

Semestering: Effects on Student Attitudes and Achievement

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In applying the methodology of the Second International Mathematics Study to monitoring of the grade 9 general-level mathematics course, it was possible to compare the performance of students in semestered and non-semestered schools. Statistical comparisons of the performance of students in 16 non-semestered and 17 semestered classes revealed no significant differences in either their attitudes or achievement.

Le recours à la méthodologie de la *Second International Mathematics Study* en vue de faire le suivi du cours de mathématiques général de la 9e année a permis de comparer le rendement des élèves qui fréquentent des écoles disposant ou non de programmes semestriels. Les comparaisons statistiques de la performance des élèves inscrits dans 16 programmes non semestriels et 17 programmes semestriels n'a révélé aucune différence significative quant à leurs attitudes ou à leurs résultats scolaires.

My earlier review of the literature on semestering noted that

Relatively little research has been done and most of the studies are limited to surveys of the opinions of various groups . . . students, teachers, administrators . . . about the purported advantages and disadvantages of different organization plans. No "hard data," for example, have been gathered about the effects of semestering on such important issues as dropout rates, student achievement, accelerated graduation, student and teacher absences or any of the actual dollar costs or savings. (Stennett, 1982, p. 1)

In 1986, Raphael, Wahlstrom, and McLean published an article based on an analysis of data collected for the Second International Study of Mathematics (SIMS) and concluded that, as far as mathematics in grades 12 and 13 is concerned, students in semestered classes achieve significantly less well and do not have more positive attitudes than students in year-long classes. During the 1984–1985 school year, the value of the SIMS methodology as a program-monitoring vehicle (Stennett & Rachar, 1985) was tested by applying it to an assessment of the grade 9 general-level mathematics program. Since subjects were about equally divided between semestered and non-semestered schools, it was possible to answer the questions raised by Raphael and his colleagues.

This paper reviews the results of our program-monitoring study to assess the impact of semestering on students' attitudes and achievement.

METHOD

All of the study's data collection and measuring instruments were either developed locally or adapted from those used in the SIMS study.

Subjects

The subjects for this study were all 659 students enrolled in the grade 9 general-level mathematics program in late May of 1985 and the 27 teachers who taught them. The students attended 10 different secondary schools in 33 different classes ranging in size from 5 to 26 and averaging 20 students per class. Six of the teachers taught two classes each. The subjects, therefore, included all the students and teachers involved in the grade 9 general-level mathematics program during the 1984–1985 academic year except those students in semestered schools who took the course in the first semester and, of course, their teachers. About half of the students, 17 of 33 classes, attended semestered schools.

Students

Data for students came from four sources: a locally developed, 60-item, multiple-choice achievement test; a questionnaire that included 18 attitude items used in the SIMS study, 9 locally developed attitude or information items, and 4 items in which students were asked to rate their ability or achievement; grade 7 intelligence and achievement test scores obtained for about half of the students from historical system-wide testing computer files; and final marks and absence records obtained as a by-product of the computerized mark-reporting process operated by the secondary schools.

Teachers

Data about teachers came from a single three-part questionnaire. The first part asked the teacher, for each of the 60 items on the student achievement test, first, to estimate the percentage of students in the class who would answer the item correctly; second, to indicate whether they had taught or reviewed the material relevant to the item before the students were tested; and, finally, if the material had not been taught, to indicate whether they would teach it before the end of the course. The second part of the questionnaire asked the teachers about their teaching experience and

certification and the texts, materials, and instructional aids they employed. The final part of the questionnaire asked the teachers to answer various questions about their use of instructional time, out-of-class time, and homework assignments, and their opinions about the ability and prior preparation of the students and the relative importance of several factors which might account for lack of satisfactory student progress. It also solicited teachers' ideas for program improvement.

Achievement test development

The 60-item achievement test was developed locally with the assistance and advice of the Measurement and Evaluation Department.¹ This test was based on a document entitled *City General Grade 9 Core 1982-83* (Rachar, 1983) which, by agreement of the mathematics heads, forms the basis of the grade 9 general-level mathematics program. An initial version of the test was administered to three classes of grade 9 mathematics students who were enrolled in the London Separate School system.² Analysis of the resulting data led to modification of 2 of the 60 original items.

The revised test produced a mean raw score of 27.08, with a standard deviation of 7.06. The raw scores ranged from 9 to 50 and were distributed normally about the mean. The KR-20 estimate of test reliability is 0.76, and the standard error of measurement is 3.39. The average percentage correct score for 586 students was 45.04, and the item difficulties ranged from .13 to .83.

Data collection and analysis

The student attitude and achievement tests were administered to the students by their own teachers during two successive mathematics periods in the last week of May, 1985. The attitude test was always administered first. Students were not allowed to use calculators when doing the achievement test. Teachers completed their own questionnaires during the same week.

All of the data from all sources were coded and keyed to produce two computer files, one for teachers and one for students. Selected information from each teacher was then added to the file of each student that the teacher had taught. Then, using this augmented student file, a number of additional or summary score variables were created. For example, an achievement test score was calculated for each student based on the percentage of right answers on those items that were taught. In addition, since many of the attitudinal items could be grouped to form short scales, summary or total scores for each such scale were calculated and added to the student file.³

All the file manipulation and data analyses were done by computer using

TABLE 1
Comparison of Semestered and Non-Semestered Teachers and Classes

<i>Variable</i>	<i>Semestered</i>	<i>Non-semestered</i>	<i>t</i>	<i>p</i>
Total years teachers taught	15.7	14.1	-.73	ns
Total years teachers taught mathematics	10.7	12.5	.80	ns
Total years teachers taught grade 9 mathematics	5.2	7.4	1.67	.11
Percentage of achievement items covered at time of testing	74.4	82.9	3.51	.001
Class size	20.6	19.8	-.57	ns

TABLE 2
Comparison of Students in Semestered and Non-Semestered Class in Terms of Program-Entry Characteristics

<i>Variable</i>	<i>Semestered</i>	<i>Non-semestered</i>	<i>t</i>	<i>p</i>
Proportion of girls	.49	.47	-.45	ns
Grade 7 standardized test scores				
Math computation	53.3	53.9	.65	ns
Math problem solving	54.6	54.3	-.33	ns
Reading comprehension	53.8	54.5	.78	ns
Intelligence (IQ)	99.9	99.9	-.02	ns

TABLE 3
*Comparison of Students in Semestered and Non-Semestered Classes in Terms of
 Attitude and Achievement Outcome Measures*

<i>Variable</i>	<i>Semestered</i>	<i>Non-Semestered</i>	<i>Univariate F-ratio (1,31)</i>
Achievement test score			
unadjusted	44.81	44.61	<1
adjusted	48.74	47.73	<1
Final mark	58.83	58.37	<1
Attitude scales			
Importance & relevance of math	10.69	10.54	<1
Liking & enjoyment of math	13.49	13.58	<1
Math self-concept	12.85	13.18	<1
Math anxiety	7.84	7.99	<1
Linking the Grade 9 course	2.50	2.47	<1
Intentions for math education	2.42	2.25	1.976

programs contained in SPSSX, release 2.0. The primary analyses consisted of compiling frequency distributions, calculating correlations among all variables, and comparing the class means of key variables for classes in the semestered and non-semestered schools using univariate *F* tests.

RESULTS

Most of the results are presented in terms of comparisons between teachers, classes, or students in semestered (S) and non-semestered (NS) schools. When teachers or classes are being compared, the number of cases is 16 for NS schools and 17 for S schools. When students are being compared, the number of cases is 309 for NS schools and 350 for S schools. Since the data are not complete for all variables for all students, the number of cases for some comparisons is slightly fewer. Because not all of the grade 9 students came from London public elementary schools, grade 7 standardized ability and achievement measures were available for only about half of the students.

Comparisons of teachers and classes

Table 1 gives the mean values and *t*-test results for several comparisons of teachers and classes in semestered and non-semestered schools. As these data indicate, there are no statistically significant differences in the teaching backgrounds of teachers in S and NS schools. The average size of classes is also comparable across school types. However, as anticipated, teachers in the

NS schools had taught significantly more of the course, about 8.5% more, at the time students were given the 60-item achievement test.

Comparisons of students on entry-level characteristics

Table 2 gives the mean values and *t*-test results for several comparisons of entry-level characteristics of students in S and NS classes. As these data indicate, the sex distribution, prior achievement, and intellectual ability of students attending S and NS schools are very similar. Thus, any differences between S and NS students' achievement in the grade 9 general-level course cannot be attributed to initial achievement or ability differences.

Comparisons of student groups on attitude and achievement outcomes

Table 3 gives the mean values and univariate *F* test results for comparisons of S and NS students on several achievement and attitude outcome measures. Since the class was used as the unit of analysis, the figures in this table are the means of the class means. Although a hierarchical design would be most appropriate for this analysis, the differing numbers of students within classes, classes within schools, and schools within semestering made this impossible. The best solution, therefore, appeared to be a univariate *F* test on the class means. As these data indicate, the two groups of students do not differ significantly in terms of their achievement, whether assessed by achievement test or teachers' final marks.⁴ The very slight difference in achievement test scores is accentuated a bit by correcting the achievement test score so that it includes only material taught. The enhanced difference between S and NS students, however, is still not statistically significant.

There were no statistically significant differences between S and NS students on any of the six attitudes measured.

Students in semestered classes performed as well as students in year-long classes on the 60-item achievement test despite the fact that, at time of testing, they had had about 10% less instruction. This finding suggests that the achievement test used may not be very sensitive to instructional effects even though it correlates .55 with teachers' final marks.

CONCLUSIONS

Although the results of this study parallel those of Raphael's et al. (1986) on student attitude outcomes, they are not consistent with the conclusion that students in semestered classes achieve less well than those in year-long classes. These inconsistent findings about achievement could be explained by various factors. While we believe the critical factor is differences in the

amount of curriculum covered at the time of testing, it is possible that differences in the populations, the particular courses and grade levels studied, or the ways in which semestering is administered in different jurisdictions could account for inconsistency. Unfortunately, neither the study by Raphael et al. nor this one were designed specifically to investigate the issue of semestering. As in the case of all research findings derived from a single jurisdiction, one should be very cautious about generalizing the findings of this study either to other jurisdictions or the provincial level or to other grades, school subjects, or levels of difficulty. However, we believe that the conflicting findings and methodological limitations of the studies lead to the conclusion that the true impact of semestering on student attitudes and achievements is not yet established.

NOTES

- ¹ The author would like to thank J. R. Bramwell and R. Guthrie for their help in developing and piloting this test and the subsequent analysis and machine scoring of the final version administered to all students.
- ² The author would like to thank Mr. Michael Elsie, Head of Mathematics at Catholic Central Secondary School, and his colleagues for their help with this pilot study.
- ³ In the interest of brevity, the factor analytic work done to develop such scales will not be reported in this paper. However, the detailed results of these analyses may be obtained from the author.
- ⁴ A more powerful test, using students as the unit of analysis, produced the same results.

REFERENCES

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Die Anwendung der Methodologie der 2. Internationalen Mathematik-Studie auf die Aufgabe, den durchschnittlichen Mathematikkurs für die 9. Klasse zu überprüfen, ermöglichte einen gleichzeitigen Vergleich der Leistungen von Schülern in Schulen mit und ohne Semestereinteilung. Statistische Vergleiche von Schülerleistungen in 16 nicht-semestrigen und 17 semestrigen Klassen ergab keine bedeutenden Unterschiede weder in ihrer Einstellung noch in ihrer Leistung.

La aplicación de la metodología usada en el Segundo Estudio Internacional de Matemáticas al control del curso general de matemáticas del 9o grado ofreció una

oportunidad para comparar el desempeño de estudiantes en escuelas organizadas en semestres y escuelas que no lo están. Las comparaciones estadísticas del logro de estudiantes en 16 clases no semestrales y 17 clases organizadas en semestres no revelaron diferencias significativas ni en sus actitudes ni en su desempeño.

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