

# Design of Hypothetical Teacher Tasks (HTT) to Access Pre-service Elementary Teachers' Knowledge on Rational Numbers

Zetra Hainul Putra<sup>1,2</sup> and Carl Winsløw<sup>1</sup>

<sup>1</sup>Department of Science Education, University of Copenhagen, Denmark

<sup>2</sup>Faculty of Teacher Training and Education, University of Riau, Indonesia

[zetra.putra@ind.ku.dk](mailto:zetra.putra@ind.ku.dk)

*In this poster, we present the idea of the PhD-project of the first author: to use hypothetical teacher tasks (HTT), designed and analysed with the anthropological theory of the didactics (ATD) to study pre-service elementary teachers' mathematical and didactical knowledge on rational numbers, with a comparative focus on Indonesia and Denmark. An example of a HTT is also included.*

*Keywords: hypothetical teacher tasks (HTT), teachers' knowledge, rational numbers*

Studies about pre-service and in-service teachers' knowledge on rational numbers have been done by many researchers, with various approaches (Ma, 1999; Hourigan & O'Donoghue, 2013). Most of the studies focus on teachers' mathematical subject matter knowledge (MSMK), content knowledge (CK) and pedagogical content knowledge (PCK) on rational numbers, based on cognitive paradigm - that is, focusing on individual knowledge.

Meanwhile, our study takes a different approach, based on the *anthropological theory of the didactic* (ATD) introduced by Chevillard (1992). In this framework, knowledge is considered as institutionally situated, and is studied through *praxeological reference models*. We develop *hypothetical teacher tasks* (HTT) about rational numbers based on the ATD framework (Durand-Guerrier, Winsløw & Yoshida, 2010). The aim is to develop a framework to study pre-service elementary teachers' mathematical and didactical knowledge on rational numbers. The framework will be applied to comparative pre-service elementary teachers from Indonesia and Denmark. We choose both countries because Danish students performed significantly above the OECD average compare to Indonesian students who performed significantly below the average (see the result of PISA 2012, OECD, 2014). We assume that the result has a link to teachers' mathematical and didactical knowledge. The subjects for this study are pre-service elementary teachers from the University of Riau, Indonesia and from the Metropolitan University College, Denmark. The results of this study are expected to contribute to develop our knowledge about teaching rational number models to pre-service elementary teachers.

## **HYPOTHETICAL TEACHER TASKS (HTT)**

Five *hypothetical teacher tasks* (HTT) are designed to access pre-service elementary teachers' mathematical and didactical knowledge about rational numbers. The HTT are designed based on a *praxeological reference model* for the practical and theory blocks of both mathematical and didactical praxeologies. A practical block is formed by a type

of tasks ( $T$ ) and corresponding techniques ( $\tau$ ), and the theory block consists of a technology ( $\theta$ ) and a theory ( $\Theta$ ). So, each of HTT can be described based on two kinds of four tuples ( $T, \tau, \theta, \Theta$ ). As an example, we outline one HTT about multiplication and division of decimals. The task is given to the pre-service elementary teachers as follows:

*As a teacher, you ask students to compute the following as homework: a)  $0.25 \cdot 8 = \dots$ , b)  $8 \div 0.25 = \dots$ . At the next meeting in the class, a student notices that when he enters  $0.25 \cdot 8$  into a calculator, the answer is smaller than 8, and when he enters  $8 \div 0.25$ , the answer is bigger than 8. He is confused with this answer and thinks that the calculator must be broken. What can you do to help such students understand this result? (discuss in pairs in 8 minutes, use the space below if necessary, and write your ideas to support the discussion)*

From the task we can derive *praxeological reference model* for a mathematical task ( $T$ ) and for a didactical task ( $T^*$ ) as follows:

$T$  = given a decimal number  $a$  and an integer  $b$ , calculate  $a \cdot b$  and  $b \div a$ .

$T^*$  = given a type of task  $T$  (where  $0 < a < 1, b > 0$ ) explain determine what to do as a teacher to make students understand why  $a \cdot b < b$  and  $b \div a > b$ .

and then a-priory analysis can also be described for both tasks contains techniques ( $\tau$ ), technologies ( $\theta$ ) and theories ( $\Theta$ ).

**Acknowledgment:** We would like to thank to the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia for funding this PhD research.

## REFERENCES

- Chevallard, Y. (1992). Fundamental concepts in didactics: perspectives provided by an anthropological approach. In R. Douady & A. Mercier (eds), *Research in Didactique of Mathematics* (pp. 131-167). Grenoble : La Pensée sauvage.
- Durand-Guerrier, V., Winsløw, C. & Yoshida, H. (2010). A model of mathematics teacher knowledge and a comparative study in Denmark, France and Japan. *Annales de didactique et des sciences cognitives*, 15, 147-172.
- Hourigan, M., & O'Donoghue, J. (2013). The challenges facing initial teacher education: Irish prospective elementary teachers' mathematics subject matter knowledge. *International Journal of Mathematical Education in Science and Technology*, 44(1), 36-58.
- Ma, L. (1999). *Knowing and Teaching Elementary Mathematics: Teachers' understanding of fundamental mathematics in China and the United State*. New Jersey: LEA.
- OECD. (2014). Results in Focus: What 15-year-olds know and what they can do with what they know. Retrieved <https://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf>.