

A Web-based Learner-Controlled Adaptive Group Formation Technique

Alexandros Papadimitriou, Greek Ministry of Education, Athens, Greece

Maria Grigoriadou, Department of Informatics and Telecommunications, National and Kapodistrian University of Athens, Athens, Greece

Georgios Gyftodimos, Department of Philosophy and History of Science, National and Kapodistrian University of Athens, Athens, Greece

ABSTRACT

This paper presents the learner-controlled adaptive group formation technique offered by the web-based adaptive educational hypermedia system MATHEMA. More specifically, this paper describes why we take into consideration the group effectiveness, concerning the concrete-abstract dimension of learners' learning style, in forming learner groups and how the adaptive group formation algorithm generates a priority list of possible matching candidate collaborators for a certain student, taking into account the abstract or concrete dimension of his/her learning style and his/her possible candidate collaborators' learning style and knowledge level on the current learning goal as well. Moreover, the paper describes how the algorithm supports the learners in selecting the most suitable collaborator, and how it automatically links them up via a chat tool with the aim of negotiating a collaboration agreement. An evaluation of the adaptive group formation of our system indicated that it is usable and useful enough tool for collaborative learning.

Keywords: Adaptive Group Formation, Collaboration Willingness, Group Effectiveness, Learning Styles, MATHEMA

INTRODUCTION

Adaptive Educational Hypermedia Systems (AEHSs) combine ideas from hypermedia and intelligent tutoring systems (ITS) to produce applications whose content is adapted to each student's learning goal, knowledge level, performance, background, interests, preferences, stereotypes, cognitive preferences, and learning style that are stored into the learner's model. A number of research groups has independently

realized that a hypermedia system coupled with an ITS can offer more functionality than a traditional static educational hypermedia (Brusilovsky & Peylo, 2003). AEHSs can be considered the solution to the problems of traditional online educational hypermedia systems. These problems are due to the static content, the "lost in hypermedia" syndrome and the "one-size-fits-all" approach. In Web-based AEHSs, several adaptive and intelligent techniques have been applied to introduce adaptation such

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as curriculum sequencing, adaptive presentation, adaptive navigation support, interactive problem solving support, intelligent analysis of student solutions, example-based problem solving support, and adaptive collaboration support or adaptive group formation and/or peer help (Brusilovsky & Peylo, 2003). According to Brusilovsky and Peylo (2003) a real AEHS should implement all the above-mentioned techniques. Some examples of AEHSs are the AHA! (De Bra & Calvi, 1998), TANGOW (Carro, Ortigosa, Martin, & Schlichter, 2003), CA-OLE (Santamaria, 2006), and MOT 2.0 (Cristea & Ghali, 2011).

According to Brusilovsky and Peylo (2003), the technologies for adaptive group formation and/or peer help attempt to use knowledge about collaborating peers (most often represented in their student models) to form a matching group for different kinds of collaborative tasks.

One major goal of learner-centeredness is to provide active and collaborative learning environments (Lambert & McCombs, 1998). Also, the group effectiveness should be one of the goals of a system supporting collaboration. These goals are adopted by the AEHS MATHEMA. It combines both the constructivist and socio-constructivist didactic models, and it also supports both individual and collaborative learning. The general aim of the AEHS MATHEMA is to support senior high school students or novices of higher education, through an interactive and constructivist educational material, in learning science conceptually, individually and/or collaboratively, and overcoming their possible misconceptions and learning difficulties. So far, the AEHS MATHEMA has supported curriculum sequencing, adaptive presentation, adaptive and meta-adaptive navigation, interactive problem solving, and adaptive group formation techniques. In the present paper, we mainly focus upon the adaptive group formation technique offered by our AEHS MATHEMA. The innovation of adaptive group formation technique, that makes it to be distinguished from other AEHSs', is that the learner the full control for the selection of his/her collaborators

is given, including the negotiation of a collaboration agreement with them, through a list of matching candidate collaborators, generated by the algorithm which takes into account their learning styles and the knowledge level on the current learning goal. Unlike, the CSCL and AEHSs which have been developed so far are based upon a system-controlled and/or upon an educator-controlled design, that is, the group formation is decided by the system and/or by the educator and the learners are informed without having the ability to change it or to negotiate a collaboration agreement with their possible candidate collaborators.

The remainder of this article is structured as follows. In Section 2 we present related work on group formation and/or peer help. In Section 3 we describe the learner-controlled adaptive group formation technique offered by the AEHS MATHEMA. In Section 4 we present the evaluation of the adaptive group formation technique, and in Section 5 we summarize the most significant points of our work and we refer to our future plans.

Related Work in Group Formation and/or Peer Help

Collaborative learning refers to two or more people that learn or attempt to learn something together. Until recently, the primary goal of collaborative learning was the investigation whether and under what circumstances collaborative learning was more effective than individual learning (Dillenbourg, Baker, Blaye, & O'Malley, 1996). Under the premise that the collaborative learning process depends on contextual, physical, and temporal factors (Vosniadou, 2008), numerous conditions have been studied such as composition of the group, individuals prerequisites, the features of the task, the context of collaboration, and the medium available for communication. Recently, the nature of collaboration for learning and the dynamics of group interactions in learning environments have gained considerable interest. The *group productivity* (the ability of the group to solve a problem) is determined by how

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