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Abstract: Increasingly, teacher involvement in curriculum (re-)design is viewed as a form of professional development. However, the research base for this stance is limited. While it is assumed that the activities teachers undertake during (re-)design of curriculum materials can be beneficial, few studies involving teachers (re-)designing curriculum design measure more than effects of this activity on teacher attitudes, the quality of the designed artifacts, and/or implementation of the curriculum innovation at hand. One reason for this could be the lack of theoretical framing for robust studies on teacher learning by design. Toward supporting future research on the benefits and limitations of this approach as a form of professional development, this paper offers a framework that could be used to explore teacher learning through engagement in collaborative design teams.

Teacher learning by design

Scholars in the field of teacher professional development argue that teacher learning needs to be meaningful to a teacher's practice, is social in nature and distributed. Teacher learning therefore cannot be limited to formal professional development only, but takes place in all the arenas in which the teacher participates: the classroom, the community of (student-)teachers, and the school environment (Borko, 2004). Professional learning arrangements for (student-) teachers are challenged to make use of these different arenas when they provide opportunities for teachers to learn. Research on teacher professional development arrangements aiming to improve or change classroom practice, that aligns with these views on teacher learning, emphasize that teacher professional development needs to: (a). focus on a deeper understanding of subject matter and on guiding students' thinking about subject matter (Borko, 2004; Whitcomb, Borko, Liston, 2009; Garet et al., 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007); (b) provide examples of concrete classroom applications of the general ideas underlying the change (Elmore & Burney, 1999; Davis & Krajcik, 2005, van den Akker, 1988); (c) expose teachers to actual practice rather than providing them with descriptions of practice (Elmore & Burney, 1999; Penuel et al., 2007 Garet et al, 2001); (d) provide opportunities for collaboration with peers and experts in attuning the practice to the local context (Borko, 2004; Ball & Cohen, 1996; Elmore & Burney, 1999; Penuel et al., 2007, Garet et al, 2001); (e) involve follow up support (Elmore & Burney, 1999; Joyce & Showers, 1995; Penuel et al. 2007; Garet et al, 2001); (f) be coherent with teachers' own professional development goals and the goals for their student learning (Penuel et al, 2007; Garet et al., 2001); and (g) be stretched over time (Penuel et al, 2007; Garet et al., 2001).

These features can be incorporated into many in-service scenarios. They are also, to a large extent, present when teachers collaborative (re-)design instruction, curriculum or materials (Handelzalts, 2009; Simmie, 2007; Voogt, 2010). In collaborative (re-)design, teachers create new or adapt existing curriculum materials in collaboration with each other, and often with external experts. The process of (re-)design provides opportunities for teachers to reflect on the curriculum starting from their personal knowledge and beliefs, their practice, and their goals for student learning (Parke & Coble, 1997). The interaction with other teachers and experts may deepen and challenge their reflections (Borko, 2004). Because (re-)designing curriculum results in concrete artifacts – curriculum materials – teachers are not only exposed to new practice, but actively shape it. Through enactment of the curriculum materials in their classes allows them to observe and reflect upon the outcomes. Participation in well-scaffolded collaborative curriculum design processes therefore has the potential to contribute to teacher learning (Borko, 2004; Ball & Cohen, 1996; Parke & Coble, 1997) and to the production of materials which are valid and practical (Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Ben-Peretz, 1990; Clandinin & Connelly, 1992).

Although it is assumed that the activities teachers undertake during (re-)design of curriculum materials, can be beneficial, most studies on teacher collaborative curriculum design tend to only focus on measuring effects of collaborative design on teacher attitudes and on the implementation of curriculum innovation. Toward learning about the benefits and limitations of this approach as a form of professional development, this paper offers a framework that could be used to explore teacher learning through participation in Teacher Design Teams (TDTs). We define TDTs as teams of at least two teachers who collaboratively design or re-design curriculum

materials, with the aim of improving or changing their own instructional practice. They may or may not work collaboratively with others (e.g. researchers, other facilitators) in this process.

Toward a model for teacher learning through TDT engagement

To study how TDTs provide opportunities for teachers to learn, understanding is needed about the outcomes which may be expected from teacher professional development arrangements. Usually, outcomes from teacher professional development are described in terms of change. Changes are expected in knowledge and skills, beliefs and attitudes, classroom practice and/or student experiences. Researchers generally agree that teacher professional development ultimately should lead to improved student learning (Guskey, 2000; Cochran-Smith, 2005; Parke & Coble, 1997; Clarke & Hollingsworth, 2002). However, the relationship between student learning and the other outcomes is complicated, often reciprocal and not very clear (Guskey, 1986). To underline that the changes in teachers are deeply rooted in teacher's experiences in the classroom, Guskey (1986, 2000) proposed a linear relationship in which teacher learning of new knowledge and skills impacts classroom practice, and classroom practice impacts student learning. Beliefs and attitudes according to Guskey (1986) only change after experiencing the effects on student learning. Guskey's view (2000) is interesting in that he takes into account the fact that effects of professional development may not visibly result in changed classroom practice, because the environment does not always support classroom implementation of the newly learned knowledge and skills. Contrary to the linear model Guskey proposed, Clarke and Hollingsworth (2002) developed the Interconnected Model of Professional Growth (IMPG), which allows for individual paths in teacher development. In their model, Clarke and Hollingsworth explicate the underlying processes that mediate teacher change. We take this model as a starting point for our thinking about teacher learning through design. We then propose an adaption of that model to suit the specific activity of engagement in TDTs.

Clarke & Hollingsworth's Interconnected Model of Professional Growth

Clarke and Hollingsworth identify four domains in which change can take place: the personal domain, the domain of practice, the domain of consequences, and the external domain. The personal domain constitutes teacher knowledge, skills, attitudes and beliefs. Change in this domain happens when teachers acquire new knowledge, skills, attitudes or beliefs. The domain of practice refers to all forms of professional experimentation. Although Clarke and Hollingsworth note that the domain of practice is often limited to teachers' experience in the classroom, they explicitly mention that teachers' professional experimentation is not limited to the classroom only. Teachers participate in different professional arenas in which they learn: the teacher community, the school environment, their professional associations, etc. As teacher design activities can be considered an inherent part of the teaching profession, we therefore see these activities as belonging to the domain of practice. Change in this domain occurs when teachers develop new curriculum materials and try-out new practices. The domain of consequences deals with the outcomes of new practices for the teachers themselves and their students. Change in this domain occurs when teachers perceive these outcomes as salient. The three domains form a part of the teacher's professional life. We will call them 'teacher-related domains'. One domain is outside the professional day-to-day world of the teacher. This is the external domain. This domain offers the teacher sources of information and/or stimuli and support to develop new practices. Change in this domain is defined as becoming acquainted with new ideas, practices and/or strategies, introduced and developed by others. Change may occur in any domain, and is mediated through the processes of enactment and reflection. Reflection refers to teachers' thinking about their practice ('reflection on action') and during practice ('reflection in action') (Schön, 1987). Enactment refers teachers' acting on their practice. The interaction that takes place in the TDTs with peers, experts, support materials or classroom practice, are essentially enactment and reflection. According to Clarke and Hollingsworth, the processes of enactment and reflection can be described in terms of paths connecting the various domains, which mirror the learning processes taking place. The model of Clarke and Hollingsworth allows for teachers participating in the same professional development initiative to follow different paths in their learning processes.

The model neither prescribes the changes that may occur as a result of a professional development initiative, nor the paths – the reflection and enactment processes - that mediate the change. To characterize teacher professional development, Clarke and Hollingsworth distinguish among change sequences and growth networks. A change sequence consists of '…two or more domains together with the reflective or enactive links connecting these domains; where empirical data support both the occurrence of change and their causal connection' (p. 958). They typically consist of teachers discussing and experimenting with the stimuli offered through professional development initiatives. Change sequences are the learning and development processes fostered by the professional development initiatives. Change sequences may result in teacher change as the immediate short term outcome of the professional development initiative. In our study, teacher change reflects the immediate

outcomes of teacher participation in a TDT. A growth network is a change sequence resulting in long lasting change (as supported by the data) in any of the three 'teacher-related domains' (the personal domain, the domain of practice, the domain of consequences). According to Clarke and Hollingsworth, long lasting change, which they call professional growth, is more relevant than the short term changes that usually occur due to a professional development intervention.

Adapted Model for studying teacher learning by design

The Clarike & Hollingsworth model depicts general professional growth. It provides a useful starting point, but for looking specifically at teacher learning of new knowledge, several additional aspects warrant attention. For example, focusing specifically on the development of pedagogical content knowledge, Van Driel (2010) indicates that the following elements are important: (a) an explicit focus on teacher knowledge, beliefs and concerns; (b) opportunities for teachers to experiment in their own practice; (c) collegial cooperation or exchange among teachers; (d) sufficient time for changes to occur. Van Driel combined those elements into an adaptation of the Clarke & Hollingsworth model; we take these refinements into consideration as we propose a model for studying the teacher learning that ensues from engagement in TDTs. The model (Figure 1) identifies four domains which can trigger and affect teacher learning: the external domain; the personal domain (consisting of both individual and team factors); the domain of collaborative design and the domain of experimentation and consequence in practice.

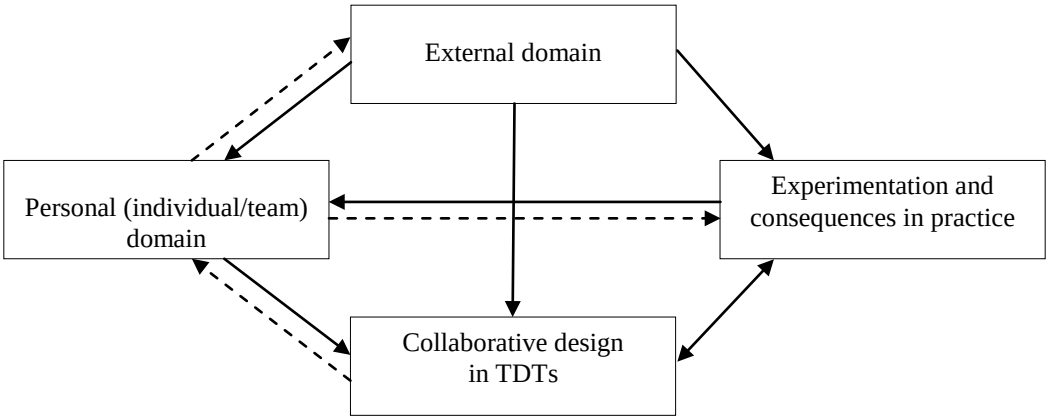

Figure 1
Interconnected Model of Professional Growth (adapted); legend: → enactment - -▸ reflection

Teacher learning takes place through enactment and reflection processes between these four domains. Salient aspects of teacher learning are addressed in each domain of the adapted IMPG model, which also includes main elements of engagement in TDTs. This section briefly addresses the main focus of each area, and proposes methods for study in each.

External domain: Participation in well-scaffolded collaborative curriculum design processes has the potential to contribute to teacher learning and to the production of materials which are valid and practical (Penuel et al. 2007). The scaffolding and support in different design team scenarios can vary widely. Two aspects in which it can vary are responsiveness to the context and participants, and also in terms of the degree to which the design process is pre-structured or left open. The external domain may be studied by interviews with key stakeholders in that domain, as well as document analysis and possibly field observation.

Personal domain: The personal domain refers to knowledge, skills and attitudes held by both individuals and teams. The construct of mental models could be used to study both individual and collaborative learning in teacher design teams. Mental models are organized practical knowledge frameworks that allow individuals to understand and change situations. Teachers develop both individual and team mental models when they (re-)design, enact and reflect on curriculum materials. When the members of a team communicate and coordinate their knowledge they share mental models (Mohammed et al., 2010). Only very few studies exist on the development of individual and team mental models in design teams. Heuristic goal mapping is one technique that could be used to measure teacher mental models, as could questionnaires and interviews.

Domain of collaborative design: Careful examination of the act of design is essential to understanding the process. Questions asked in this domain could include: How differently does design team engagement vary? How much is this dependent on the (external domain) scaffolding provided? And what are teachers' natural inclinations? Studies in this domain could build on Walker's classic curriculum work (1971) as some have already (Boschman, McKenney & Voogt, submitted to this workshop) to understand and eventually leverage teachers intuitive approaches to design. In addition to observation, Walker's work, as that of others (cf. Horn, 2010) use (teacher) discourse analysis as a window to (pedagogical) reasoning.

Domain of practice and consequences: Central to this model is the notion that 'drawing board' design alone is insufficient for learning, and that meaningful insights and powerful convictions stem from experience. For teachers to learn from design in a way that will influence their practice, they must not only design conceptually, but experience the fruits of their labor being enacted in classrooms. It is assumed that experiences during enactment and the resulting consequences for student learning are critical for individual and team learning, for the interactions in the TDTs and for the effects on student learning (Voogt et al., 2011). Designs constructed by TDTs are usually locally adapted and enacted in the classroom (by the designers, and often by other teachers as well). Tracking this experimentation and mapping its relation to teacher learning would seem essential to understanding the relationship between engagement in TDTs and teacher learning.

Enactment and reflection: We find it both essential and challenging to endeavour to understand the interaction between the domains. It is essential if we are to begin to ascertain if the hypothesized causalities are, indeed present. But because this interaction likely occurs over time, and possibly (at least in part) subconsciously, we find that measuring it presents an extreme challenge. We suspect that retrospective analysis, possibly prompted by an inventory of critical incidents, could help gain insight into the influences of enactment and reflection across domains.

Inviting discourse

We intend to use this model to help shape our own studies, and to help us build instrumentation that, across diverse projects, can be used to begin to understand the strengths and limitations of TDTs as a strategy for teacher learning. We hope that the ICLS workshop can offer the opportunity to discuss the model, as well as its underpinning ideas. We welcome critique that can lead to refinements to the model and to our thinking about this exciting line of inquiry.

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