A New Strategy for STEM Learning in a Changing Society: Focusing on the Undergraduate Program

Chapter 1

Characteristics of *Rikei* Students (Science & Technology Majors) in Japanese Universities Indicated by Statistical Anaysis

By

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INTRODUCTION

✓ The Japanese have had ample reason to believe that the quality of *Rikei* education would be well sustained；The outcome of *Rikei* programs in Japanese universities, especially those for science and technology, had been considered "world class."

✓ However, in the middle of the 1990s, industry began to question the quality of the graduates.

✓ At present, almost all university professors agree that the level of STEM learning in higher education is declining.

✓ In this study we shed light on the reality of student life and the students' attitudes via analysis of statistical data obtained through institutional research (IR) conducted in cooperation with 56 universities.

DATA BASE

✓ Statistical data were obtained from the University IR Consortium.

✓ In this report, we call the original four IR members Universities A, B, C, and D.

✓ For the purpose of taking a closer look at the real features of *Rikei* students in comparison with *Bunkei* ones, we focus attention on the results obtained by University D, a traditional, national university in the northern part of Japan.

METHODS

- ✓ To investigate the difference between *Rikei* and *Bunkei* students, we conducted factor analysis of 19 questionnaire items about the first- and third-year students self-assessments of the abilities acquired in their university life.

- ✓ For the freshmen, three components (*a*, *b*, *c*) were found to be principal components with each eigenvalue having a value of one or more. For the juniors, four components (*A*, *B*, *C*, *D*) were principal components.

Components *A*, *B*, *C*, and *D* are tentatively called in this report:

 A: Communication Skills (CS)

 B: Adaptability to International Environment (AIE)

 C: Academic Skills (AS)

 D: Mathematical Ability (MA)

STUDENT LIFE

✓ It is well known that *Rikei* students have busy daily lives.

✓ On average, one student attends two classes and one experimental or practical training session per day. One class usually takes 90 minutes and one class lecture per week is counted as two credits in a semester and one experimental or practical training session as half of a lecture class. It follows that the total number of credits per semester ranges from 20 to 25 depending on the student's choices.

✓ Considering the fact that the credit number necessary for a bachelor's degree is 124, it seems that there are too many subjects in the third year of undergraduate programs: a student obtains as many as 40-50 credits a year according to the curriculum.

STUDY HOURS

✓ The *University Establishment Law* requires one lecture hour plus two study hours outside of the class for one credit.

✓ It turned out in this study that *Rikei* students spent 9.2 hours a week outside of the classes for credit, about two hours longer than *Bunkei* ones, suggesting that the reputation of *Rikei* students as hard-working ones is worth believing.

✓ In short, *Rikei* students spend a longer period of time attending class and doing lab work and for their own free study; one hour and two hours longer a week, respectively. On the other hand, they tend to spend less time on part-time jobs outside of the campus and show less interest in reading books of general interest.

FACROR ANALYSIS

✓ Factor analysis was made on 19 questions about what the students gained after entering the university. In the histograms of the third-year students of University D, *Rikei* students were distinguishable from *Bunkei* students by their pattern.
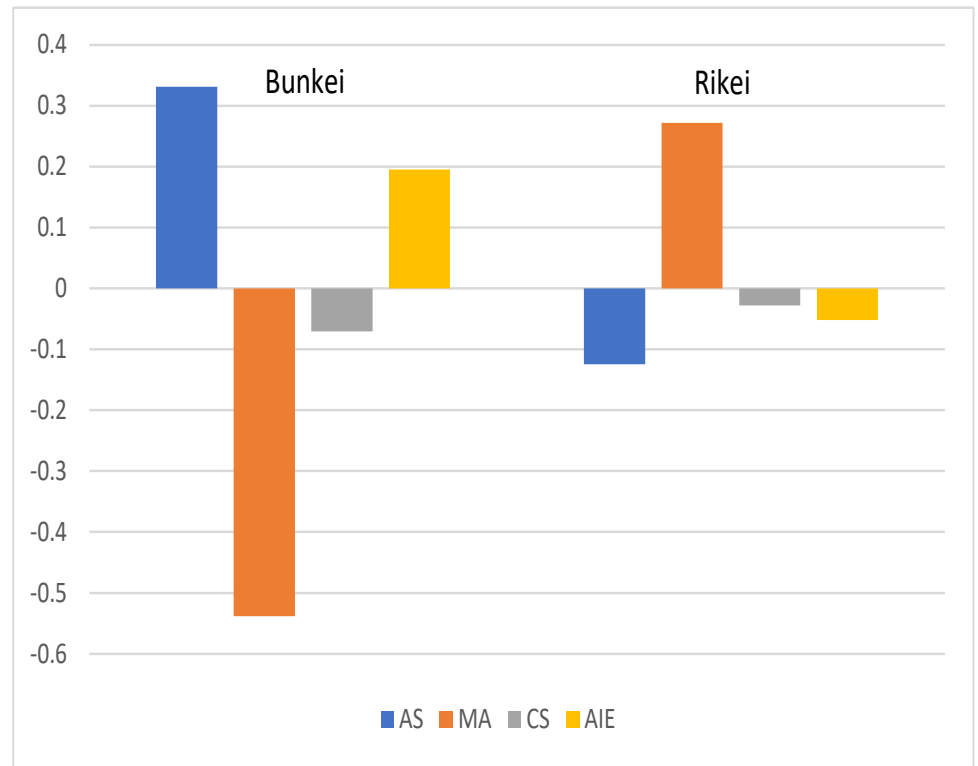
✓ *Rikei* students self-judged themselves to have developed solely on *MA,* but expressed no clear confidence in other factors. In contrast, *Bunkei* students had much more confidence about *AS* and a little about *AIE*, although they feel a considerable drop in *MA*.

FROM ELITE TO POST-ELITE

✓ When the new higher education system began in 1949, Japanese universities were in the elitist stage.

✓ According to some evidence, the elite nature of *Rikei* students was lost in the 1980s, probably because of the expansion of the universities and changes in the society.

✓ Despite all these changes, the departments have never changed the traditional way of undergraduate training. They are seemingly successful in retaining a hard-working attitude, but a closer look at the inside of the departments reveals many conflicts in classes and laboratories.

✓ The knowledge or skills are separated and fragmented in their minds, a problem we must consider seriously.

WHAT IS THE POINT?

✓ Because of the mismatch of the German research ideal and the present Japanese system, the course work is suppressed in terms of not only the hours of study but also the weight in the curriculum.

✓ It is time to reposition the research work in the undergraduate programs and to decide whether research work should be included in these programs or not.

✓ Eeach department should organize the course work so that students can more easily learn the contents and meaning, with (1) reasonable subject distribution in the curriculum, (2) more teaching and learning support, (3) modularization of the classes, and (4) introduction of a quality assurance system.

CONCLUSIONS

✓ Engineering and technology are the main stream of STEM education in Japanese higher education, but, the importance of arts and humanities are forgotten. STE<u>A</u>M nature, such as
     interface between human and science,
     "Problem-solving skill" as an essential part of the programs,
     and comprehensive understanding of each discipline,
 should be emphasized.

✓ We are now living in an exciting era of science and technology. In the university curriculum, the introductory part, at least, of sciences and technologies should be integrated.

✓ The world of science and technology is intrinsically one world in which everybody, regardless of age, sex, race, and nationality, can communicate with each other and enjoy its fruits.

Thank you for your attention!

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