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The Effects of Laboratory Group Size on Student Performance*

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A study was made comparing student performance and laboratory group size. Information of this type could be useful in making decisions regarding the amount of laboratory equipment to purchase and the number of laboratory sections to offer. Literature review showed very little directly applicable information and dealt primarily with elementary school class size. Results indicate that students in laboratory groups did consistently better grade-wise than those in groups of three or four. Comparison of the students course grades with their overall grade point averages again showed that the students in groups of two fared better.

INTRODUCTION

DO STUDENTS taking courses that include laboratory work learn more when the laboratory groups are 'small'? This is one of the questions facing administrators when they set out to decide on the amount of laboratory equipment to buy, the number of laboratory sections to offer, and, possibly less directly, how many instructors to hire. To begin to gather information regarding the laboratory group size question, a study was made of the records of engineering technology students at Midwestern State University. These students are required to take several courses that include laboratory experiments, tests or projects. Because of the limited number of workstations, the students work in groups, the group size depending on the number of students enrolled in the class, the number of laboratory sections, and the number of work stations available. This paper presents the results of a comparison of student performance and laboratory group size for two different courses over a period of three years.

INFORMATION IN THE LITERATURE

Along with the work carried out on the Midwestern State University student records, an effort was made to find related previous studies. The papers found dealt primarily with class size rather than group size and, in most cases, with elementary school classes. Questions considered were usually of the type: do students learn more in a small class? Does smaller class size increase the likelihood of positive schooling outcomes? Does instruction improve when teachers work with smaller numbers of students? Are smaller classes more enjoyable places for students and teachers to work?

Cahen *et al.* [1] state that research findings up to that time suggest that smaller seems better in some cases and not in others. Their goal was to shed new light on the issue by going beyond the primary question of whether class size has an effect to the question of how class size influences teaching and learning. They proposed that understanding what changes did and did not occur and the possible reasons associated might help to explain why achievement gains have been found in some studies and not in others. Also, perhaps smaller class practices could somehow be at least partially incorporated into larger classes. Their findings showed that individuals in smaller classes engaged in 'meaningful activity' 75% of the time as compared to 57% for the larger classes; 'waited for help' percentages were 5 for the smaller class versus 9 for the larger classes; and 'off task activity' was 8 versus 12%. Among the observations were that smaller classes made discipline easier, teachers met student needs better and curricula were covered more effectively. Figure 1 shows an achievement/class size relationship given in the paper. The decrease in achievement with increasing class size is significant.

Hallinan and Sorensen [2] discuss work done by others which shows on the one hand that reducing class size alone would not increase pupil achievement, and on the other that sufficient reduction of class size led to mean achievement increases of several percentage points. Their work re-examined the relationship between class size and student academic achievement. Their findings show that the size of instructional groups (made up from the original class) may be more relevant for achievement growth since this group size affects the length of time the student is exposed to instruction. It is

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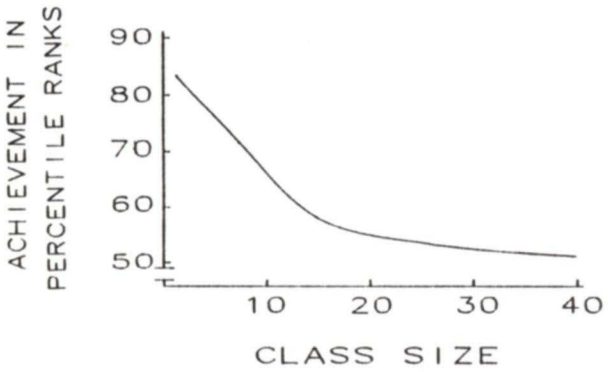

Fig. 1. Glass–Smith curve (from Cahen *et al.* [1]).

interesting to note that a preliminary finding indicating a class size effect was eliminated when 'control' for student race was taken into account.

Mueller *et al.* [3] present the results of their study, which was a follow-up to a pilot project for assessing the effect of class size reduction. The pilot had noted significant increases in reading and mathematical achievement and in attitudes toward self and school. The follow-up found an 8% higher amount of individual attention, a 16% increase in below-average student performance, and a 16% improvement in classroom conduciveness for the smaller class sizes. Using standardized achievement tests, 50% of the schools involved had significantly higher test scores after the program than before.

A presentation concerning a meta-analysis of the relation between class size and achievement is given in McGiverin *et al.* [4]. A 2 year program showed significantly higher achievement in basic skills and more effective learning in smaller classes. Reduction in class size was of the order of 25%.

In an article summarizing research on the effects of class size, Robinson [5] says that the results are mixed and that class size has little impact on achievement of most students in most subjects, above the primary grades. There is also some indication that positive results with smaller classes may not be sustained in subsequent years. One of the situations in which smaller classes positively affected achievement was for economically disadvantaged and ethnic minority students.

Preece [6] presents a theoretical model for the relationship between class size and achievement based on the assumption that teachers adjust their style and pace to the least-able student in the class. The model was tested with data from Glass (referred to by Preece). It was shown that the model and an extension to consider the duration of instruction account well for various features of the collected data. A correlation of 0.62 was obtained between predicted and empirical results. The findings were independent of age and ability of students.

RESULTS OF CURRENT STUDY

It should be restated that the focus in this paper is on a college course situation rather than elementary grades as discussed above. The information was taken from the records of two different courses, each taught once a year for 3 years. Thus, a total of six classes is considered. In each of the courses, there is emphasis on both lecture and laboratory work and the grades earned reflect what the students have learned in both. Although it is difficult to pin down the individual contributions of lecture or laboratory to the final grade, it would appear to be in the vicinity of half lecture/half laboratory. This is about as close as one can come, keeping in mind that concepts presented in lecture aid in understanding laboratory work, and visual observation in the lab plays an important part in solidifying the lecture material.

A total of 76 students are represented in the information presented. The laboratory group size ranged from two to four, depending on the number of workstations, number of laboratory sections and the number of students enrolled. A given laboratory section would usually have groups of two or three students or groups of three or four students. No particular method was used in setting up the groups; sometimes an alphabetical arrangement was used, at other times they were arranged randomly (not in the strict statistical sense).

Figure 2 shows the average final grades for individuals in the three group sizes. Note that the average grade for those in a group size of two is noticeably higher than for three or four. Personal observation indicates that in the two-person groups, both individuals would tend to understand the steps involved before moving ahead. The fact that the grades for those in groups of four is slightly higher than for groups of three might or might not be significant. Again, personal observation of groups of three indicated that some of the time one of the three people would be less involved than the other two and, hence, perhaps getting less from the laboratory—it was as if as soon as two of the three understood, they moved on. What happens with

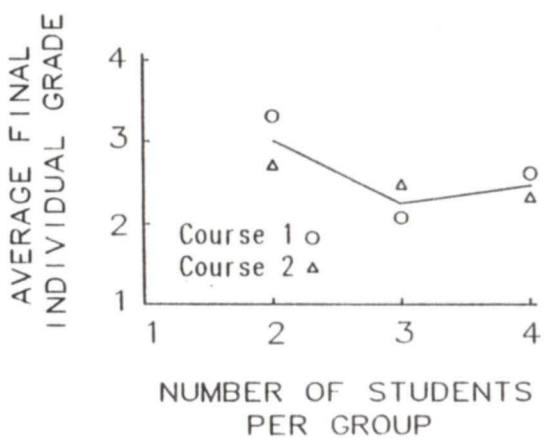

Fig. 2. Effect of group size on individual final grade.

four in the group? If the differences in Figure 2 are significant, it could be that the groups of four unwittingly break into two groups of two, and so we have the 'two-person group' working again.

Another way to look at the results is shown in Table 1. It indicates the percentage of each group size that scored above or below their grade point average. Again, the numbers for groups of two are much more favourable than for three or four. The difference between three and four in this instance is probably not significant.

Table 1. Comparison of individual's course grades in 'group classes with their overall grade point average

	Group size		
	2	3	4
Percentage of students scoring at or above their grade point average	62	29	32
Percentage of students scoring below their grade point average	38	71	68

GENERAL OBSERVATIONS

Tying back to some of the references, Cahen *et al.* say there is a morale drop with increased class size. Perhaps for the current consideration it is not so much a morale drop as a 'slipping past' the steps without understanding what is going on. Cahen *et al.* also say the smaller classes are more 'to the task'. That appears to be true for our groups of two.

Hallinan and Sorensen say that students with strong academic backgrounds are less affected by class size. More information would be needed to assess this for our situation.

Although the amount of data used for this paper is rather small, if one were to act on it, one would need either more teachers or more equipment (or both) to have the smaller group size. Either of these alternatives would cost more money, the primary factor being the expense of a given laboratory workstation. Perhaps the best solution would be to try harder to find why small groups are better, and then incorporate these findings into the larger group situations.

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