A PARTITIONING TECHNIQUE FOR DEFINING INSTRUCTIONAL GROUPS

FRANK B. BAKER
University of Wisconsin, Madison, Wisc., U.S.A.

LAWRENCE J. HUBERT
University of California, Santa Barbara, Calif., U.S.A.

ABSTRACT

A technique is presented for partitioning N students into K groups of fixed sizes using a given measure of proximity for all student pairs. The measure of proximity is typically calculated from a set of variables, such as completed curriculum units or learning style, and constitutes the data needed for a criterion of partition “fit”. This latter index is explicitly defined by the sum of within-group proximities and when used in conjunction with the optimization procedure discussed, homogeneous groups can be obtained that satisfy externally imposed size requirements. Finally, a simple generalization is suggested for the related task of grouping students to meet upper limit size constraints only.

1. Introduction

The need to assign students to different groups for instructional purposes is a perennial problem in education that reoccurs at many different levels of the educational process. For example, schools may be separated according to vocational and college preparatory goals, multiple tracks may be defined within a single school to accommodate students of different abilities, and very specifically, transient groups may be formed within an individual classroom for various instructional purposes. It is not surprising that a considerable literature exists dealing with the educational, sociological, and psychological effects of grouping. In addition, since the practice is not limited to American schools, a substantial international literature on grouping also exists (see Yates, 1966).

Although grouping can be considered at several different levels, our emphasis is on the individual classroom. In the past, say prior to 1960, grouping within the classroom was based primarily on ability, and students were assigned to instructional groups as a function of a single test score or the teacher’s subjective assessment of student competence. More recently, however, the use
of individualized programs of instruction, which allow students to proceed asynchronously through a curriculum, has required the formation of instructional groups on the basis of student accomplishment relative to the curriculum plan. In Individually Guided Education (IGE), for instance, a computer program routinely provides teachers with periodic recommendations as to the most likely groupings of students based upon the pattern of curriculum units completed (Belt and Spuck, 1974). Similar schemes have been developed in a number of other individualized programs of instruction as well (see Talmage, 1975; Weisgerber, 1971).

Despite the extensive interest in classroom grouping, the basis for the creation of such groups is generally ad hoc. Typically, teachers merely scan the list of units completed by the students and form the instructional groups intuitively. Even when a computer is available, very simple counting rules or other such clerical schemes are usually employed. Given the widespread administrative use of computers in public school settings, it is somewhat surprising that more rigorous grouping methods are not already commonplace.

At present, only a limited literature deals with the methodological aspects of defining instructional groups. Most of the available work is very recent and typically uses some cluster analysis technique as the primary grouping strategy. For example, two studies (Rodgers and Linden, 1973; Lawrence, 1976) have compared several different cluster analysis procedures with respect to their usefulness for defining instructional groups. Specifically, Rodgers and Linden (1973) compared three techniques on a data set defined by three scales of an academic self-concept instrument; Lawrence (1976) formed instructional groups by a particular cluster analysis strategy and compared the results with those generated by teachers. Even though cluster analysis appears to be a useful technique for finding groupings within a set of N objects, its possible applications are limited since the more common procedures automatically determine the number of groups and/or their sizes. In short, since teachers may have to exert more control, there is a practical need to develop an analysis procedure that will provide the “best” partitioning of the students subject to the a priori size constraints. The technique described below, referred to as the quadratic assignment (QA) approach, offers one such procedure that is computationally very simple to implement.

2. A Grouping Methodology

Although the QA approach to grouping has its origins in operations research and in the problem of locating manufacturing facilities, a recent paper by Hubert and Schultz (1976) has shown it to be a very general model encompassing a variety of disparate data analysis techniques in nonparametric