

論 文 の 要 旨
Summary of the Dissertation

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論文題目：

Dissertation title:

Mongolian Secondary School Teachers' Mathematical Knowledge for Teaching with a Reference to Geometry

This research aims to identify Mongolian secondary school teachers' mathematical knowledge for teaching with a particular reference to geometry, and to reveal how teacher beliefs and context where teachers are trained and work is likely to situate and contribute to teachers' MKT. To achieve the aims, the following questions are set:

1. What is Mongolian secondary school teachers' MKT geometry?
2. How do these teachers believe about the nature of geometry and its teaching and learning?
3. How is teacher beliefs associated with their MKT geometry?
4. How does school context situate secondary school teacher MKT geometry?
5. How is pre-service teacher education context in Mongolia likely to contribute to teachers' MKT geometry?

In order to answer the questions, an extensive literature including Mongolian secondary education geometry curriculum and mathematics teacher review was carried targeting teachers' MKT, belief and context. Review of the secondary school geometry curriculum identified the focus of content of geometry; such as the plane shape and symmetry concepts.

Based on the literature review and findings from the curriculum, a conceptual framework of the research is developed consisting of several components. First of all, the framework is built on Ball et al's (2008) MKT model, nevertheless, it does not include HCK because KCC deals with teachers' knowing of how a particular mathematics curriculum content are taught preceding years and will be taught later years. By Hill, Ball and Shilling (2008), the framework focuses on the plane shape and symmetry concepts applying CICD theory (Tall & Vinner, 1986). A rationale why applying this theory is that there is a tension between the concept image and concept definition in the shape; and this is a cognitive theory that can be applied in learning concept image and definition. Teachers' belief is not distinguishable from teacher MKT as it affects teacher choices of instructional tasks, representations, approaches in geometry teaching. For teacher beliefs in this research, a particular attention is to teachers' belief about nature of school geometry. The belief in this research adapts Beswick (2011) conceptualization that teachers' beliefs about the nature of school mathematics may be separated from beliefs about the nature of geometry as a science discipline. It is important to know what kind of mathematical knowledge teachers hold and why that knowledge is important in the particular countries in which they teach (Stylianides and Delaney, 2011). They noted that teachers' MKT is shaped in in the

context of teacher education program. Thus, this research considers context in teacher education comprises from pre-service teacher education as it establishes fundamental knowledge for teacher MKT, and secondary school context which is represented by situated aspect of teacher MKT. At the school context, an aspect of situated-ness is investigated through teachers' individual and collaborative reflections.

Based on the conceptual framework, instruments are developed for teachers. The questionnaire for teachers' MKT has 2 category of items such as MKTCI and MKTCD referencing the plane shapes. Teacher belief questionnaire consists of 2 parts such as teachers' belief about the nature of school and belief about discipline geometry (Beswick, 2011). Teachers' belief about the learning geometry reflects characteristics of three different views of belief about the learning geometry - content focused with performance, content focused with understanding, and learner-focused. As for school context, teacher individual and collaborative reflections based on Turner (2008) are investigated focusing on certain aspects of geometry teaching and learning.

Using the instruments, data was collected during December 2014 when geometry is widely taught to secondary school students. The instruments are administered to 57 secondary school mathematics teachers who work in Ulaanbaatar, a capital city, and Khovd aimag, a rural area, of Mongolia.

Data was analyzed using a combination of quantitative and qualitative methods. The analysis revealed several results for teachers' MKTCI and MKTCD, beliefs, and context. In Mongolia, teachers' MKT can be characterized by limited KCT and KCC, and some inconsistencies between the concept image and formal definitions for the shapes in terms of CCK, SCK and KCS. These teachers hold Platonist view of belief about the nature of geometry, and learner-focused view of belief about the geometry learning. A certain views of teachers' belief are negatively associated with SCK and KCS sub-domains of teachers' MKT. Teachers who hold stronger Problem solving and Platonist view of belief possess less SCK. Teachers' MKT is likely to be positively situated in school context through teachers' individual and collaborative reflections, however, how and what to reflect is a matter. Pre-service teacher training is likely to contribute school teachers' KCTCD developing students with better CCKCD and enabling them to develop KCSCD, KCTCD and KCCCD.

Based on the results and findings, recommendations for the improvement of teachers MKT geometry emphasizing the concept image of the plane shapes, and pre-service teachers training and schools context can be provided; as a result, secondary school students' achievement in geometry can be potentially increased.