ROLE-BASED ADAPTIVE COLLABORATIVE LEARNING MODEL

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Abstract
In recent years, the field of education has witnesses the emergence of many elearning systems. These systems support varieties of students who have different preferences, performances, knowledge, and who are working on various courses. Furthermore, these systems maintain several communication tools that provide a great opportunity for collaborative learning. Effective collaboration is critical to student learning success. Therefore, in this paper we propose a new flexible, role-based adaptive collaborative learning model. Our approach is based on roles and rule management of each user of the system. This approach was successfully adopted in the field of information security and we believe it will have similar success in the area of adaptive collaborative learning processes.

Keywords
Education, Elearning, Collaborative Learning, Role Based Access Control

1. INTRODUCTION
Numerous computer-based systems have been used in education during last four decades. Within the last decade, elearning has increasingly appeared, taking advantage of major advances in technologies and the availability of the Internet. Elearning has grown in popularity because it is convenient for both students and teachers, at anytime, anywhere. Thus, elearning is being integrated in institutions, corporate organizations, and military to support learning and teaching. In early stages of elearning development, static documents were posted on the Web. Then, gradually, elearning evolved into more advanced systems, such as Adaptive Hypermedia Education Systems, Course Management Systems, and Learning Management Systems.

Nowadays, it is common for institutions to have tens of thousands of students located throughout disparate locations. This major shift toward elearning is driven by internet technology, improves communication, and collaboration. ELearning provides a completely new set of virtual relationships that is very different from traditional learning. In traditional learning students can share authentic information face-to-face in the classroom. This feature is limited by location and time.

Existing elearning systems is increasingly promote and support collaborative learning depending on modern communications tools such as WebCT [16], TopClass [14], and Blackboard [3]. Communication can be divided into two modes: asynchronous and synchronous. Asynchronous (delayed time) mode includes discussion forum, bulletin board, newsgroup, and mailing list. Synchronous mode (real-time) mode includes text-based internet chat, instant messaging, audio, and video conferencing, and virtual whiteboard applications.

In traditional learning, it is easy for student to turn to their smartest peers for consultation. In addition, it is easy for teachers to know their students educational level and give them proper assignments or projects to improve their understanding. In elearning systems students have no time or border restrictions to communicate with others, using several tools such as chatting, and discussion forums. However, they lack information about other students' expertise and knowledge. Furthermore, elearning students usually are assigned to groups, teams to accomplish various goals regardless of their performance or capabilities.

Moreover, collaboration can propagate misconception among students if it is not carefully managed, and organized. It is necessary for elearning systems not to provide loosely structured communication tools, but also control the collaborative learning. Collaboration is very broad concept; therefore, we propose a new model that facilitates collaborative learning for two categories: first, Peers Learning Management (PLM) that focuses on interaction between two students collaborating toward achieving specific support. Second is Team Participation Management (TPM) that is usually performed by group of students with different knowledge and expertise to achieve common goals.

The rest of the paper is organized as follows. In section 2 we briefly provide a review of collaborative learning systems. In section 3 we address the related work. Section 4 describes a motivation example. Section 5

briefly presents our framework. Section 6 provides a conclusion.

2. COLLABORATIVE LEARNING

The idea of using computers to facilities individual and collaborative learning goes back to the 1940's when Vannevar Bush described his famous "Memex", [4]. However, two decades ago, the focus was directed toward individualized learning using Intelligent Tutoring Systems (ITS). ITS is dedicated to helping students learn at their own pace and through individualized instructions and responses. The objective is to provide students with effective, appropriate, and flexible instruction based on Artificial Intelligence (AI) techniques [13], and [17].

However, development of the internet brought up great changes in the field of education. Most educational institutions deployed elearning systems. This shift toward elearning has expanded the opportunities for students to work collaboratively with dozens of diverse students everywhere at anytime across traditional boundaries. It is obvious that teaching and learning require a variety of approaches to suit diverse domains and students, one of which is collaborative learning that has integrated in the elearning paradigm.

Collaborative learning encourages and supports students to work together as a team on problems or projects, and share information. Furthermore, it enhances instructional effectiveness, promotes teamwork skills among students, and helps them accomplish something that they could not achieve individually. Several studies have shown collaborative learning to be an effective pedagogical tool [12].

Collaborative learning usually requires some form of communication between participants, either through natural languages in face-to-face learning or virtual communication in elearning systems. Nowadays, within the tremendous shift toward elearning, the collaborative learning paradigm is gaining popularity. It is an essential mean for the improvement of student learning and productivity [6]. In addition, it has attracted the attention of the investment community as companies are eager to capture market opportunities in technology, content, and services. Several systems were developed in order to offer students a collaborative environment. These systems range from group discussion and chatting to sophisticated systems that employ virtual realty (VR) technologies.

3. RELATED WORK

3.1 RBAC MODEL

Even though role concept has been used for administrative purposes in the 1970's and 80's, the development of Role-Based Access Control (RBAC) model and its extensions became recently a focus of significant research. While RBAC is extensively described, and defined in the literature [5, 10 and 11], we briefly describe its basic concepts in the section.

RBAC is a form of nondiscretionary access control that is designed for managing large organizations. It is based on the role concept to facilitate access control by associating roles to permissions and users. Roles are created based on the organizational needs for various permissions to gain access to functions and objects. On the other hand, users are assigned to roles based on their responsibilities in the organization in order to acquire the roles' permissions.

3.2 TMAC MODEL

There are several models extending the RBAC model, such as Team-based Access Control TMAC [9, 15]. A recent model of Team-based Access Control is TMAC04 [1]. In TMAC04, we do not create new roles for team members, but we use the existing organization roles. In TMAC04 users are grouped in teams based on their assigned roles. Each single user admitted to the team is assigned team permissions to participate in team efforts. These permissions are automatically revoked when team members do not meet team conditions. The model accommodates team access control within the organization that has various types of user occupations.

3.3 GRBAC MODEL

Another extension of RBAC, is the Generalized Role-Based Access Control (GRBAC) which provides more freedom to access control. GRBAC enhances the traditional RBAC by incorporating several types of roles: subject roles, object roles, and environment roles. This model can express complex access control policies because it applies the role concept uniformly to subjects, objects, and environmental states. It is an elegant model that makes access control policy easier and efficient [7,8].

4. A Motivation Example

Students usually learn individually, turn to their mates for support, or work in teams collaboratively. This nature of learning remains true in the elearning paradigm. However, in elearning systems the situation is different than in the classroom; students randomly collaborate with others via the internet to obtain help or support. Students usually have different educational backgrounds, intelligence levels, needs, and learning styles. Furthermore, they are assigned into teams to accomplish certain goals regardless of their knowledge.

Let us assume that there are thousands of students using an elearning system that contains hundreds of courses. These courses are taught by various instructors. Students are free to share information, inquire for help, discuss ideas, or gain support from peers. In addition,

teachers or mediators are able to assign students to certain projects to form a team in order to accomplish certain tasks. This type of collaboration emphasizes the communication among students to share and pass information, which is good in developing social interaction skills between participants.

However, it does not take into consideration the student strength, weakness, or performance on the subject matter. Collaborative learning activities in the system need to be adaptive to the actual needs of students to fully meet student that needs and lead to effective learning. Therefore, in our model we make it possible for participants to engage in collaborative activities with others in a way that meet their specific needs.

5. OUR FRAMEWORK

The framework consists of six learning components, which encapsulate various sub-components aimed to provide specific features. The components are as follows: Users Management (UM), Assessment (ASSESS), Student Management (SMG), Collaborative Learning Management (CLM), Learning (LRN), and Teaching Management (TCH).

The components can be used across multiple system vendors. In addition, the components provide students with personalized learning based on their needs and performance. As well, the components allow students to collaborate and share their knowledge with their peers. They also help students to work in a favorable way by providing high value learning materials anytime at anyplace. Furthermore, they support teacher involvement in the system so that teachers can enforce the right teaching strategy on their students to guide them in the learning process; furthermore, it controls, monitors, and analyzes students' actions in the system [2].

Collaborative learning offers an extremely valuable approach to increase student retention, promote positive race relations, enhance student self-esteem, and encourage student responsibility for learning. Nowadays, with the enormous support of internet technologies, the great potential chance of collaborative learning can be achieved. As well, communication tools are becoming increasingly widespread within most elearning systems.

However, some questions have not been addressed: on what basis are students collaborating, and with whom would it be beneficial to collaborate? In this model, we use the role concept to categorize students based on their performance, preferences, study level, and project or team conditions. Thus, we adopt the Generalized Role Based Access Control (GRBAC) idea. GRBAC support several types of roles: subject roles, object roles, environment roles.

The important concept in RBAC and other extensions, such as TMAC and GRBAC, is the role concept, which supports our framework as a user grouping mechanism. In RBAC, a role is a collection of permissions to perform operations assigned by the system. Individual user is called a subject, and can be revoked and assigned to the appropriate roles by the administrator. Each user has a set of authorized roles that grant the user permission to access specific resources. Users possess a role based on various characteristics within an organization, such as position, title, and occupation. So RBAC has focuses on the users and on the duties that users perform in a large structured organizations. See Figure 1 Below.

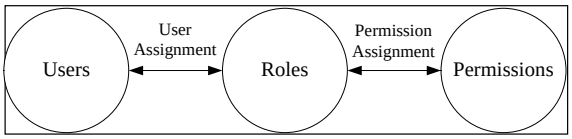

FIGURE 1: FLAT ROLE BASED ACCESS CONTROL

In contrast to large organizations that have many users having dozens of occupations, collaborative learning in elearning systems has one type of users: students. Therefore, roles are very similar for all students in the system if RBAC was adopted. Therfore extending RBAC to collaborative requires redefinition of students' role. Student according to our model will be categorized in many roles automatically

Generally speaking, a role can represent specific task, position, qualification, responsibility and so on. Thus, there are several proprieties in collaborative learning can be defined in roles. Instead of associating permissions with subject-centric roles, we associate them with three types of roles: learning preferences, study level, and performance roles. Students can have individual roles or a combination of roles to collaborate in the system. See Figure 2 below.

Learning roles are based on student performance in the system, such as normal, good, and outstanding roles. Study level roles are based on student's grades in school or courses and so on. However, in this system we take each course as study level. The system extracts the study level information automatically from student model. The study level role used to associate students with suitable peers at equivalent levels.

Collaborative environment roles can be defined for administrators, students or teachers based on the context, the state of the project, student preferences or the team. Therefore, these roles facilitate efficient collaboration between participant peers and allow teachers to set the policy rules that are associated with

all roles to manage and organize the collaboration. See Figure 3 below. Performance roles are categorized into the standard evaluation process of traditional learning: A+, A, B+, B, etc. Study level roles categorization depends on the curriculum of the school. For example, in college students levels may be categorized into: junior, sophomore, and senior. However, preferences are very flexible and may change over time. Examples of preferences categories are student interaction preferences such as text-based only, voice-based, video-based, or some form of combination of theses choices. The choices of how much discloser of student identity to peer is also part of the preferences such as: anonymous interaction or fully disclosed.

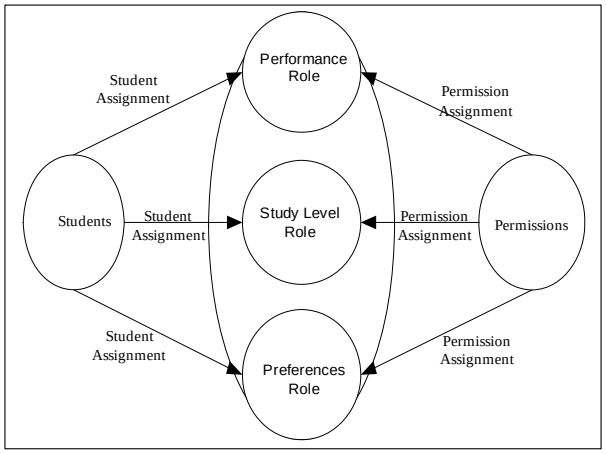

FIGURE 2: ROLES FOR ADAPTIVE COLLABORATIVE LEARNING MODEL.

Roles are defined by authorized people, such as administrators or teachers along with the role entry condition. The conditions must be met by students to gain admission to a role. Furthermore, teachers have to define team roles membership conditions, which specify roles that students need to have in order to join a team. In addition peer roles membership conditions are based on the student preferences.

For example, consider a student who wants to discuss certain issues about a subject with qualified students. The system will allow the student to collaborate with other students according to their roles. However, the system does not limit students in collaborating with certain students, but it allows students to have enough knowledge about their peers' capabilities prior to collaboration. Furthermore, student identities are obscured from other students.

Regarding team collaboration, usually teachers or students form teams randomly, which sometimes negatively influences students learning. However, this model enables teachers or administrators to construct suitable policy rules to form teams. For example, a teacher creates a team associated with certain policy rules such as: team members must not be more than six students, and the members must hold certain roles. The system will enforce these policy rules on students, therefore only admitted students in the team can collaborate with others.

According to figure3, role assignment is carried out at the login of student to the system. This process is performed automatically and transparent from the stuend. The system retrieves student preferences, study level, and performance from student model as well as the policies rules. Based on all of that information the student gets assigned to a set of roles. Then these roles control student's choices of collaborating with teams or peers.In addition, these roles that student receive controls his previliage to access different recourses and learning objects within the system..

Policy rules are defined by teachers or administrators. Rules defines how teams are formed and for how long. For example, a teacher may define a project and set up a set of rules for the teams working in that project such as maximum and minimum number of student in the teams, accepted student level or performance level of team members, and the duration of the team. An administrator may setup also some rules such as a student may not join a team unless he or she has fully paid the fees.

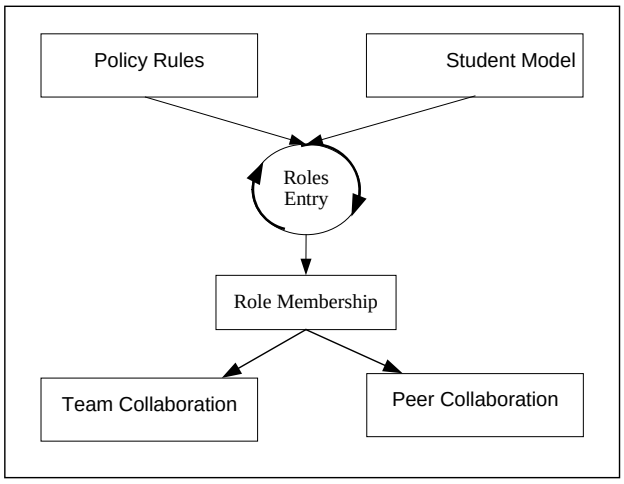

FIGURE 3: ROLE-BASED ADAPTIVE COLLABORATIVE LEARNING MODEL ARCHITECTURE

6. CONCLUSION

Elearning communities can only be successful when people participate actively and provide meaningful collaboration. It is very important to take into consideration aspect of student learning and to support a feeling of commitment to peers and affiliation with the teams. In this paper, we proposed an adaptive model that allows student to share their knowledge, and expertise. Furthermore, we showed how teachers and administrators can use students' roles according to the defined rules. The model can be seen as development of

Generalized Role Based Access Control (GRBAC) in collaborative elearning environment. In addition, this model makes it possible to have adaptive collaboration among students. It enhances and authenticates collaborative learning in elearning systems.

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