs of nodes. The entity in this example would be a DAG T-IBIS-GRAPH whose nodes and links are instances of the abstract definitions found in T-IBIS-DEFN. The objects T-IBIS, T-IBIS-DEFN, and T-IBIS-GRAPH make no assumptions about each other. Each knows that the others exist, but only in a specific application that uses them.

5. CURRENT FUNCTIONALITY AND AN USAGE EXAMPLE

In the previous section, we described CATT from a design perspective. Here we present some of the key functional characteristics of the current CATT prototype through an example of its usage.[15] The case used in the example is the CMI case (Applegate 1988).

There are six main functional characteristics of the current prototype.

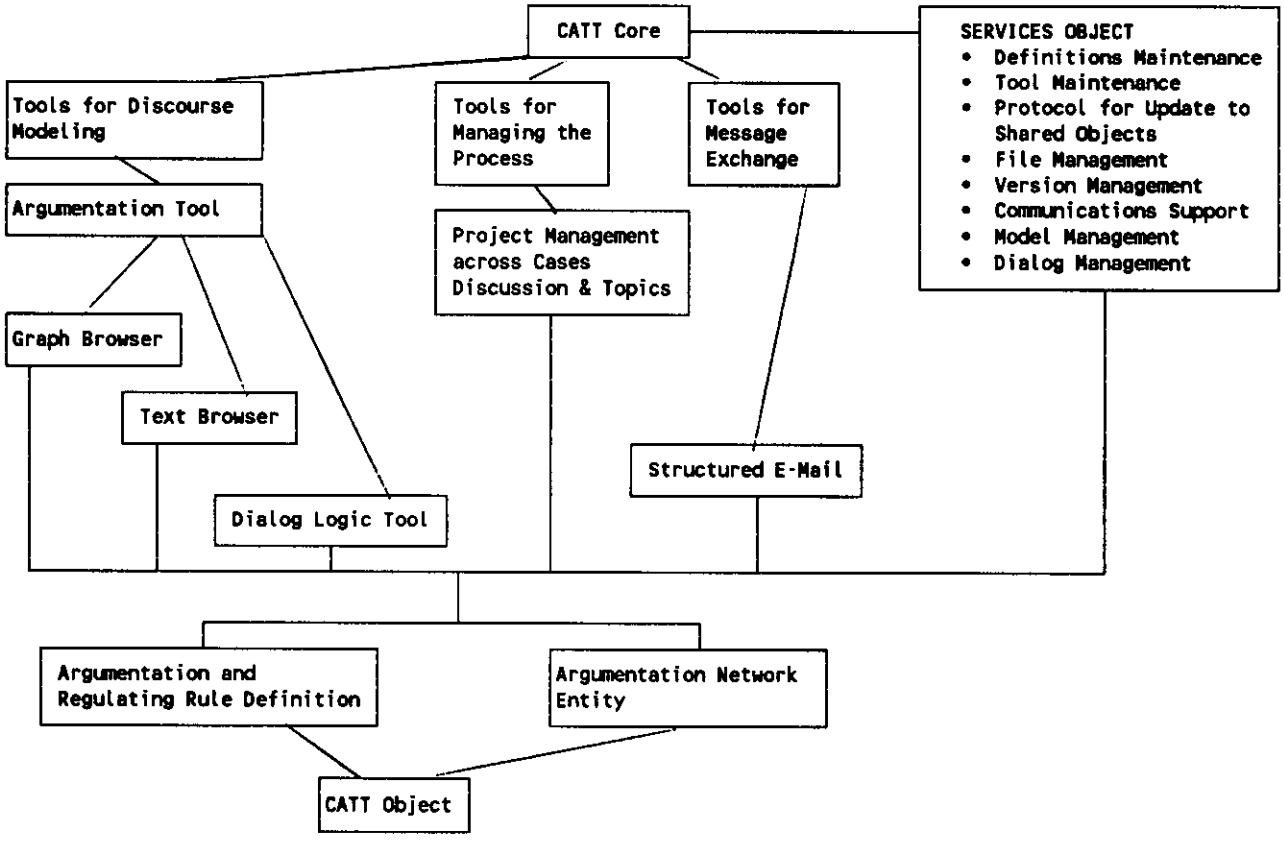

Figure 4. Design Model for CATT

- *Editing*: Students and instructors can create, build, modify, cross-reference, and browse the argumentation networks that are generated during the case discussion process. It is at this level of interaction that the dialogical rules and interaction locking mechanisms become visible to the students and instructors. The interaction between users and CATT is conducted through a direct manipulation graphical human computer interface and input from a variety of media (graphics, text, etc.) and devices (mouse, keyboard, joystick, etc.). Currently all discussions have to recorded by the use of keyboards.[16] In the future it is planned to provide participants with speaker phones and headsets so that the verbal channel can supplement and augment the discussion.

  This interaction is typically asynchronous and notification of entry and exit is based on the pictograph metaphor introduced in GROVE (Ellis, Gibbs and Rein 1989). Students and instructors need not view the whole discussion at one shot (which can be overwhelming in a protracted discussion). Instead, a view mechanism is provided. This mechanism allows the creation of "logical view filters" (similar to a query) and then applies them to the actual discussion network. Hence, students and instructors can focus on the portion of the case discussion in which they are interested in. Figures 5, 6 and 7 depict the argumentation network, created during the discussion of the CMI case and the T-IBIS tool that was used.

- *Query and report generation*: CATT provides students and instructors with the ability to query the network and generate several kinds of reports. The query is specified through the use of a syntax directed direct-manipulation editor. The query language is really an implementation of a "discourse calculus" and allows for queries to be expressed in terms of both the structure and the content of the argumentation network. For example, an instructor can define the notion of an accepted position as "one for which there are accepted supporting arguments, rejected opposing arguments, no rejected supporting arguments, and no accepted opposing arguments" (Hashim 1990a) and check how many positions are still open in the current discussion. Similarly, closure can be declared on an issue by an instructor if "all the positions which respond to it are accepted." This permits the generation of several interesting kinds of discussion guidelines for students, as well as "reports" and evaluation schemes for instructors. Examples are:

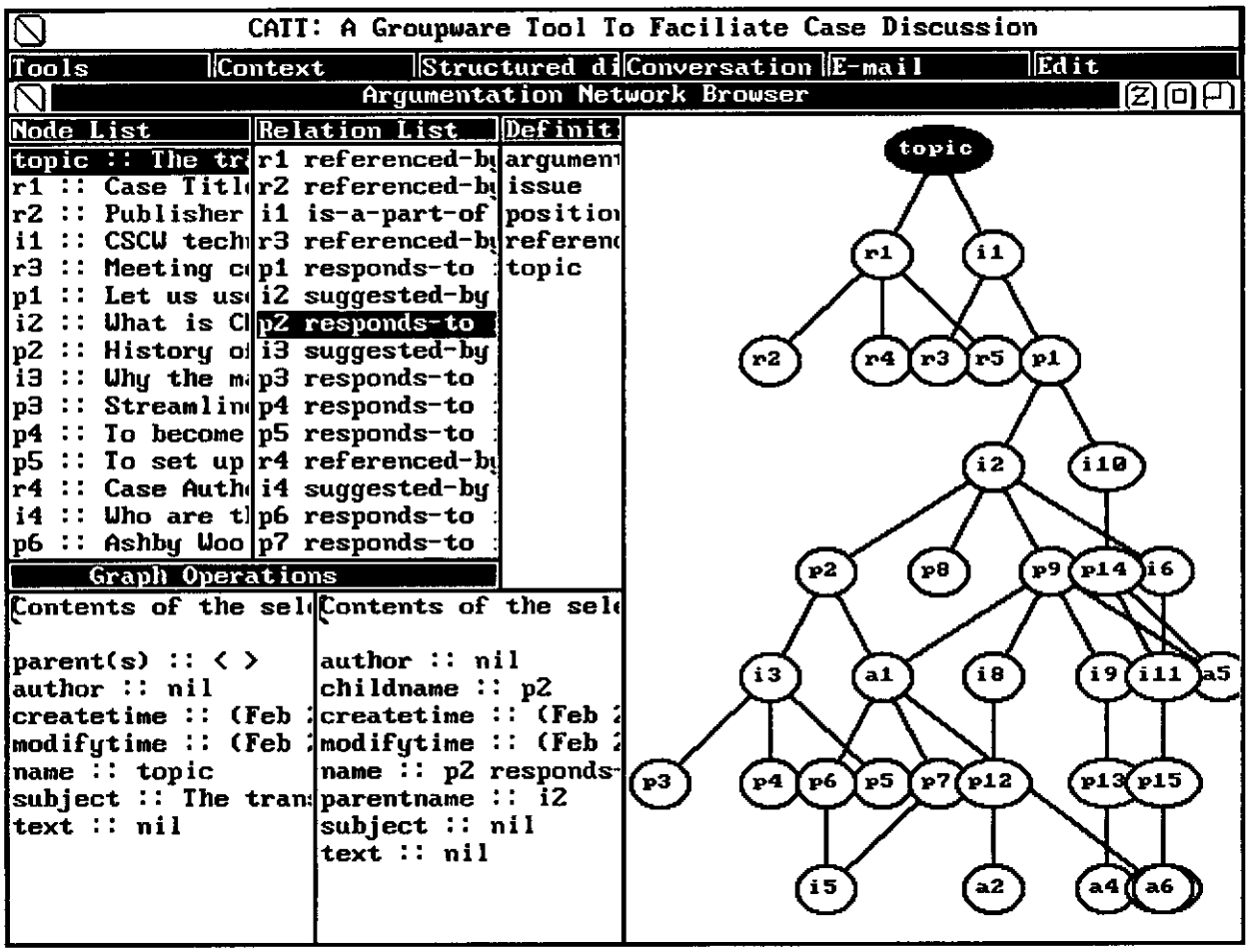

Figure 5. CATT: The Structured Argumentation Tool

- Summaries of the data contents in the interaction process; e.g., what are the arguments against which a particular position can be obtained. Thus, a student "listening-in" on the discussion of the CMI case can delve into the details of why Ann Arbor, Michigan was chosen as the site of the lab. A map of the area could even be displayed.

- Process reports about the structure of the interaction patterns, the roles people played and the positions they took; e.g., what are all the currently open issues on which HHS has taken a position, or how often did WBA react to the issue of the site location for CMI.

- Persuasion reports about the dynamics of the team in terms of the temporal structure of events. For example, the presence of long linear interaction sequences would imply that no one has been able to put a finger on the precise problem. Recurrent patterns of interaction will be detected through the structured format of the discussion (for example, while discussing the CMI case, does JLS always object to a position RS raises). Likewise, themes recurring throughout the discussion can also be detected (for example, while discussing the CMI case, the discussion always seems to come back to who the key players are). In the context of the CMI case it would be possible to detect those issues (like i9 in Figure 6) which are potential dead ends.

- *Automated reasoning and sensitivity analysis*: In the course of case discussions, participants often change their viewpoints, positions, and arguments. In the context of the CMI case, a student could change his/her position on who the key players in the development of the lab are and examine what other issues, positions, and arguments are affected as a consequence of this change. This facility would also allow an instructor to determine how important a particular issue or position is to the overall discussion (for

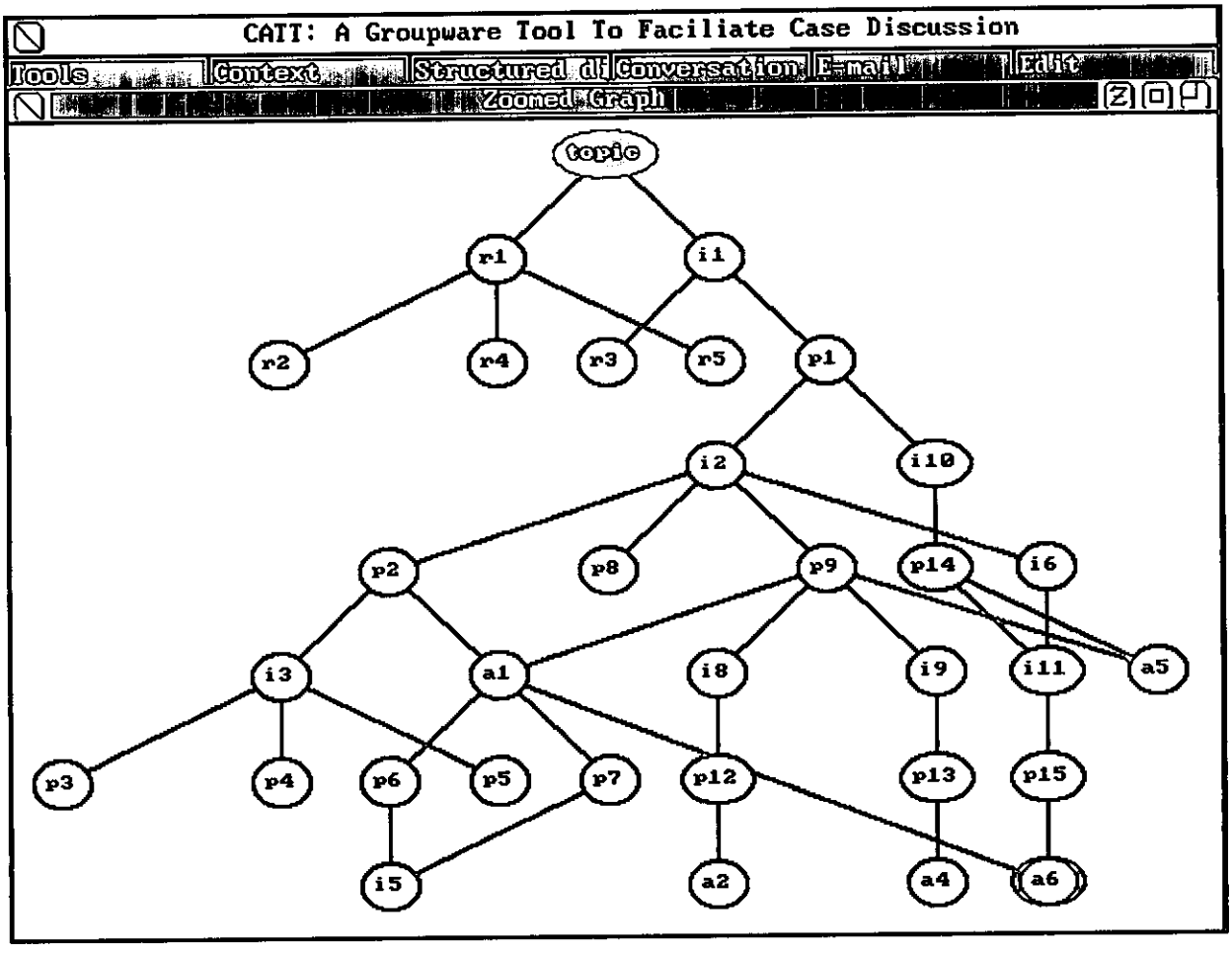

Figure 6. A View of the Argumentation Network for the CMI Case

example, a change in an unimportant position will not impact too many other issues, positions, and arguments). CATT implements a dependency-directed back-tracking algorithm similar to the TMS algorithm (Doyle 1980) to keep track of changes and notify students and instructors when changes to nodes they are interested in occur. Such analysis is possible because CATT represents argumentation networks in terms of objects which can be interpreted in terms of mathematically isomorphic structures such as relations, graphs, and Horn clauses.

- *Dynamic configuration of the interaction process*: CATT accommodates several pre-defined models of argumentation such as IBIS and the Potts and Burns scheme (Lee and Lai 1991). Instructors can add their own models of argumentation and dialogical rules in order to tailor the system to the specific requirements of the case being discussed. For example, while discussing a case dealing with a design problem, it is preferable to use a argumentation scheme such as DRL (Lee and Lai 1991), which is more suited for capturing design rationale. If the instructor decides to reconfigure the argumentation scheme dynamically, then the attributes of entity objects representing nodes and links in the argumentation network are automatically updated to reflect this change.

- *Evaluation tools for instructors, graders, and students*: A mood meter (Rein 1991), voting tools, statistical tools, on-line questionnaires and surveys are provided for in the design of the discussion evaluation module of CATT. These tools would allow an instructor to have simple visualizations of the "state of the discussion" in terms of attributes such as coherence, diversity of issues, and depth of discussion and to integrate the evaluation process into the learning process. Having on-line evaluation tools provides instructors with the infra-structure required to tightly monitor and control (if so desired) the discussion process.

For the CMI case (Figure 6): The list of nodes in the argumentation network and the subjects associated with each node

name :: topic	subject ::	The transfer of CSCW technology to business
name :: r1	subject ::	Case Title
name :: r2	subject ::	Publisher
name :: i1	subject ::	CSCW technology transfer
name :: r3	subject ::	Meeting context
name :: p1	subject ::	Let us use CMI of EDS
name :: i2	subject ::	What is CMI?
name :: p2	subject ::	History of CMI in EDS
name :: i3	subject ::	Why the massive restructuring
name :: p3	subject ::	Streamline the functions
name :: p4	subject ::	To become customer oriented
name :: p5	subject ::	To set up product management groups
name :: r4	subject ::	Case Author
name :: i4	subject ::	Who are the key players?
name :: p6	subject ::	Ashby Woolf
name :: p7	subject ::	Ron Hudler
name :: p8	subject ::	Ron Hudler's view of CMI
name :: i5	subject ::	What is their relationship
name :: p9	subject ::	Woolf's view of CMI
name :: i6	subject ::	Where is CMI?
name :: p10	subject ::	Ann Arbor MI
name :: i7	subject ::	Why Ann Arbor MI?
name :: p11	subject ::	Site should be close
name :: a1	subject ::	Woolf argues for it
name :: i8	subject ::	Woolf's view of personnel
name :: p12	subject ::	Diverse group of researchers
name :: a2	subject ::	Why do we need researchers
name :: i9	subject ::	Woolf's view of personnel selection criteria
name :: p13	subject ::	They should be specialists
name :: a4	subject ::	Why we need specialists
name :: i10	subject ::	What are the projects CMI will undertake?
name :: p14	subject ::	Projects which focus on the relationship between technology and organizations
name :: a5	subject ::	The case for studying all the relationships rather than the technology per se
name :: r5	subject ::	Copyright
name :: i11	subject ::	What kind of collaborative technology project do we want to undertake
name :: p15	subject ::	Computer supported meeting rooms
name :: a6	subject ::	Because.....

Figure 7. Subject Titles for Each of the Nodes in the CMI Case

- *Hooks to external systems and databases*: CATT provides users with the ability to link attributes, nodes, and links in an argumentation network to externally created objects such as a spreadsheet, a database, or a document created by a word-processor. CATT provides links to Internet, USENET and standard databases. For example, a student could build a linear programming model to support his position on where the location of the site for CMI ought to be. Other students and instructors could then browse through the actual spreadsheet calculations and figures that were used to build the model and possibly raise arguments supporting and opposing the rationale behind the model.

6. EMPIRICAL ISSUES, CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

> The successes of such individuals tend to be born and to die with them. The only way by which we can prevent such waste in the future is by methods which enable us to make an analysis of what the gifted teacher does so intuitively, so that something accruing from his work can be communicated to others.
>
> John Dewey on the gifted teacher in *Sources of a Science of Education* (1929)

In this section, we present some of the key research questions which need to be studied in the future from an empirical point of view. We also present our conclusions and directions for future research.

6.1 Experimental Issues

Our use of CATT has been restricted to a few experimental situations. We are in the process of conducting extensive tests of the prototype using participants from the M.B.A. program. We are currently examining three key empirical issues.

- The effect of the type of the case (theory based case versus non-theory based case) as a contingency factor on the nature of the interaction process. A measurable effect of this variable we have found in preliminary studies is the amount of "lecture time" required of the instructor.

- The development of a series of operational guidelines. How active a role do we wish to play as instructors. Should we intervene on numerous occasions or merely enter the discussion when changes in direction are needed? How should class time be divided?

- The opening and closing of the discussion. The opening minutes of a "session" present the instructor with a series of decisions that, if made appropriately, can do much to ensure a productive discussion.

6.2 Conceptual Directions for Future Research

A complete, integrated model of case discussion needs to be developed at three levels. At the first level, students explore a problem by sorting out the relevant facts, developing logical conclusions, and presenting these conclusions. The role is typical of the traditional commentator-observer. The second level is achieved by assigning students roles in the case under discussion. Their comments tend to reflect a sense for the organizational and personal circumstances of the company managers whose robes they wear. When role-playing concludes, the traditional case method takes over. Dialogue is rooted in the practical and a shift from the external observer to the involved insider is made. The third level is reached when students, on their own initiative, project themselves into the situation. The classroom and case meld together, with the students vicariously acting as the firm's executive group. Problems are not discussed as abstract topics but as issues inextricably bound up in a manager's career and power circumstance.

The creation of a truly global classroom environment requires the development of groupware-based systems to support the case discussion process. CATT is a prototype system that would provide students and instructors in business schools with an on-going case discussion process that spans the boundaries of time and space. The removal of the "tyranny of geography and time" will no longer require that the instructor and students be physically present at the same time. We are currently internationalizing the use of CATT by establishing linkages with Monterrey Tech in Mexico as the first step in achieving this goal.

We see the process of supporting case discussion as logically culminating into a process of supporting and integrating education with business. This symbiotic relationship between "classroom" case discussions and organizational activity could be through role scripting, simulating, and business gaming in a "cyberspace" or virtual world. Through these technologies, it will become possible to provide students with learning experiences that cut across today's spatial, temporal, functional, and cultural boundaries. The realistic hands-on experience of making quick decisions with global input during case discussion (with the aid of CATT) will help shape the competent executive of the future.

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9. ENDNOTES

1. For the remainder of this paper we use the term groupware as defined by Ellis, Gibbs and Rein (1989): "Groupware is a class of applications arising from the merger of computation and communication. Groupware systems must be able to support two or more users engaged in a common task and provide the users with an interface to a shared environment." This definition thus contrasts with the definition of GDSS as used in the CSCW literature.

2. During the academic year 1990-1991, out of the 930 students enrolled in the MBA Program at our university 148 were international students. During the same period twenty students from our university participated in international student exchange programs: three went to Lyons, five to Rotterdam, three to Copenhagen, three to Manchester, two to Helsinki, two to London and three to other places.

3. Elaborate facilities, like Classroom 2000 at the Graduate School of Business, University of Texas at Austin, have been created in recent years. While providing networked computers to students for use with single-user applications, these facilities do not have the software systems required to actively support the education process in an interactive way by taking into account the group processes involved.

4. As part of our research, we are in the process of planning CATT supported case discussions between M.B.A. students at our university and those at Monterrey Tech in Mexico.

5. This role varies significantly from teacher as the expert, formal authority, socializing, agent, facilitator, ego ideal model proposed by McKeachie, Mill and Mann (1968).

6. From an ontological point of view, the case discussion consists of the state of the world as it is, the case – an abstraction of the world as viewed by the authors, the students, and the instructor.

7. These interactions are those that occur between two people or between a person and a computer system, rather than those in which multiple participants simultaneously interact with each other.

8. Interestingly, the inability to simultaneously cooperate and compete has been cited as one of the main reasons for the failure of American managers, especially when compared to Japanese managers.

9. An exception to this trend is the restructured MBA program (starting Fall 1991) at the Wharton School (Byrne 1991, p. 43).

10. Relaxed WYSIWIS relaxes the constraints imposed by strict WYSIWIS on four dimensions: display space (the set of display objects to which WYSIWIS is applied), time of display (when displays are synchronized), subgroup population (the set of participants involved or affected) and view congruence (the visual congruence of displayed information).

11. Interestingly, the current process has an advantage over some CSCW tools which can be used to support case discussion because of media-richness. For example, in the classroom gesticulation is possible and participants can use non-verbal gestures, eye-contact, etc., as signalling mechanisms.

12. Note that consensus is not a part of the argumentative process although it can emerge as an outcome of the process. Consensus is outside of the argumentative process and when it is reached it is to help (at the end of an extensive argumentation) bring the case discussion to a close.

13. The use of regulating rules is important in sideline development because instructors should not let a class dwell unproductively on any issue nor should they let a potentially important sideline go undeveloped.

14. Smalltalk provides a rich descriptive system and a natural way of transforming the design meta-language to a formal (computable) specification. Modeling case discussions has a natural fit with object-oriented programming because the entities in the case discussion are actors who communicate (receive and send messages) and coordinate with each other through known structures. Application objects are organized into classes which have a hierarchical taxonomy. Objects communicate with each other by exchanging messages. Objects make no assumption about the way other objects process messages (through methods) and thus interact only through their message interfaces.

15. This case was specifically used because it deals with issues of technology transfer as they relate to computer supported cooperative work. The case discussion presented was one in which the members of the design and implementation team participated during the development of the prototype.

16. We do recognize that technological and resource constraints on providing an integrated and seamless full multi-media environment would impact the use of the system.