Online Smart "Discussion Forum" – An Environment for an Effective Task-based Collaborative Discussion among the Adult Learners

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Abstract: Asynchronous online discussion forums play an important role in adult online courses, and have many possible functions. Our experience in using the discussion forums in online courses for task-based collaborative discussion has led us to many questions about the optimal ways of using online discussion to support collaborative learning, such as how should instructors structure online discussions in a way that it promotes collaborative learning? What should instructors do to enhance learners' reflective thinking, critical thinking, or problem solving in online collaborative discussions? The challenges of using forum in learning also have been highlighted by many researchers. In this paper we present "smart" discussion forum to support, monitor and facilitate task-based collaboration for the learning process of the adult learners to advance their development of critical thinking.

Introduction

Online learning in open and distance learning which caters adult learners is different from traditional face-to-face learning in many ways. One obvious difference is that there are lack of direct face-to-face interactions among students or between students and instructor (Gao, 2009) The quality and quantity of student-student interaction and student-instructor interaction influence the quality for any course, online or face-to-face. In this regard, one of the challenges to teach online is to cultivate meaningful online interactions among the adult students who have diversified background (Gao, 2009). To achieve this goal, the asynchronous online discussion forum is one of the most effective tools, as it promotes reflection, frees learners from time and space constraints (Anderson, 1996) and provides abundant possibilities for communication. In online courses for adult learners, discussion forums have been used for a variety of purposes such as to discuss general issues of the subject matter; share and obtain resources and information from each other and more importantly act as centers for groups of students who work collaboratively on task assigned to them (Gao, 2009).

Problem Statement

Asynchronous online discussion forums play an important role in adult online courses, and have many possible functions (Dennen, 2008). At the same time, our experience in using discussion forums in online courses for task-based collaborative learning has led us to many questions about the best possible ways of using online discussion to support collaborative learning, such as how should instructors structure online discussions in a way to promote collaborative learning? What should instructors do to enhance reflective thinking, critical thinking, or problem solving in online collaborative discussions? The reality in online discussion forums, however, does not always live up to these expectations (Gao, 2009). This is more so for online task-based collaborative learning implemented through discussion forum. When asynchronous discussion forum is used to support the understanding of the subject matter among the learners, there have seen both successful and unsuccessful situations (Gao, 2009). There are times when passionate discussions started with one student sharing a piece of reminiscent experience, when discussions came alive with a thought-provoking question, and when a group of students argued keenly about their ideas. There are also times, however, when discussions failed to achieve the preferred goal (Gao, 2009). In this paper we discuss how we have designed and developed a "smart" discussion forum to support, monitor and facilitate task-based collaboration for the learning process of the adult learners to advance their development of critical thinking.

Literature Review

Various collaborative tools have been developed to support learning and discussion among the learners. The comparison of some of the tools commonly cited in the literatures and tool that we have developed is given in Table 1.

Table 1: Comparison of various CSCL tools widely cited in the literature.
(Adapted from Soller et al., 2005).

Tool	Platform	Task	Performance Indicator	Roles	Pedagogical Constructs applied in the Tool
COLER (Constantino-Gonzales & Suthers, 2000)	Real Time non-Forum	Concept Learning	Participation, Agreement with group procedure	Coach	Collaborative Learning
iDCLE (Inaba & Okamoto, 1996)	Real Time non-Forum	Concept Learning	Advice	Coach	Collaborative Learning
Gracile (Ayala & Yano, 1998)	Real Time non-Forum	Concept Learning	Appropriate student helpers , Learning tasks	Coach	Collaborative Learning, Zone of Proximal Development (ZPD)
HabiPro (Vizcaino et al., 2000)	Real Time non-Forum	Concept Learning	Ideal participation, Motivation	Coach	Collaborative Learning
LeCS (Rosatelli et al., 2000)	Real Time non-Forum	Concept learning	Participation, Group Coordination	Coach	Collaborative Learning
Group Leader (McManus & Aiken, 1995)	Real Time non-Forum	Concept Learning	Trust, Leadership, Communication	Coach	Collaborative Learning, Sentence Opener
Epsilon (Soller & Lesgold, 2000)	Real Time non-Forum	Concept Learning and Problem Solving	Knowledge Construction	Coach	Collaborative Learning, Knowledge Construction, Problem Solving Actions, Sentence Openers
Our proposed "smart forum"	Asynchronous - Forum	Problem solving	Critical Thinking	Coach	Scaffolding using sentence opener, Community of Inquiry, Problem-based Learning, Critical Thinking Model, Collaborative Learning

Design & Implementation

In this section, the design framework and implementation of the proposed smart forum environment are discussed. The proposed architecture of the system will use agent approach which is based on the rule-based expert system framework. Agent approach is adopted as it is goal oriented, take action when necessary to fulfill the goal, capable to perform tasks given by the user autonomously, monitor the environment and adjust an event without direct intervention from the user. Figure 1 shows the components that make up the proposed system. It has seven agents performing different tasks. The facts and rules for the agents will be stored in the knowledge base and Java class programs respectively. In smart forum, the students are given a task or problem to be solved through collaborative discussion in a small group. In order to engage in the discussion, the students will post their messages in the asynchronous forum using sentence openers provided in the forum. Only one sentence opener can be used per posting to start the discourse. Subsequent sentence(s) in the same posting should not use any sentence opener. There is no restriction on the number of words per posting but each posting (which may consists of more than one sentence) must highlight a *single issue*. This will enable the agents to do their tasks efficiently. Sentence openers are pre-defined approach to start a conversation using menu or buttons.

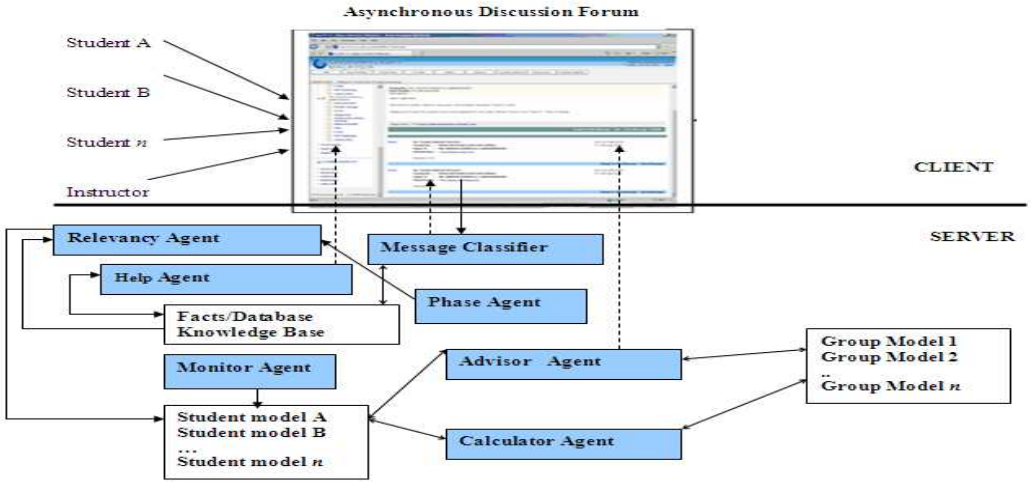

Figure 1. Architecture of the Smart Forum.

We are motivated to use sentence openers based on the result obtained by Baker & Lund (1996). In this study, the sentence opener that have been adopted is based on the Collaborative Skills Network (CSN) proposed by Israel (2003). Israel (2003) model is adopted as it has included more "working on task" sentence opener which are appropriate for task-based discussions. In our proposed expert system, each message typed by the students using the sentence openers will first be parsed by the ***Message Classifier*** agent that will do the following tasks:

i. Identify which sentence opener that has been used by the students and the tutors. Tutors and students are given separate set of sentence openers (Figure 2).
ii. Identify the main keywords used by the students in completing the sentence (sentence closer) using the sentence opener. The analysis is done using Knuth-Morris-Pratt string matching algorithm.
iii. Based on the sentence opener and sentence closer used by the students, the agent will classify the message as either *discussion messages*, *not relevant message* (such as "how are you?") or *specific question* from the students on the domain or problem that need to be solved. The agent will ignore any other message that could not be classified.
iv. If the message is classified as discussion message, the agent will assign appropriate tag(s) available in Newman's content analysis model (Newman et al., 1995). Here a message can have more than one indicator depending on the keyword used in the sentence closer.

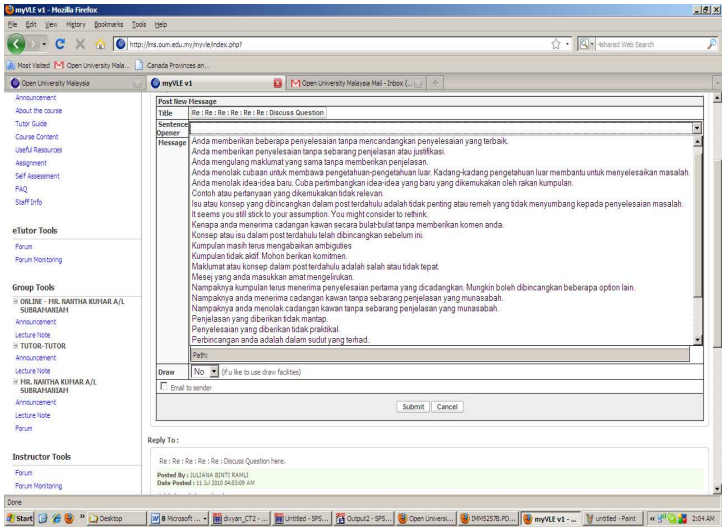

Figure 2. Sentence Openers are Provided as Pull-down Menu (Student View).

Calculator Agent will Calculate the critical thinking (CT) ratio of the individual learner and the groups for each of the category in the Newman's content analysis model. (Newman et al., 1995). In calculating the CT ratio, messages that relevant to the groups' current phase in the Garrison's "practical inquiry model" (Garrison

et al., 2001a; Garrison et al., 2001b) will be taken into consideration. Other messages which are considered to be not relevant for the current phases will be ignored. Calculator agent will also calculate the cumulative CT ratio of the learners and groups independent of the phases. The ***Monitor Agent*** will monitor students' participation level in the discussion forum. This agent will send postings/message or reminders in the forum to the students who are not active by asking them to participate actively in the discussions in a week. This is to ensure that there are plenty of postings so that other agents can perform their tasks. The formula used to determine student activeness is based on the learners' out-degree centrality of their discussion (Suh & Lee, 2006). Learners with high out-degree centrality are more active in providing information to others in discussion or providing comments on the opinions of others. Newman et al. (1995) also have mapped the relevant indicators of content analysis to each of the phase in the Garrison's "practical inquiry" model. If a message is tagged by the Classifier agent, the ***Relevancy Agent*** will use this mapping information to update the relevant parameters in the student model regarding the status of the current message posted by the learners (i.e. whether the message is appropriate for the current phase or not). This is to ensure that the students are in the same level of discussion and there are no students ahead or left out in the discussion. The ***Phase Agent*** will keep track in the transition of the phases in the Garrison's "practical inquiry" model. Only the tutor is allowed to change the phase of the group and the Phase agent will notify the relevant agents if there is any change of phase for the groups. The Phase agent will also identify in which phase a message has been posted by the student. This information is vital for the Relevancy agent. Phase agent has influence on the Calculator and Relevancy agents as information from Phase agent is used by these two agents in executing their tasks. The ***Help Agent*** will provide possible answers for the students queries on the subject matter in the form of FaQs in a new pop-up window. If the agent could not give the possible answers or if the student is not happy with the answers given by the agent, the student has the option to alert the tutor by just clicking an alert button provided by the agent on the same screen. When this is done, the agent will send the user's searched keyword together with their email to the tutor. The tutor can then reply to the student with the appropriate answer.

Information in students' and groups' model will be updated accordingly by the relevant agents as they perform their tasks. The student model for each of the student stored in the database table consists of the following information: CT ratio of the phase, overall CT ratio, magnitude of the learners activeness (out-degree centrality ratio), indicator of relevant message tags posted in a message for a phase, the learners CT ratio of the prior phase and information on the relevant tags for the latest posting. The group model will consist of the following information: overall CT ratio of the groups, CT ratio for the each phase, CT ratio of the group's prior phase. Finally, the ***Advisor Agent*** will swing into action to do the following tasks using all the messages classified as *discussion messages* and has been tagged by the Message Classifier agent earlier:

i. Monitor learners' and groups' CT ratio in moving from one phase to the another
ii. Based on (i) above and the status of the students and groups model, the Advisor agent will give its feedback, advice or consultation to the students or/and their group (Figure 3).
The message or feedback from this agent to the student or the group will consist of three sections in a single message:
    - The current status of the learners or the group
    - How they can overcome their problem if there is a deadlock in the group or the individual student
    - The current rank of their performance and their past performance (in the form of percentage from 0 to 100)

In addition, the Advisor agent will alert the groups if they are spending too much time in a particular phase

Conclusions and Future Work

This paper has present an architecture for smart forum prototype which support, monitor and facilitate adult learners task-based collaborative discussion. The system was built using agent approach utilizing the very natural set-up of forums to enhance adult learners critical thinking in solving a task/problem online collaboratively. The initial feedback from the students show that the system has contributed to the enhancement of their capability and critical thinking on the subject matter. We are currently investigating the ways to incorporate fuzzy logic and neural network in the system in order to increase the processing power of the agents.

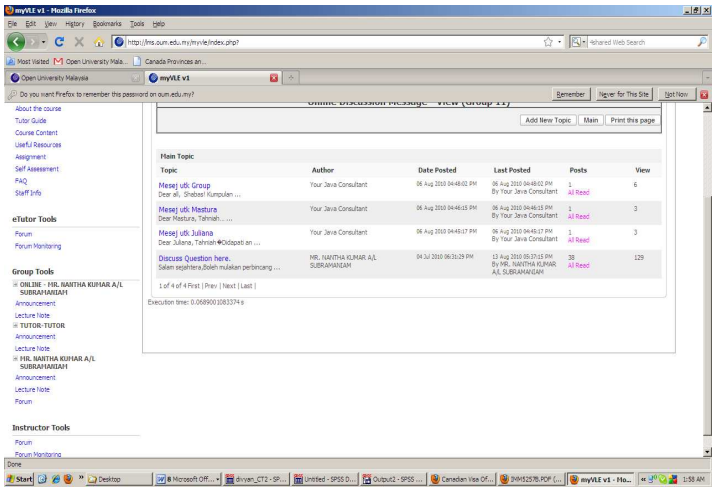

Figure 3. Agent Drafted Responses Sent to the Individual Student and Group.

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