

Noticing in pre-service teacher education: Using research lessons as context for reflection on student thinking, learning and sense-making

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Professional noticing of children's mathematical thinking is a crucial ingredient of a mathematics teacher's competence. The process of professional noticing progresses through three interrelated phases: attending to learner thinking in classroom interactions; the interpretation of learner thinking in this setting; and lastly deciding what actions should be taken based on inferences from this analysis (Barnhart & Van Es 2015; Jacobs, Lamb & Philipp, 2010; Mason, 2002). These phases entail reflection-in-action during the lesson as well as reflection-on-action during the post-lesson discussion (Schön, 1987).

Reflection and noticing are essential components of lesson study, a professional development approach aimed at the improvement of instruction that originated in Japan (Lewis & Tsuchida, 1998; Stigler & Hiebert, 1999). Lesson study is the systematic and collaborative planning and reviewing of a research lesson by a community of teachers and a 'knowledgeable other' to bring together theoretical and practical learning in an authentic way. The lesson study cycle entails the collaborative planning of a lesson, observing the research lesson, and an in-depth post-lesson discussion (Lewis, 2002; Pothen & Murata, 2006). In some cases, the lesson is then revised and taught again, with another post-lesson reflection. The revision and re-teaching of the research lesson is optional. The focus of a research lesson is on sense-making and building of mathematics concepts.

A focus on learner thinking is central in the lesson study process and the very thorough process of planning for student learning, noticing how the tasks and activities foster learning during the lesson, interpreting what happened during the lesson and deciding how to plan and teach the lesson more efficiently in future, provides a structured environment for reflection and teacher professional noticing.

Because student teachers often do not know how to reflect or what to reflect on in lessons they observe, they tend to focus on teacher behaviour and actions and not on learner thinking and sense-making. They need structured support and appropriate framing to develop the necessary focus and skill for systematic reflection (Barnhart & Van Es, 2015). Learner thinking should be central in this process and used as evidence for judgements about the effectiveness of practices and subsequent pedagogical decisions for the future.

Lesson study is used during school practice in the fourth year Mathematics Education module instead of the traditional crit lessons. Students in groups research their chosen topic and prepare a research lesson which is presented by each group member in her own class and observed by some of the other group members. The lesson is then refined and finally presented by one of the group members while the lecturer as 'knowledgeable other' and other

group members are observing. A session of thorough *reflection-on-action* by all observers follows, which includes what *reflection-in-action* took place during the lesson. Due to the strong focus on learner thinking during all the phases of a problem-centered lesson (planning, solving of a problem and class discussion on solution strategies afterwards, reflection afterwards) professional noticing plays an important role in this whole process. After this joint reflection session, each group member has to submit an individual written reflection guided by four specific questions based on Gibbs' model for reflection (1988). The Gibbs' cyclical reflection model also shows strong similarities with the phases of professional noticing, focusing on what transpired during the lesson; the evaluation of what went wrong or well and why - analysis of the situation to make sense of it and to explore alternatives, culminating into an action plan for the future.

This paper reports on a longitudinal case study on 60 preservice teachers' noticing during research lessons in their third and fourth year school practicum. Student teachers' reflections have been analysed to determine which aspects of a problem-centred approach in mathematics they notice and reflect upon.

Four pre-service teachers' reflections have further been investigated for growth and depth in reflections from the third to the fourth year. Data include individual reflections of student teachers according collected on five different occasions over the two-year period. Questions based on the Gibbs reflection cycle were used for two of the reflection opportunities, while the other opportunities entailed reflection in a narrative style on a wiki.

Preliminary results show that student teachers' noticing and reflections despite a concerted effort of the facilitator still focus more on teacher actions and teaching than on learner thinking and sense making. Individual student teachers however showed growth and increasing depth in their reflections over time. The implication for pre-service teacher education is that students need well-structured and focused opportunities individually as well as in groups to reflect on and make sense of learner thinking.

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