CURRICULUM DEVELOPMENT IN THE TEACHING OF MATHEMATICAL PROOF AT THE SECONDARY SCHOOLS IN JAPAN

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Aim and key questions of the Workshop

In the workshop, we aim to share a theoretical framework as well as some issues on the teaching of mathematical proof throughout six years (grade 7-12) of secondary schooling in Japan. The difficulties faced by students in learning mathematical proof are well-known (e.g., Reid & Knipping, 2010). Although the present research project is targeting Japanese mathematics curriculum, in developing a framework we attempt to synthesize multiple theoretical perspectives well known within the international mathematics education community in order to enable the framework to be comparable with those in other countries. Key questions in the workshop are as follows: (1) What kinds of teaching contents should be included in the secondary curriculum for the teaching of mathematical proof? (2) What kinds of evolution should be envisioned in the course of the curriculum? (3) How can we allow comparing different curriculums of the teaching of mathematical proof with different countries in terms of our proposed framework?

Planned structure:

The workshop in ICME13 will meet once with 90 minutes working time. At the beginning of the time, we first introduce our research project and theoretical perspective by using the projector or poster. In this introduction, we consider the first and second key questions mentioned above. Then we would like participants divide into three small topic groups, depending on their interests. Each contributor will take part in each topic group such as theoretical framework, teaching materials [A] and [B]. The following table is a tentative timetable that we anticipate.

Planned timeline	Topic	Material / Working format / Presenter
16:30-16:50 (40 minutes)	Overview of the research project	Opening session by using electric display / All participants / T. Mizoguchi
	Introduction of each topic	T. Miyakawa, T. Mizoguchi, & Y. Shinno
16:50-17:00 (10 minutes)	Discussion: questions and comments from participants	

17:00-17:50 (30 minutes)	Topic group activities:	Interactive sessions by using electric display, poster, teaching materials (algebraic and geometric contents) / Group activities /
	(1) Theoretical framework	T. Miyakawa, K. Otaki, & H. Iwasaki
	(2) Teaching materials [A]	T. Mizogushi & Y. Suginomoto
	(3) Teaching materials [B]	Y. Shinno, H. Hamanaka, & S. Kunimune
17:50-18:00 (10 minutes)	Summarizing: reflections and further considerations	Closing session by using electric display / All participants / T. Miyakawa, T. Mizoguchi, & Y. Shinno

The following table shows our framework for curriculum development in the teaching of mathematical proof (Shinno et al., 2015). Although we do not explain this framework in details here, in the workshop we will make a presentation about this framework with teaching materials relevant to secondary school level, and also we are welcome some critical comments or questions from international participants.

	Statement	***Proof***	***Theory***
Contents	a. Singular proposition b. Universal proposition c. Existential proposition d. Others	a. Direct proof b. Indirect proof c. Mathematical induction	a. Normal theory (e.g., algebra, geometry, calculus, etc.) b. Meta-theory (e.g., modus ponens, etc.)
Levels	**Object** i. An object in the real world ii. An objects in the mathematical world **Formulation** i. Drawings, diagrams, manipulation, gesture ii. Ordinary language, words iii. Mathematical words, symbols	**Validation** i. Explanation ii. Mathematical proof iii. Formal proof **Formulation** i. Drawings, diagrams, manipulation, gesture ii. Ordinary language, words iii. Mathematical words, symbols	**Nature of system** i. Logic of the real world ii. Local theory iii. Axiomatic theory

References

Reid, D. A. & Knipping, C. (2010). *Proof in mathematics education*. Rotterdam, The Netherlands: Sense Publishers.

Shinno, Y., Miyakawa, T., Iwasaki, H., Kunimune, S., Mizoguchi, T., Ishii, T., & Abe, Y. (2015). A theoretical framework for curriculum development in the teaching of mathematical proof at the secondary school level, In Beswick, K., Muir, T., & Wells, J. (Eds.). *Proceedings of the 39th Conference of the International Group for the Psychology of Mathematics Education*. *Vol. 4*, 169-176, Hobart, Australia: PME. Note

Acknowledgement

This project is supported by the Grant-in-Aid for Scientific Research (No. 15H03501), Ministry of Education, Culture, Sports, Science and Technology – Japan.