

## **TSG 29: The Pre-service Mathematical Education of Teacher**

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### **Introduction**

TSG 29 concerned pre-service mathematical education of elementary and secondary teachers. We discussed basic definitions and the underlying preparation to become qualified teachers. We refer to both mathematical content and to knowledge that acts as the integral part of mathematics teacher education.

Five issues were proposed:

1. a comparison of mathematical content or curriculum of pre-service mathematics education in different countries;
2. the kinds of mathematical content and knowledge that could be presented to pre-service teachers, and the mathematical qualifications and expectations needed to teach;
3. the relationship between the kind of mathematical knowledge and the role of mathematical experiences of pre-service primary and secondary mathematics teachers;
4. the impact and effectiveness of pre-service mathematical education on pre-service primary and secondary mathematics teachers;
5. innovative and creative approaches to developing mathematical content knowledge of pre-service mathematics teachers

We received 13 papers. After peer-reviewing, nine papers were accepted for presentation:

1. Chap Sam Lim (Malaysia): A Comparison of Pre-Service Mathematics Teacher Education between Malaysia and China
2. Sandy Dawson (USA): A hybrid model for mathematics teacher education: Face to face and at a distance
3. Sergei Abramovich and Peter Brouwer (USA): Exploring hidden context of pre-service teachers' intuitive ideas in mathematics
4. Xin Ma, Richard Millmann and Matt Wells (USA): Infusing assessment into mathematics content courses for pre-service elementary school teachers
5. Nathalie Sayac (France): Study of the Practices of educators in Mathematics, on Pre-service Teachers Training
6. Heidi Krywacki-Vanio (Finland): Pre-service mathematics teacher education orienting the formation of teacher identity- mathematical education as the basis for development
7. Jérôme Proulx & Nadine Bednarz, (Canada): The mathematical preparation of secondary mathematics school teachers: Critiques, difficulties and future directions
8. Marta Molina, Jose Luis Lupiáñez, Isidoro Segovia, Pablo Flores and Paco Ruiz (Spain): Mathematics for prospective primary teachers : A pilot experience for adapting to the European Higher Education Area
9. Pedro Gómez, María José González, Luis Rico, Francisco Gil, José Luis Lupiáñez, Antonio Marín, María Francisca Moreno, Isabel Romero (Spain): Future secondary mathematics teachers training from a functional perspective

Overall, these papers addressed issues 1, 2, 3 and 5. Below we summarise and discuss the four issues as related to the papers presented.

### **Issue 1: A comparison of mathematical contents or curriculum of pre-service mathematics education in different countries**

Lim compared the structure and content of pre-service mathematics teacher education in Malaysia and China (Shanghai and Chongqing). She observed that education programmes in Chinese universities focus much more on mathematical content while the Malaysian counterparts place more stress on teaching practices. Relating to this, one question was posed for discussion: “Should the number of mathematical courses be increased to propose a better programme for the pre-service teachers?” After much active exchange and debate on this issue, there was no conclusion as the question emphasises the need to look at the relevance of the course content rather than the number of courses. This question nicely led to the second issue.

### **Issue 2: The kind of mathematical content and knowledge that could be presented to preservice teachers**

Proulx and Bednarz gave an illustration of the need to review the sense of mathematics. They postulated that mathematical experiences implicitly promote values, techniques, methods, conceptions and ways of thinking that are needed in academic mathematics. They proposed the need to include the concepts of school mathematics (for example, reasoning, ways of making sense of concepts, range of specific procedures, strategies and representations, dealing with errors, incorrect inferences, using mathematical models, historical aspects on the evolution of a concept), as well as the need to instil mathematical culture (for example, how to generate ideas, questions and problems, making explicit and sharing understandings, developing explanations and argumentation, negotiating meanings, sharing and exploring different ways of understanding problems, concepts, symbolisms, representations, solutions, or strategies).

### **Issue 3: The link or relationship between the kind of mathematical knowledge and the role of mathematical experiences**

Three papers discussed this issue. We recognised that different conceptions could be used to examine prospective teachers’ knowledge and problem solving skills (Ma et al.) or to interpret the construction of identities (Krzywacki-Vainio). In Ma et al. studied the perception of pre-service primary teachers about (i) procedural knowledge; (ii) conceptual knowledge; and (iii) problem-solving. Pre-service teachers were asked to explain the meaning of, and provide an example for, each of the three concepts. They found that perceptions between procedural knowledge and problem solving were loosely connected. In addition, these three types of perceptions were not associated with gains in mathematics performance.

Similarly, Krzywacki-Vainio looked carefully at how student teachers were guided toward personal development as a teacher by examining both educational courses and also mathematical education courses. She concluded that in the development of the teacher education programme, there is a need to make the hidden agenda explicit.

In another study, Abramovich and Brouwer attempted to make a connection between pre-service teachers’ knowledge and the hidden context of mathematics. For example, a mistake by a prospective teacher led them to reflect on the contexts in which students answer a question. This implies the importance of identifying the nature of a mistake.

### **Issue 4: The impacts and effectiveness of pre-service mathematical education on pre-service primary and secondary mathematics teachers**

Though this issue was not directly addressed by Sayac’s study, she proposed to document the role of the teacher trainer. The notions of practices organiser, efficiency, and epistemological posture were used to do analysis. She recognised that if a programme is defined in a formal way, the influence of the teacher trainer is fundamental. The projection of the pre-service teacher in the class or the academic mathematics of preservice teacher take place under the influence of teacher trainer. This kind of research seemed to be new.

## Issue 5: The innovative and creative approaches of developing mathematical content knowledge of pre-service mathematics teachers

Three papers discussed a variety of approaches used in developing the mathematical content knowledge. Dawson presented an approach that combined face-to-face and distance education using a software called “Elluminate”. This kind of approach allows the possibility of teaching even when students live far away. He observed there was an enhancement of the mathematical language used with each approach. However, the kind of mathematics (explained by Proulx and Bednarz) does not seem to be modified by the use of one approach or another.

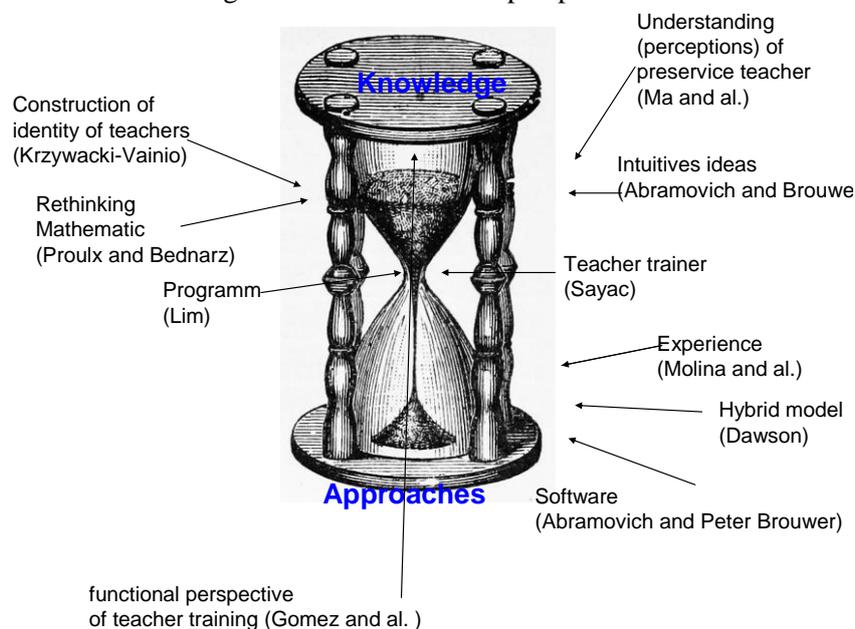
Molina described their experience adapting mathematics education training for prospective primary school teachers. Their aim was to present mathematics from a cultural, social and epistemological perspective consistent with the current official curricula. They observed coherence in epistemological separation between theoretical and practice knowledge, as well as between competencies and approaches to teaching. They reported that their approach promoted active debates and discussion, and consequently generated significant changes in the attitudes of the student teachers.

Gomez et al. proposed looking at pre-service mathematics teachers’ learning from a functional point of view. They noted how some mathematics education notions are approached as conceptual and methodological tools with didactic purposes.

### Conclusion

To integrate the contributions of this TSG, Lucie suggested the metaphor of an hourglass. She depicted the two balloons representing respectively the set of knowledge (perceptions, identity, etc.) and the set of approaches. The narrow part of the hourglass represents the programme constraints on one side and the qualities of teacher trainers on the other side. Neither knowledge nor approaches can easily pass through the narrow part. The paper of Gomez and al. presents an example of challenge of crossing the narrow part of the hour glass.

The hour glass of a researcher on prospective teachers



In summary, there was a lot fruitful discussion. Although we did not manage to produce significant conclusions from these discussions and presentations, we have gathered a group of mathematics educators and researchers who are interested in the topic of mathematical education for pre-service teachers. We have explored the issues and hope our discussion will continue to impact on our future programmes for pre-service mathematics education.