The Leading Group Effect:


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In the present study, we examine whether the Z scores (hensachi) obtained from a typical group size of Japanese junior high schools with six classes each year-grade, about 200 pupils in total, properly show the scholastic achievements of pupils as expected.

Method

We obtained all the Z scores of term examinations conducted during the academic years of 1998-2009 at a junior high school in a suburb of Nagano city. The socio-economic status of families of the school pupils varied within a narrow middle-class range.

We used the scores from the four term exams for the present study; the first mid-term exam at the first year, and the three year-end exams for 1-3 years. Each term examination consisted of a set of achievement tests in the five major school subjects, Japanese language, social studies, mathematics, natural sciences, and English. The five test scores were summed up into a total score and then converted into a Z score.

We obtained data from nine cohorts of pupils of 1998-2009, each cohort consisted of about 200 pupils, 1,962 in total. In each cohort, we split pupils into four quarters according to their Z scores of the first mid-term examination by dividing at the three quartiles; 0-25 (U25), 26-50 (U50), 51-75 (U75), and 76-100 percentiles (U100). Considerable number of pupils failed to take the following examinations owing to several reasons. We omitted all these incomplete data. The number of complete data was 1,780 in total.

Results and discussion

The results are shown in Figure 1. We conducted a three-way ANOVA with the four quartile levels, gender, and examination periods. The average Z scores were proved to be stable: the main effect of examination periods was not significant ($F = .95, ns$).

However, the Z scores of the two middle-range groups, and those of the lowest groups fluctuated significantly over the three school years: interactions of quartile groups by examination periods were significant ($F = 22.41, p < .01$). A post hoc interaction analysis showed that the average scores of the two middle-range pupils (U50 and U75) declined significantly from the first mid-term exam to the later exams by 1.49 point for U50 and by 1.29 point for U75 ($MSe = 10.37, LSD = .43, p < .05$).

On the contrary, the average scores of the lowest group (U25) improved gradually and significantly. As for the average scores of the highest group, although they were significant, the differences were within a relatively small range and not consistent.

The main effects of gender and the interaction of gender by exam period were also found to be significant ($F = 8.72, p < .01$ for the main effect and $F = 25.47, p < .01$ for the interaction). However, we do not discuss it here.

We examined the distribution of Z scores in the four examination periods (See Fig. 2). As can easily be seen, the distribution was left-skewed for the first term examination, and became less skewed later. If the distribution of Z scores is left-skewed, as was that of the first mid-term examination of the present study, mid-range pupils get superficially higher scores. We dubbed this the Leading Group Effect.

The Z scores (hensachi) are widely believed by schoolteachers, pupils, and their parents that they properly reflect the relative ranks within their peers. Therefore, if their Z scores decline, they may think their scholastic performances should have been somewhat deteriorated. In the present study, we found that average Z scores of middle-range pupils showed an illusionary decline caused by the left-skewedness of the distributions of test scores. Though the magnitude of declines was as small as 1.5 point or so, it may affect the motivation of almost half of pupils with middle-range scores. Schoolteachers should recognize this illusionary statistical phenomenon and explain it to pupils appropriately so that they should not be discouraged by the illusionary decline.

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