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DIANA: A computer-supported heterogeneous grouping system for teachers to conduct successful small learning groups

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Abstract

Teachers interested in small-group learning can benefit from using psychological factors to create heterogeneous groups. In this paper we describe a computer-supported grouping system named DIANA that uses genetic algorithms to achieve fairness, equity, flexibility, and easy implementation. Grouping was performed so as to avoid the creation of exceptionally weak groups. We tested DIANA with 66 undergraduate computer science students assigned to groups of three either randomly (10 groups) or using an algorithm reflecting [Sternberg, R. J. (1994). Thinking styles: theory and assessment at the interface between intelligence and personality. In R. J. Sterberg, & P. Ruzgis (Eds.), *Personality and Intelligence* (pp. 169–187). New York: Cambridge University Press.] three thinking styles (12 groups). The results indicate that: (a) the algorithm-determined groups were more capable of completing whatever they were "required to do" at a statistically significant level, (b) both groups were equally capable of solving approximately 80% of what they "chose to do," and (c) the algorithm-determined groups had smaller inter-group variation in performance. Levels of satisfaction with fellow group member attitudes, the cooperative process, and group outcomes were also higher among members of the algorithm-determined groups. Suggestions for applying computer-supported group composition systems are offered.

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1. Introduction

Cooperative learning is recognized as an effective teaching approach that benefits students in terms of achievement, motivation, and social skills (Cohen, 1994a; Johnson & Johnson, 1989; Sharan, 1999; Slavin, 1995). Numerous studies have been conducted on factors that influence cooperative learning success, including intra-group interdependence, group development, task demands, resources, process, and race and ethnicity (Abrami et al., 1995; Cohen, 1994b; Johnson & Johnson, 1994; Kagan, 1994; Sharan & Sharan, 1992; Slavin, 1995).

However, managing cooperative or small-group learning poses challenges for teachers, who often deal with students who lack the requisite social skills or who have problems with social loafing and time management (Johnson & Johnson, 1991). Experienced teachers know that simply putting students together to perform a task does not ensure quality cooperative learning. As Johnson and Johnson (1990) and Slavin (1995) have observed, successful cooperative learning requires positive interdependence, meaningful interaction, individual accountability, collaborative skills training, and appropriate rewards.

Teachers who are committed to cooperative learning must make two important decisions. First, they need to identify specific student characteristics for establishing groups. Suggested characteristics include race, gender, and ability (Cohen & Lotan, 1997; Cordero, DiTomaso, & Farris, 1996; Savicki, Kelley, & Lingenfelter, 1996). Other researchers have reported that psychological features such as self-efficacy (Bandura, 1997) and learning style (Sternberg, 1998) strongly affect group-learning outcomes.

Second, teachers must consider group type – either heterogeneous or homogeneous. According to Dembo (1994), many cooperative and small-group learning researchers believe that heterogeneous groups are more effective in terms of performance and process. In contrast, heterogeneous groups are thought to: (a) provide ample opportunities for students to learn how to interact with different types of classmates, and (b) improve chances of academic success (Cohen, 1994a; Johnson & Johnson, 1994). However, extreme differences among group members can impair cooperation (Webb, 1989).

Teachers who are willing to consider multiple psychological variables to create heterogeneous groups must deal with major computational requirements. To assist them in this task, we designed a computer-supported grouping system called *Differences In And Non-differences Among groups*, or DIANA. The system is the result of a four-year Internet-based cooperative learning project conducted by Sun and Lin (2003) to test various grouping techniques.

2. Literature review

According to the literature on cooperative learning, the majority of teachers use one of three methods to assemble small learning groups:

1. They allow students to form their own groups. However, as Abrami et al. (1995) note, students tend to form teams based on friendship or common interests in a topic, and friendship-based groups generally result in homogeneous groups. While cooperation