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Some subjects made clear by the study of modelling, on the school mathematics in Japan

Author conducted "Scatter of Data" investigation for mathematics teachers in Japan. Almost all teachers resulted in not understanding statistical modelling. Author want to get them to recognize the importance of modelling using this opportunity. But, the present condition on the mathematics education in Japan is imbalanced between "mathematical academic ability" and "the ability utilizing mathematics. Author conducted two kind skill tests for university students. Many students have resulted in not achieving standard line and have head scratcher.

1. The object of study, and one traditional usage in Japan

The purpose of research is to build the curriculum of effective mathematical modeling in university and school education. To aim children's learning effect,

(1) A teacher must deal with the solution method of the natural phenomenon or daily life by the method suitable for children's capability.

(2) Teachers should recognize children's challenge and must support them.

(3) But first, themself such as teachers must learn the method of modeling very well and must learn the skill enough.

Students want answer immediately. But, many teachers are too busy to guide some students. Instead of teachers, students should just read the polite answer book. The appearance of these exercise books looks like serving a dual purpose. But, this support seems to have lost students' mental capacity and discussion opportunity. Many teachers had been also indulged by this support when they were still students. And, they didn't study mathematical modelling at either school or university.

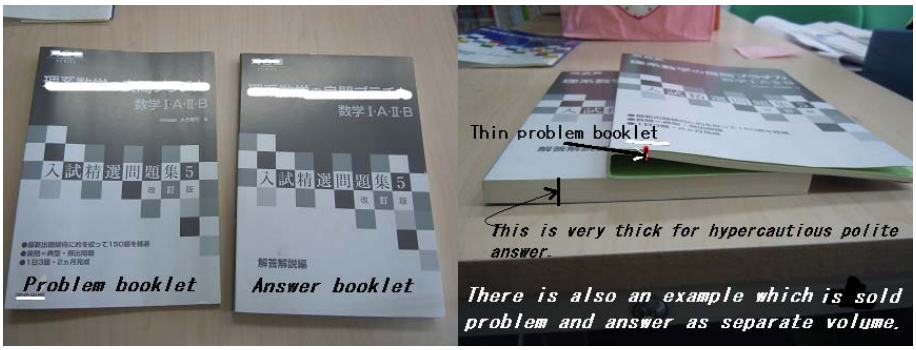
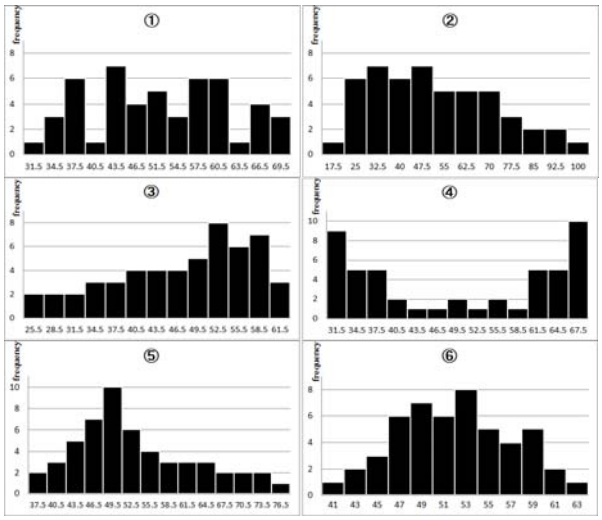


Photo.1 An example of problem booklets in JAPAN

2. Simple modelling experience to high school teachers; "*What is mathematical modelling?*"

Luckily this year, statistics will revive to high school mathematics for the first time in about twenty years. Because teachers have sense of crisis for statistics, I succeeded in teachers' modeling experience.

Check "amount of statistics" and "histogram"



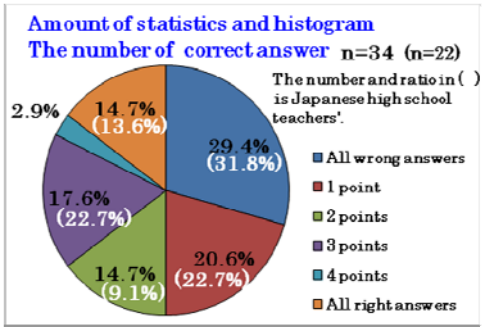
Data group	Average	Median	Standard deviation	Histogram No.
A	50	50	10	
B	50	50	15	
C	53	50	10	
D	53	50	20	
E	47	50	10	
F	50	50	5	

This is the modeling which makes a graph from numerical data.

This will be connected with F-test and t-test.

Fig.1 Summary statistic and histogram (cf. Meletiou, M ., & Lee, C., 2003)

This is Statistical Modeling. Many high school teachers could not make models (Graph. 1). The scales seemed to fall from teachers' eyes. Probably, they will be to understand a little meaning of mathematical modelling.

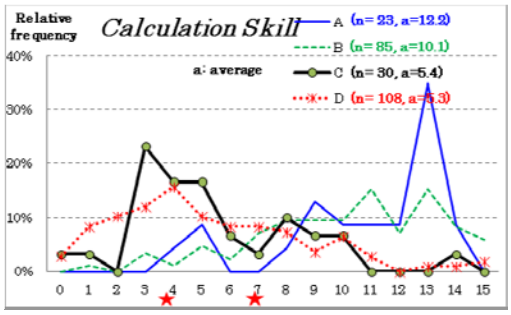


Graph.1 The result of this modelling exercise

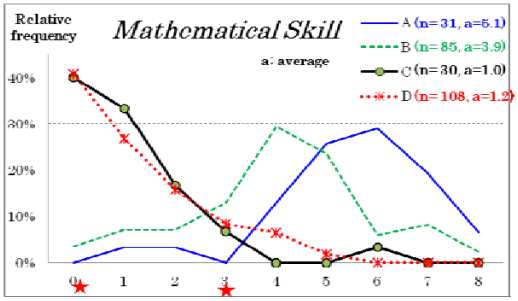
3. Discussion for major difficulties; "*Which comes first, the chicken or the egg?* "

Children need mathematical modelling training at early stages of their growth, such as during elementary school (cf. Blum & Ließ, 2007). Mathematical modelling training needs at early stages of students' growth. But because university education and students taking teacher-training courses have major difficulties in mathematics, proper human resources may be unable to be given to the field of school education. I measured the students' academic ability. One is calculation skill problem, and another is

mathematical skill problems. These levels are elementary school employment examination level and it is a tenth grade student completion level. " , " lines are private university (teacher training course) students datas (Graph.2, 3). Other lines are national universities. Clearly, the national universities students are excellent. In Japan, since the number of the elementary school teacher is insufficient, many university students are employed. A red star mark "★" is the score of college seniors adopted as the elementary school teachers this spring. If other scores are high even if a mathematics score is low, they will pass examination.



Graph.2 Academic ability university-by-university comparison (Caluculation Skill, October, 2011)

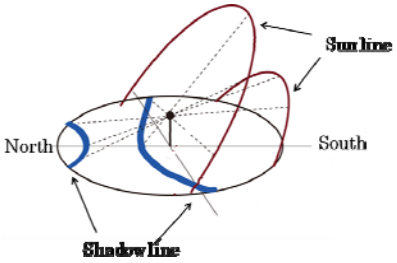


Graph.3 Academic ability university-by-university comparison (Mathematical Skill, October, 2011)

Probably, the academic mathematics ability of elementary school teachers will also expect a similar result. However, the mathematical modeling must use mathematics. Elementary school teachers will not be able to practice mathematical modelling if their mathematical academic ability is low.

Another trouble is students' daily experience unsolvable in only mathematics. For example, "A shadow becomes extended at the time of sunrise or sunset". Such a phenomenon does not seem to be their common sense (Table.1). These are the shadow motions of the summer and winter solstice, spring and autumn equinox. These motions are the hyperbola models. This graph's data is concentric circles with the constant length of

shadows (Table.2). It seems that students have an image with which winter's shadow is extended rather than summer.



Pattern	Summer solstice	Equinox	Winter solstice
University : n=79 Highschool : n=102 Elementary : n=37			
University students	25.3%	3.8%	8.9%
High school students	20.6%	5.9%	2.0%
Elementary students	32.4%	16.2%	13.5%

Table.1 Accuracy rate (February, 2012)

Pattern	Summer solstice (Winter solstice)	Spring equinox Autumnal equinox	Winter solstice (Summer solstice)
University : n=79 Highschool : n=102 Elementary : n=37	大円	中円	小円
University students	12.7%	17.7%	16.5%
High school students	12.7%	19.6%	14.7%
Elementary students	21.6%	18.9%	16.2%

Table.2 Wrong recognition of daily life by students (February, 2012)

Their confusion are two, "(1) Length of a radius ＝ Length of a shadow, and (2) Length of an arc ＝ Daylight hours".

Probably the recognition of many teachers may be wrong, too. Changing their recognition is above everything else, then it is necessary for teachers to change the recognition of students afterwards. Much time will need the work.

4. Conclusion and future subjects

Mere imitation form of mathematical modeling will be troubled. It is dangerous to finish with "feeling and mood of modelling-practice". I hope that university students will recognize the importance of academic ability through mathematical modelling. Such teaching materials in university education should be developed as speedily as possible.

5. Literatur

Blum, W., & Leiß, D. (2007). How do students and teachers deal with modelling problems? In C. Haines, P. Galbraith, W. Blum, & S. Khan (Eds.), Mathematical modelling (ICTMA12) (pp. 222-231). Chichester, UK: Horwood.

Meletiou, M ., & Lee, C. (2003): “Studying the Evolution of Student’ Conceptions Of Variation Using the Transformative and Conjecture-Driven Research Design,” in Reasoning About Variability: A Collection of Current Research Studies, ed. C. Lee, Mt. Pleasant, MI: Central Michigan University.