

Chapter 4

Forming Groups for Collaborative Learning of Introductory Computer Programming Based on Students' Programming Skills and Learning Styles

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ABSTRACT

Collaborative learning is pointed out as an effective approach to reduce apprentices' difficulties that arise during the effort to learn computer programming. In a collaborative learning process, the formation of groups is a fundamental activity and one of the most complex, because grouping students randomly is ineffective in obtaining real collaboration. PQAS and Group Organizer were developed to address the lack of tools that support group formation in the context of collaborative learning of computer programming.

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These tools form groups based on the theories of socio-cognitive conflict and learning styles. In order to stimulate the social-cognitive conflict, PQAS groups students with significant differences in programming style. GroupOrganizer extends PQAS and forms groups also considering students' learning styles. Two experiments involving students taking introductory programming courses provide evidences that the adopted approaches contribute to increase students' learning both in terms of programming style and workgroup skills.

INTRODUCTION

Learning computer programming is one of the first and major challenges for computing students. The difficulties faced by students are usually reflected by high failure rates on the courses related to learning programming abilities and on the courses that directly depend on those abilities. This scenario is in part due to the difficulties faced by instructors to effectively follow up practical programming assignments with many students.

The literature suggests that collaborative work among students contributes to increase their learning outcomes (Harrer et al., 2006; Constantino-González & Suthers, 2007), provided that appropriate mechanisms are used. But frequently this is not what happens because instructors using work in groups allow students themselves to define the groups according to their own criteria. This approach has major problems that arise mainly from the fact that the groups are usually formed taking into account the bonds of friendship rather than functional or learning interests.

Group definition without due care can lead to the formation of groups with many problems, for example, groups formed only by strong or weak students. The disadvantage of groups that contain only weak students is obvious, but keeping only strong students in a group is equally undesirable: First, because strong groups have an excessive advantage over other group types. Second, because these groups tend to divide the work into pieces to be developed individually, so that their members communicate superficially, without causing the dynamic interactions that provide the benefits of collaborative learning. On the other hand, in groups

of mixed abilities, weaker students profit from perceiving how strong students address problems, and stronger students gain greater understanding on the subjects they teach to the weaker students (Felder & Brent, 2004).

Several strategies have been used to form effective groups for collaborative work. In this article there is interest in tools that explore two approaches to group formation: the neo-Piagetian theories of the socio-cognitive conflict and learning styles.

SOCIO-COGNITIVE CONFLICT THEORY AND LEARNING

The use of the socio-cognitive conflict theory in the learning process is based on the equilibration of cognitive structures (Piaget & Brown, 1985). The socio-cognitive conflict theory applies when individuals have different responses to the same problem and are motivated to achieve a joint solution. A socio-cognitive conflict can occur, for example, during a social interaction that results from the comparison of different computer programs produced by students to solve the same problem.

Developmental social psychologists have proposed that interindividual conflicts are essential to the stimulation of cognitive development. These socio-cognitive conflicts have proved to be beneficial for learning in different contexts (Buchs, Butera, Mugny, & Darnon, 2004).

Although the socio-cognitive conflict theory has been the subject of many educational research projects on several areas, its use on computer education is unusual. An exception to this trend

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