The Virtual Participant: Lessons to be Learned from a Case-Based Tutor's Assistant

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Abstract

We describe a system which uses an agent-based approach to support teaching in the collaborative setting of asynchronous plain-text electronic conferencing. We have identified areas within which tutors who use conferencing need support and developed a system which provides help in an opportunistic manner. The agent we have developed uses a case-based approach to instruction by offering help on common student problems. The cases used are examples of problems experienced by students in previous years and discussions of how they were resolved. These cases are presented by the agent when it identifies an appropriate point in the conference. An experimental version of this agent, which we call the 'Virtual Participant' (VP), has been tested on the Open University MBA course 'Creative Management'. We review the effect of the system and the lessons to be learned from this experiment.

Keywords—distance education, educational groupware, case-based instruction, support tools for collaborative teaching.

Introduction

The development of the 'Virtual Participant' (VP) stemmed from two observations. First, electronic conferencing allows distance learning students to communicate more freely with each other and their tutors, resulting in an increased drain on staff time and resources [8]. Second, we have observed that conference interactions form a case-base of problems and solutions. This paper addresses the drain on resources by the reuse of this case-base.

Case-based teaching [10] is founded on the reuse of the previous experiences of others. A case-base of student interactions provides the tutors with examples of common problems experienced by the students. To use these cases to the full we must provide them to the students in the right context and at the right time. If this task is automated, the burden on the tutors to answer common questions is reduced.

Review of the Problem

We are studying students on the Open University's 'Creative Management' Course (B882) who currently use FirstClass as their conferencing system. Conferencing is an optional activity in this course; not all students are willing, or able, to take part in it. Nixon & Salmon [8] recognize problems with conferencing and introduce a 4 stage student model describing how students access and become socially acclimatized to a conferencing environment. They note that the initial use of such a system is an important time and to prevent students from dropping out of conferencing and suggest that "learner support is concentrated at the early stages". We have noted that a case-base of examples can be derived from the student interactions of previous years. These can be used for teaching, but are not initially in an appropriate form. To summarize our position:

- The number of students using electronic conferencing is growing, and there may be no other contact for some students.
- The content of the discussions can be poor and not all topics relevant to the course may be discussed.
- The increased load on tutors may delay feedback.

In addition the conferences from previous years represent useful knowledge in the form of cases of common problems faced by students. These cases are not indexed and therefore difficult to search. This makes it difficult for a tutor to present them at the time when they would be most useful.

Our intention is to address these in a way that can enhance the students experience of conferencing and helps them benefit from the discussions of previous students.

Review of Related Work

The use of examples in teaching (i.e. 'cases') to help students learn from the experiences of others is known as case-based teaching [10]. Here we review 4 methods for the presentation of cases; a summary is given (see Table 1). The approaches could use the same set of cases, but each has its own presentation style.

System	Interaction with users	Format of cases	Retrieval	Maintance & Maintainer
FAQ [3]	Passive	List of cases	Manual	Low/Single Human
Contact Finder [6]	Active	Hidden database	Automatic	Low/Automatic
ASK [2]	Users choice	Highly structured and interlinked	Manual exploration Automatic guided	High/Single or Multiple tutors
Vicarious Learner [7]	Passive	Linked to relevant course materials	Manual	Medium/Tutors or Students

TABLE 1. Summary of case presentation systems, how they interact with users, the format of the cases, how the cases are retrieved, how much and who maintains them.

First, there is the idea of a 'frequently asked questions' list (FAQs) [3], a case-base of questions and answers stored as a list. To make use of this passive list the user must manually, or using a search tool, comb the list to find something matching their problem. The list is maintained by a human who collects and saves these examples from an associated conference.

Secondly; 'Contact Finder' [6], actively watches for questions in a conference, matching them to its hidden case-base of previous examples. When a match is found it uses this to direct the questioner to someone who may be able to answer their problem. Once set up the system is automatic, requiring no human intervention. This is a 'recommender system' [9] similar to many which have been developed for collaborative filtering. There are many social issues raised by these systems which are affecting our current work (see current work section).

Thirdly, and specially intended for teaching, is 'ASK systems' [2]. When using the system students are able to switch between active exploration of the case-base, to being passively guided through in the way previously set by the tutors. ASK systems require a large amount of maintenance from the tutors, especially in the setting up stage when a highly linked case-base is created with guided steps for the students.

Finally there is the 'Vicarious Learner' project [7]. In this system students work through hypertext course materials and discuss them on-line. Relevant discussions from other years are linked into the course materials by the tutors. The students then have access to them as extra materials.

The Virtual Participant draws from the pedagogical aspects of the 'Vicarious Learner' and the automated aspects of 'Contact Finder' to create a system which provides FAQ's with some of the structure found in ASK systems. It is hoped that the VP will prove a useful tutors assistant.

Review of Approach

We combine aspects of these systems to present students with relevant discussions from previous years. We use an 'interface agent' [4] to which we delegate the task of providing the students with contextually relevant cases. The VP approach has the core aims of:

- Contextualising cases from previous years by presenting them in current discussions about similar problems.
- Eliminating the need for students to search for relevant cases.
- Being non-intrusive, so that its messages can be easily ignored by those not interested.
- Reducing the need for the tutor to repeatedly provide the same information.
- Providing an immediate response to the student in an asynchronous environment.

As noted by Watt [11] groupware fails when some users are required to do additional work without a *clear benefit*. This same effect has come to light again recently with work on recommender systems [5], where it has been noted there is not always a clear benefit for users to rate articles to be recommended to others.

In educational groupware situations (e.g. conferencing & the VP) it is necessary for such systems to provide a clear benefit to all involved. The intention of the VP approach is it requires no extra effort with its non-intrusive behavior and benefits all by providing extra materials at a relevant time.

Overview of the Virtual Participant

The Virtual Participant's case-based teaching approach [10] uses a simple pattern matching case retrieval algorithm. Starting from a case-base of previous years' discussions, the VP interacts with the conference attempting to identify current

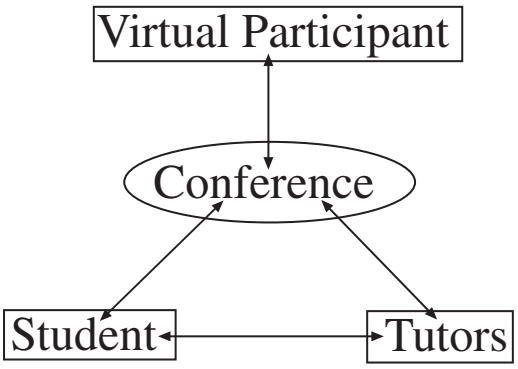

FIGURE 1. How the VP, Students and Tutors interact.

conversations (see Figure 1).

The retrieval algorithm accumulates keywords from current conversations and uses these to match cases from the case-base. When a case is retrieved an *overview message* is posted explaining that the VP has "...identified a thread of conversation from a previous year which may be of relevance to the current discussion". The message gives the original context of the case and an overview of the problem it addresses. Students are then able to retrieve further information about the case by a number of *fixed questions* that can be asked by mailing them back to the conference. Although students and tutors can interact directly, the VP only interacts

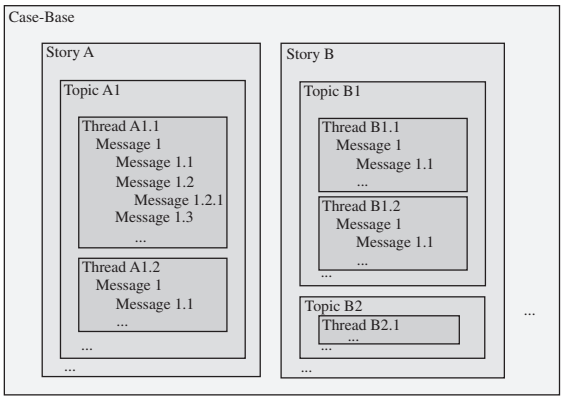

FIGURE 2. The VP's case-base contains stories which are made up of topics, which in turn are made up of threads, which in turn contain messages from previous years.

with the conference.

The VP's case-base (see Figure 2) consists of 4 types of objects used to classify previous years discussions: The basic messages make up threads of conversation, threads which discuss the same thing make up topics and topics which discuss similar

Step	Process	System
1	Group messages into threads	Threading program
2	Group threads into topics	Clustering program
3	Identify keywords & phrases for indexing	Concordance program
4	Generate stories	Manual editing using human judgement on output of above.

TABLE 2. Process for generating the initial case-base.

things make up stories. Stories are matched to current discussions by the retrieval algorithm. Overall, then, creating the case-base is a 4 step process involving 3 automated steps and 1 manual step (see Table 2).

Comparing the VP to existing classes of system reviewed earlier we have active interaction with users, a hidden structured database, automatic retrieval with the maintenance effort low to medium, but placed on the tutor.

The VP takes concepts from existing single-user case-based learning environments, like ASK, and couples them with a need to effectively reuse knowledge in discussion conferences. Through this it produces a multi-user system which gives access to contextually relevant discussions.

Design

The development plan for this system involves two prototypes. The first prototype was given the user name 'Uncle Bulgaria' [1] and was given access to the coursework conferences of the B882 course. Assessment of our prototype identified some important 'lessons' which are reported in the evaluation section. The second prototype is being developed with these in mind and is described in the current work section.

The first, of 4, Tutor Marked Assignments (TMAs) in the course encourages the students to explore their creativity through the use of psychometric tests. The students ask many questions about the tests and how to interpret them. In TMA 2 students learn various brain-storming techniques and discuss their experiences with these techniques and their application to common problems. As we mentioned earlier, students need the maximum amount of support in the early stages of using electronic conferencing Nixon & Salmon [8]. In fact, in the opening stages of the course the problems experienced and the terms used to describe them are quite constrained. The retrieval algorithm uses pattern matching, relying on the use of these simple terms in the discussions taking place. With time the terms used and the problems experienced become more diverse making the application of the VP approach inappropriate. Hence we have concentrated our efforts on the first 2 TMA's.

Before the first trial the tutors expressed some technical and pedagogical worries: “it might go haywire” and “it might put the students off”. To counter the former the VP was run only manually, rather than autonomously. To counter the latter, the VP was designed only to volunteer the *overview message* of a story; any others require questions to be asked.

Example Interaction

To illustrate the functioning of the VP we have selected an example from this years TMA 1 conference.

When the student initially logs into FirstClass they are presented with their ‘Desktop’ showing their personal mailbox and the conferences to which they are subscribed (see Figure 3).

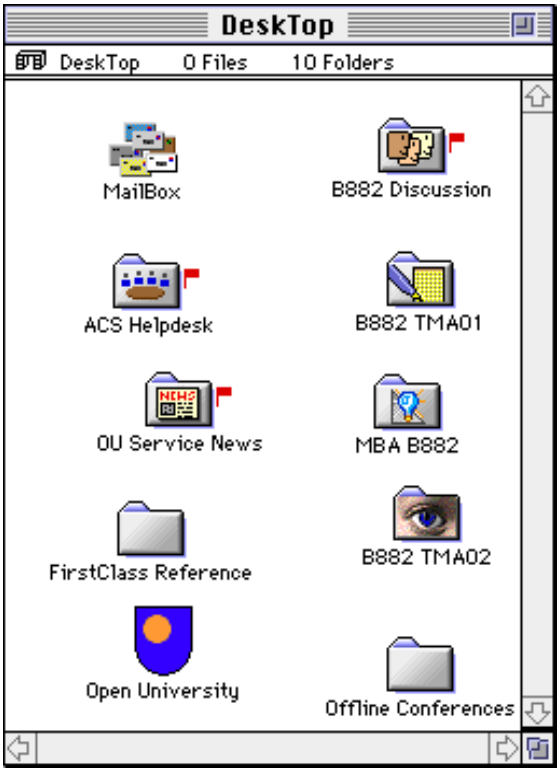

FIGURE 3. Students desktop in FirstClass. The folders represent conferences. Red flags indicate unread messages.

When they then open a conference, in this example ‘B882 TMA01’, they are presented with a list of the current messages, most recent first (see Figure 4). A number of the messages are grayed out, this means that they are open. These messages are an example of one interaction by the VP. The next 4 figures are the messages from this interaction.

Firstly we have an overview from the VP (this was triggered by a message not shown in this diagram). This message is made up of an initial editorial, a message from a former student, some

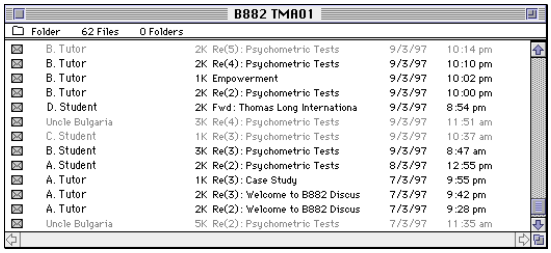

FIGURE 4. The contents of conference ‘B882 TMA01’. The names of the contributors has been changed but the distinction between tutor and student has been maintained.

questions that can be asked, and the instructions for asking them (see Figure 5).

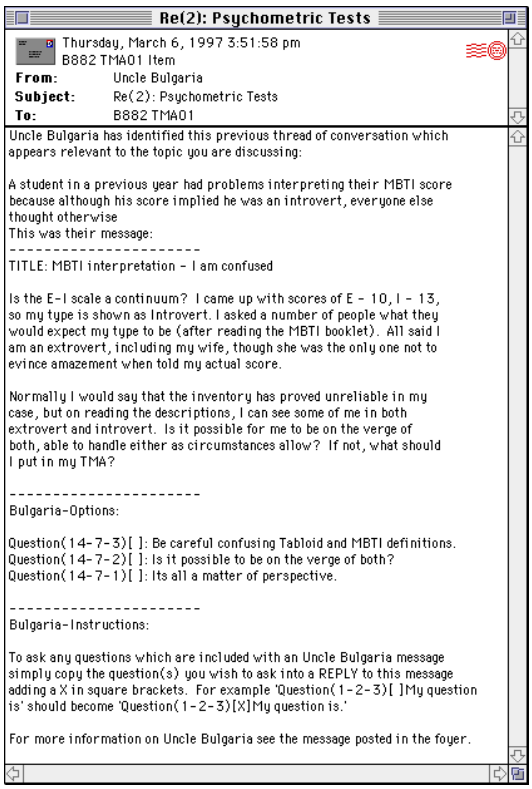

FIGURE 5. This is the first, overview, message from Uncle Bulgaria.

In the second message a student asks the VP one of the questions (see Figure 6).

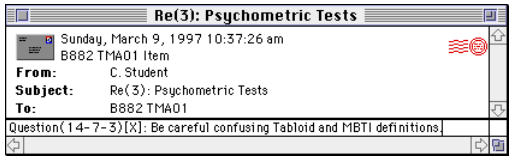

FIGURE 6. A student asks the VP a question

The third message is the VP’s response to this question (see Figure 7).

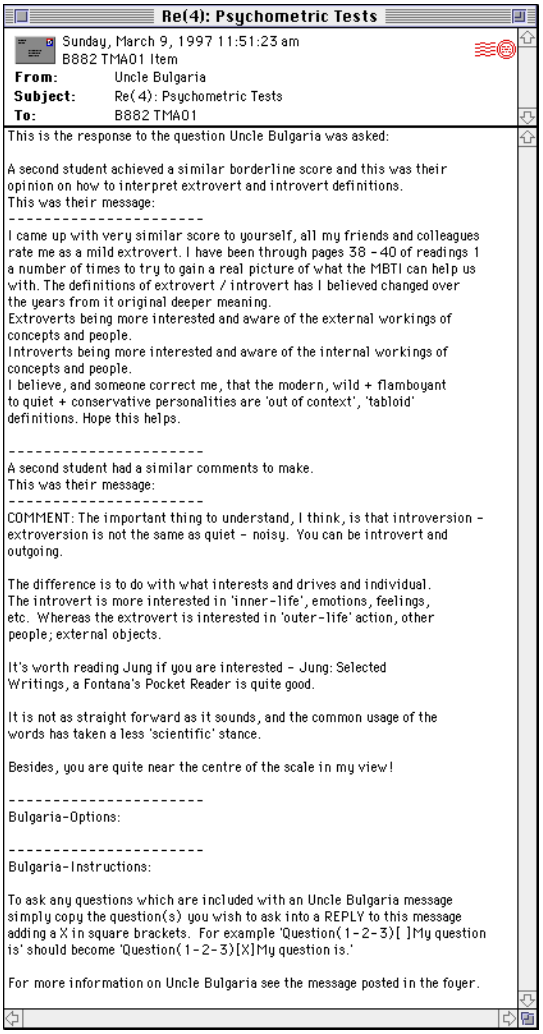

FIGURE 7. The VP's response to the students question.

This message from the VP contains another editorial, 2 messages from previous years and this time no questions.

The fourth message was a reply to the VP's second message by a tutor highlighting some of the important points (see Figure 8).

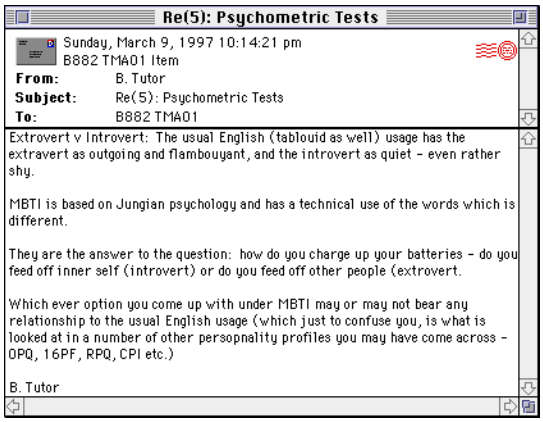

FIGURE 8. A tutor message highlighting some important points.

This is the typical form of a VP interaction, in others the students often ask more questions, and/or more than one student asks questions.

Application

Using the four step process outlined in table 2 we generated a case-base of interactions from the three previous years conference discussions. For the first and second TMA's this gave us 9 and 16 unique stories consisting of a total of 40 and 51 messages respectively. The VP then used this case-base to match with this years discussions.

During the first two TMAs the VP made 17 contributions to the discussions. As the experiment progressed some questions received by the VP were via private e-mail; the tutors agreed to let the VP place responses to these in the discussion conference. The breakdown of the VP's contributions is shown in figure 5. There were 8 unsolicited messages and 9 responses to questions. Of the 8 unsolicited messages 6 had between 2 and 4 *fixed questions* for further information. In total there were 132 messages on TMA 1 and 98 messages on TMA 2. The 'history' information stored by the VP allows us to study the number of students who have read these messages and thereby may have received some benefit from them. Of the 618 registered users 556 have logged in at least once, and of those 363 (65.3%) have read 1 or more VP messages.

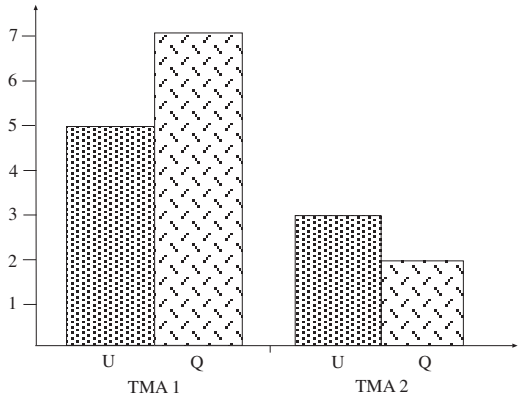

FIGURE 9. The Contributions from the VP in the conferences broken down by TMA and unsolicited (U) and questions answered (Q)

We were disappointed in the total number of messages sent by the VP. The retrieval algorithm was weaker than expected, and visual inspection of the conferences revealed discussions to which the VP had relevant stories which were not retrieved. The same visual inspection confirmed that no retrieved cases were irrelevant to the context.

Evaluation

We are completing a full survey of the students' and tutors' experiences with the VP, the results of which will be presented at the conference. We are surveying 104 students from the group of 363 who read at least one VP message. The students were selected if they had read 9 or more VP messages, which gave 120. We were forced to eliminate 16 (leaving 104) because they had already been surveyed by the university this year.

We have some student comments and some anecdotal feedback from the conference discussions. These comments fall into 4 categories: VP name, presentation of the messages, content and context in which they were presented, and finally user confusion.

Name

Some users did not like the name 'Uncle Bulgaria' (UB). They felt that messages *from that user* implied "you silly people, this topic was discussed and sorted out ages ago" [quote from a B882 student] and that "the name had an adverse affect on what the objectives of UB were" [questionnaire comment]. Given the separate feedback we received and the specific dislike expressed we believe this is due, not the contents of the messages, but to the 'avuncular' presentation of the name. Students who were not native speakers did not make any comments on the name.

Presentation

The communication protocol available to the VP was limited to the use of plain text. The normal interface to the conferencing system provides much richer formatting. Users like to skim messages and plain text does not easily emphasize important information. The conferencing system does not support threading so when more than one question was asked all replies would appear together.

Content and Context

A B882 student said that "Some of the contributions are appropriate, others are a tad on the side, but this may be useful as it may be providing a view from another angle". A surveyed student commented that "I felt UB helped structure/ensure good quality information in the conference". A B882 tutor noted "I don't get the impression from the chat that people are very strongly negative about it, and a few people have responded to it over the weeks". We feel these comments accurately summarize the general feeling from the tutors and students about the VP's contributions.

User Confusion

Finally we received comments to our survey of the form "Did not find of any great use, and did not fully understand the concept - where was it explained?", and "Was a bit confused what it was all about and had difficulty following the thread of discussion" [questionnaire comments]. In addition to our other motivations this has encouraged us to make the role and behavior of the system much more clearly defined, and we feel these reasons are summarized by this final comment: "It needs an unusual name so it is clear that it is not a student or a tutor. Unfortunately there are always some who do not read the messages explaining what UB is and then post a message asking 'who is Uncle Bulgaria?'" [surveyed student].

We also received some feedback from the tutors who felt that they would like to know more about what information the VP had, and its current state of operation. We feel that the lack of this information lead to a certain 'fear of the unknown' from the tutors.

Summary

Our introductory work has raised a number of points that need to be considered.

- The user name can provoke negative reactions.
- The format of messages should conform to the expectations of the users. Confusing formats reduce the impact of the information.
- Stories provide 'a view from another angle' that can be useful to the students.

The direct messages the VP has received has caused us to rethink our interaction model. Although we felt that having students ask questions in the conference helped others observe the interactions we feel that this has put off some students from asking questions and gaining from the information available.

Current work

We are currently developing our second prototype ready for the next presentation of the course. From our initial work and the feedback we have received we have made a number of design choices to change the functioning of our system. These choices have been affected by our opinions on how the system *benefits* and can be *controlled* by the users.

We believe that the major stumbling blocks to the acceptance and use of this system are not technical but social. In the first prototype we believed that we addressed the groupware problem of users being unwilling to do extra work for no clear benefit. This problem is of greater importance than we first suspected, and has been again found in recent work on recommender system like the GroupLens [5] and others [9]. They found that the recommending of information was not shared equally by all users and therefore the recommendations were skewed towards the subset of users who contributed all the time. Unlike most collaborative systems we are working with a contrived environment with two distinct types of users (tutors & students) in a limited time

System	Interaction with users	Format of cases	Retrieval	Maintance & Maintainer
First Prototype	Active	Hidden database	Automatic	Low/Medium by administrator
Second Prototype	Active & Passive	Public database accessible and editable	Manual & Automatic	Low/Medium shared by all users

TABLE 3. Comparison of the two prototype systems using the same classifications as table 1.

frame (course time table) with a common goal (completion and exam success). This is similar to the Vicarious Learner project, but most others only have one distinct type (i.e. usenet news readers), though they may break down into different kinds.

We need to address the social acceptance of the system by providing clear benefits to the tutors and the students. We believe that for the tutors to accept and make use of this system they need to be able to control it directly, in this way they will be in a better position to exploit the potential benefits of the system. For the students we currently only make available that information that the VP reveals during its interactions, in keeping with the idea of FAQ's we intend to make all the information available to those who wish to browse it. We will still maintain the VP's presence within the conference with the added benefit of a digest.

To best understand how the VP compares with other systems and the changes being made to it we return to table 1 and consider the VP in the terms of: interaction, format of cases, retrieval and maintenance.

Interaction with users

The design is of an active interaction with the users. The VP identifies current topics and joins in opportunistically with suggestions. The users then ask questions to retrieve more information. For the next presentation we intend to make the whole case-base available in a read only conference. This will take the form of a conventional FAQ and be called 'keypoints-digest'. There are 3 reasons for this: the course team would like an FAQ available for the students, it permits passive access to all information, and it will spread the maintenance load (see maintenance subsection below). We hope that in addition to these reasons the change in presentation to that of 'FAQ's from previous tutors and students will address the earlier student comment that "it must be made clear that it is not a student or a tutor" but rather a tool for presenting the experiences of their predecessors. To address this the VP will be known as 'keypoints', functioning as before, but allowing tutor intervention.

Format of cases

The format of the case-base was hidden. When the VP identified a match relevant cases were linked to current discussions. With the advent of 'keypoints-digest' the case-base will be open to those who are interested, however the VP will continue to link cases from this with relevant discussions (see retrieval subsection below).

Retrieval

The retrieval algorithm is automatic. In addition the case-base will be opened to manual searching by the students, and in addition the tutors will have control over the automatic retrieval algorithm. We are also thinking of introducing a *refractory period* - a time of waiting between the triggering of a message and it actually being sent. The intention here is to allow other development of the discussion to occur before the VP joins in - this would also permit the use of an 'approval' mechanism whereby the tutors are notified of the pending message and have the choice of interceding.

Manual retrieval through questioning is to be changed to direct e-mail to the VP rather than in-conference messages. The reply will go directly to the student, and if sufficient students are interested in specific questions, follow-up messages will be posted by the VP to the conference.

In addition to these changes we also aim to develop better retrieval algorithms, perhaps by using a case-based natural language system.

Maintenance

Maintenance is in the hands of the VP's administrator. With the case-base being open to the public it is intended to allow students and tutors to submit additions to be considered. This is the most important area where there needs to be a clear benefit to the students and tutors so that maintenance is actually carried out. To make sure that the submissions are suitable it will be necessary for a tutor to edit and approve them. There are two reasons for this, firstly they help keep the information current, and secondly they benefit in the following year with these answers already being present. For the students, and tutors, we rely on a certain amount of altruism for submissions which could be 'rewarded' for by being personally accredited for the FAQ (currently they are all anonymous). Additionally the system can be used to identify possible additions to its case-base. The users are then asked if they would mind their message being added to the FAQ list and whether they would like to contribute anything else. This regards them with the chance to make a permanent contribution to the course.

Table 3 summarizes how the two prototypes compare and can be contrasted with table 1 showing the other systems.

With the second prototype we have taken into account the importance of showing a clear benefit to the users of the system. With the changes we have made we hope to observe an increase in the use of the VP by the students, and in the use by the tutors of its assistant capabilities. We hope that our next trial (outlined in future work) will prove successful enough for the VP to be fully adopted by this and other courses.

Future Work

Once the second prototype is complete, and the next course presentation has started it is necessary then to assess the systems functionality and value to the user population. We intend to achieve this by surveying students at specific times during the course, along with the addition of a feedback mechanism for the VP's messages.

Initially we will introduce a feedback form for the VP's messages. This form will be available via the web and through First Class. When the VP posts a message we will include the line 'Was this helpful? 1-5' at the end of the message for immediate feedback. We will also include a method whereby students can submit FAQ's, either new ones, their own versions or corrections. We hope that by providing this facility, and crediting authorship of the new and corrected versions, students will be motivated to provide us with feedback.

Secondly we will conduct an electronic survey at the end of both TMA 1 and 2 to find out students opinions - followed by a paper based survey similar to this years. We hope that these formal evaluations along with anecdotal feedback from in-conference discussions will enable us to evaluate the VP in more detail and demonstrate the benefits of this system.

Acknowledgments

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