

17. Analytical Study on Changes in Academic Performance and Attitudes
in School Mathematics over 16 Years

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(1) Purpose and Aim of Study

This study employs the data on elementary, lower secondary, and upper secondary schools from the Long Term Tracking Study on Science and Mathematics (annual carry-over survey from the fifth-year of elementary school to the third-year of upper secondary school, and surveys at two, six, and ten years after graduation from upper secondary school) and the Fixed-Point Study on Science and Mathematics (tri-annual surveys of the fifth-year of elementary school, second-year of lower secondary school, and second-year of upper secondary school, and surveys two and six years after graduation from upper secondary school) collected over the 16 years from the instigation of the studies in fiscal 1989 through to fiscal 2004. It examines how specific schoolchildren change over the course of their elementary, lower secondary, and upper secondary school education and what changes take place across different generations, in order to evaluate past and present school curricula, teaching methods, and other matters, and to produce basic resources for use in mathematics education into the future.

The study targeted public elementary, lower secondary, and upper secondary schools from one particular region in five different prefectures. This is the only study on mathematics education that has employed the same survey forms over a long period in multiple prefectures and traced the same individual schoolchildren throughout.

The following concrete goals were set for the study.

- A. To collate and tabulate a total of 16 years of data from the Long-Term Tracking Study on Science and Mathematics and the Fixed-Point Study on Science and Mathematics.
- B. To create graphical representations of the tracking data.
- C. To use the tables and graphs to analyze the tracking data and overall data, and thereby identify the distinctive features of change in specific schoolchildren and between different generations.

(2) Outline of Research Results

- Collation and graphical rendering of 16 years of tracking data

Tabulated reaction rates for each year level and produced graphs to make changes more easily identifiable for each of the seven groups targeted in the studies: three in the Long-Term Tracking Study on Science and Mathematics (Group 1: second-year of upper secondary school in fiscal 1989; Group 2: second-year of lower secondary school in fiscal 1989; Group 3: fifth-year of elementary school in fiscal 1989) and four in the Fixed-Point Study on Science and Mathematics (Group A: second-year of lower secondary school in fiscal 1995; Group B: fifth-year of elementary school in fiscal 1996; Group C: fifth-year of elementary school in fiscal 2000; Group D: fifth-year of elementary school in fiscal 2004).

- Collection of related materials and opinions

Solicited opinions from individuals outside the research team concerning the results of specific problems and questions and how to interpret them, enabling the results to be interpreted from a broader perspective.

- Analysis of changes in specific schoolchildren and changes across different generations

Some of the distinctive points emerging from the 16-year research are described below.

1. There was astonishingly little change in average correct response rates to mathematics questions across different generations, societal conditions, and curricula.
2. Analysis of correct response rates in each mathematics question revealed that changes in response rates were within a 5% range for almost all questions, but changes of 10% or more were recorded for some questions on topics such as complex number calculations and cubical scission. This is thought to be attributable to curricular revisions.
3. A growing number of schoolchildren do not read carefully. There has been a dramatic increase in the number of children choosing two or more responses to multiple-choice questions that contain the word "two."

4. For most questions, correct response rates rose in line with the school year level of the respondents, but there were some questions that respondents answered correctly in the fifth-year of elementary school but incorrectly by the time they reached the third-year of upper secondary school.
5. Most students taking Mathematics B in upper secondary school were found to have achieved high scores in elementary school in the past. However, whether or not respondents were taking Mathematics B did not affect their attitudes to school and society as expressed through statements such as “it is important to get a good education at school,” “you will succeed if you try hard,” and “success is a matter of luck.”
6. Many changes occur in levels of enjoyment of mathematics over the course of elementary, lower secondary, and upper secondary school. Enjoyment is more susceptible to change in mathematics than in other subjects. There are thought to be many factors involved here, including changes in year levels and schools, study content, and teachers. It is important for teachers to keep in mind the fact that students’ attitudes are susceptible to change, and to use various different approaches in class routinely.