ClassroomWiki: A Wiki for the Classroom with Multiagent Tracking, Modeling, and Group Formation (Extended Abstract)

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ABSTRACT

Wikis today are being used as a tool to conduct collaborative writing assignments in classrooms. However, typical Wikis (1) do not provide group formation methods to improve the collaborative learning of the students and (2) suffer from typical problems of collaborative learning like free-riding (earning credit without contribution) and lacking conveniences to facilitate teacher interventions. To improve the state of the art of the typical Wikis used in classrooms, we have designed and implemented ClassroomWiki—a Web-based collaborative Wiki writing tool that combines a set of learner pedagogy theories with multiagent tracking, modeling, and group formation. For the students, ClassroomWiki provides a Web interface for writing and revising their group's Wiki and a topic-based forum for discussing their ideas during collaboration. When the students collaborate, ClassroomWiki's agents track all student activities and build detailed student models that represent their contributions toward their groups and uses MHCF algorithm to form student groups to improve the collaborative learning of students. We have deployed ClassroomWiki in two university-level courses to investigate the impact of ClassroomWiki. The results show that ClassroomWiki can (1) improve the collaborative learning outcome of the students by its group formation framework and (2) alleviate free-riding and facilitate teacher interventions by its multiagent tracking and modeling.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]: Computer Uses in Education – *Collaborative Learning.*

General Terms

Algorithms, Design, Experimentation.

Keywords

Multiagent, Coalition Formation, Wiki.

1. INTRODUCTION

Wikis today are gaining popularity as a tool for implementing collaborative learning for instructional uses. However, typical Wiki environments are designed to generate informative artifacts (e.g., web pages) through cooperation where the quality of the *generated content* is the focus. However, when used as a collaborative writing educational tool, the quality of the collaboration among the group members is as important, if not more, as the quality of the artifacts generated by the groups. That is because the improvement of students' knowledge and understanding due to learning largely depends on how well they collaborate to exchange knowledge and information with one another [1]. One way to improve the collaboration and thus the learning outcome of the students in a Wiki is by addressing the factors that impact the collaboration process of the students [2] such as group formation and individual assessment of students.

Here we describe the results of our deployment of MHCF algorithm for forming student groups in ClassroomWiki, a Web-based computer-supported collaborative writing tool. Our ClassroomWiki uses a set of intelligent agents, called student agents, to track the participating students' activities to build detailed *models* of those students and then uses the Multiagent Human Coalition Formation (MHCF) framework (based on [3]) using a negotiation protocol and a *Bayesian Network* to form student groups. Implementing MHCF, first, each ClassroomWiki student agent tracks its student's interactions with the Wiki and with other students and uses *natural language processing* (NLP) techniques to build a detailed model. Due to the tracking, the students' models can *closely* represent their contributions towards their group and their ability to collaborate with their group members. Subsequently, ClassroomWiki framework uses the student models built by the student agents and the Bayesian Network to *learn* the impact of the students' attributes (e.g., knowledge) on their collaboration and learning outcomes and then *exploits* that knowledge to form student groups that improve the collaborative learning outcome of the students.

We have briefly described the principles that guided our design of MHCF in [3]. Subsequently, we have reported on the architecture of ClassroomWiki and the details of the MHCF algorithm in [4]. Here we discuss previously *unpublished* results of the impact of MHCF group formation algorithm.

2. CLASSROOMWIKI AND MHCF

ClassroomWiki [4] is a Web-based collaborative writing tool that provides a typical Wiki-based interface which allows the students to collaborate and write assignments on teacher-assigned topics and communicate using a topic-based forum. While the students collaborate and communicate, a set of intelligent agents (*assigned to the students*) to track their activities into four dimensions [4]. and uses the MHCF algorithm to form student groups.

MHCF group formation algorithm [4] assigns an intelligent agent to each of the participating students where each agent maintains the *model* [4] of its assigned student and utilizes that model to (1) probabilistically estimate the contribution of a student towards his or her group's Wiki i.e., his or her performance as a group member and (2) negotiate with other agents to form better student groups. Using a *probabilistic* view of the environment, an MHCF agent, on behalf of its user, (1) uses a *Bayesian Network (BN)* to learn the *probabilistic mapping* between a group's members' model and its performance and (2) negotiates with other agent form groups that solve the current-task *well* and allow the members to collaborate and learn to solve future tasks *better*.

3. EXPERIMENT SETUP AND RESULTS

We have deployed ClassroomWiki in two university-level courses HIST 202 (145 students), CSCE 475 (17 students) and divided the students into control and treatment sets where the treatment set students were divided using MHCF algorithm and control set students were divided randomly.

Student Scores. For both deployments (see Table 1)**,** the student evaluation scores show that the treatment set students achieved better scores and lower standard deviations than did the control set students (the difference was statistically significantly as well for Deployment 1 with $p<0.05$). Since the student evaluation scores were calculated based on: (1) the quality of their Wiki and (2) their contributions towards their respective groups, these results suggest that the students in the MHCF student groups were able to collaborate better than the control set students to prepare a Wiki of better quality (recall that both the treatment and control sets, i.e., MHCF-assigned and randomly-assigned groups, had similar average prior assignment scores to begin with). This improved student performance could be attributed to the MHCF's ability to form student groups that improve the collaborative learning outcome of the students by using the BN.

Student Interactions. Tables 2 and 3 show the average revision count and average forum activity count, respectively, of the control and treatment set students for Deployment 1 and Deployment 2. Although not statistically significant, Tables 3 and 4 indicate that the treatment set students collaborated more (in terms of revisions and forum discussions) than the control set students in each of the two deployments. This could again be attributed to the MHCF's ability to form groups that motivated the students to do so. Upon closer analysis, Table 3 also reveals that the *difference* between the control and treatment set students topic

and message counts were *increased* in Deployment 2. This increase of forum-related communication effort of the students could be explained by MHCF's dependence on the BN to learn how to form student groups. The BN relies on the repetitions to learn the probabilistic mapping between students' models (prepared by the TAM) to their evaluation scores. Since the BN had more repetitions to learn from in Deployment 2 than Deployment 1, it was able to better learn the mapping of student models to their performance scores. So, MHCF was able to use that BN to form student groups that encouraged them to collaborate more than the control set student groups.

Table 1. Individual and Group Evaluation Scores

Set	Deployment 1		Deployment 2	
	Mean	StdDev.	Mean	StdDev.
Control	70.4	32.9	68.8	30.1
Treatment	74.8	24.7	78.5	16.2

Table 2. Average Revision Count per Wiki Assignment

Set	Deployment 1		Deployment 2	
	Mean	StdDev.	Mean	StdDev.
Control	3.0	2.7	6.3	5.2
Treatment	3.8	3.2	8.5	3.2

Table 3. Average Forum Activity Count per Wiki Assignment

Set	Deployment 1		Deployment 2	
	Mean	StdDev.	Mean	StdDev.
Forum Topic Count				
Control	2.1	1.4	3.4	1.1
Treatment	2.4	1.8	4.1	2.3
Forum Message Count				
Control	2.3	2.0	7.5	5.7
Treatment	2.4	1.9	10.9	6.5

4. CONCLUSIONS

Our deployment results regarding ClassroomWiki suggest that the multiagent-based tracking, modeling, and MHCF group formation algorithm in ClassroomWiki can improve the (1) collaboration and (2) learning outcome of the participating students.

5. ACKNOWLEDGEMENTS

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