Developing Mathematics Instruction with Adaptive Conceptual Frameworks

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Introduction

In this paper we elaborate on a strategy based on adaptive conceptual frameworks that we have used to guide and to justify both completed and ongoing interventions in two different lower secondary schools in Sweden. Our efforts have been inspired by co-design, as a user-centered design methodology that stresses the importance of involving different stakeholders such as teachers in the design research process (Penuel, Roschelle, & Shechtman, 2007). Working in close collaboration with teachers deepens our knowledge about pragmatic issues and promotes development of "*innovations that fit into real classroom contexts*" (ibid. p.52). Following the conceptualization of knowledge proposed by Chevallard (2007), the two different perspectives of understanding and development could be viewed as two inseparable aspects of knowledge, integrating a practice that includes the things teachers do to solve different educational tasks with a discursive environment that is used to describe, explain, and justify that practice. Our conceptual frameworks explicitly address both of these perspectives.

Adaptive conceptual frameworks

In our approach we connect empirical data with various confirmed theories that we choose in retrospect and that are used to generate additional empirical data in an iterative and adaptive process. For our purposes, we distinguish between three different frameworks depending on how they are used:

- Methodological Framework for Professional Development (MFPD)
- Conceptual Framework for Development (CFD)
- Conceptual Framework for Understanding (CFU)

The MFPD are used by the researcher to plan interventions with the teachers and to operationalize the current understanding before engaging in a new design cycle. The CFD are used to describe and justify the different activities that the researcher engages in together with the teachers. Finally, the CFU consists of several connected theoretical components that the researcher uses to understand the outcomes of an intervention and to plan the next design cycle. While the CFD and CFU naturally share similarities, since they both put focus on the design

process, the MFPD should be regarded as a separate framework for organizing and supporting the teachers' professional development.

The workflow of the formal stages of the design cycles is illustrated in Figure 1. Each design cycle starts with a planning phase followed by an implementation phase involving the teachers. The cycle is completed with an evaluation of outcomes. Furthermore, we consider the conceptual frameworks in a state of flux and changeable according to the different challenges that might emerge when conducting design-based research. For example, the notion of praxeologies (Chevallard, 2007) was introduced in the first CFU to explain the outcomes of CFD-1 (i.e. teachers focusing on only some aspects of knowledge) and was used as an explicit instrument with the participating teachers in CFD-2.
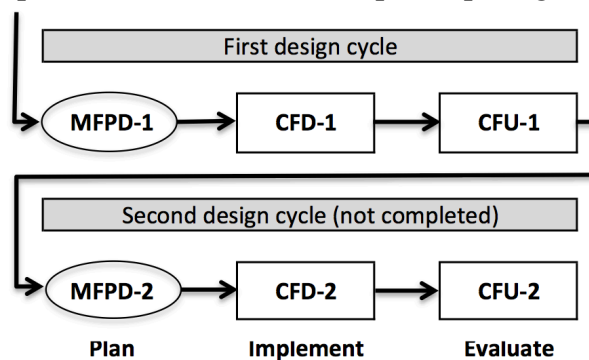

Figure 1: Adaptive frameworks

Summary

The conceptual frameworks that we seek to develop should be regarded as (permanently) tentative and a result of a research work that could be portrayed by the "bricolage" metaphor (Cobb, 2007, p. 28) particularly regarding our efforts of connecting components from different theories. Although our conceptual frameworks are constrained by the internal and external resources that are available to the researcher, this approach allows us to consider all aspects of the situation including different learning objectives and the particular learning environment. We believe that adopting such a flexible approach allows us to fully make use of our available resources to address authentic educational needs as expressed by practicing teachers.

References

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