

Understanding the design research process: The evolution of a professional development program in Indian slums

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Understanding the design research process: The evolution of a professional development program in Indian slums

Paper presented at the annual AERA meeting April 8-12, New Orleans
Division G: Social Context of Education Section 1: Local Contexts of Teaching and Learning

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Abstract

Although para-teachers make up a substantial portion of the world's educational work force, little empirical research has been conducted on their professional development. During the iterative process of analysis, design, evaluation, and revision, design research was conducted to gain insight into desirable characteristics of a professional development program for Indian para-teachers in urban slums. The design study flanking evolution of the para-teacher professional development program helped (re)shape each cycle of implementation, and to track lasting effects on organizational climate, teacher agency and pupil learning. Because long-term, high-quality design studies in the field of education are rare, this paper focuses on the research approach, and its affordances for contributing to theory-development while also capturing and speaking to the needs of practitioners. This paper is highly relevant to those interested in seeing the design research approach come to life in cooperation with the stakeholders involved.

Purpose and background

To explore how to use and apply emerging theories on professional development, design studies are increasingly being used. Design studies emphasize the whole cycle of scientific inquiry, often involving sub-studies in cycles throughout the stages of problem identification, hypothesis (re)forming, solution development and testing. Design studies require interaction and collaboration among researchers, teachers, and other stakeholders. This paper speaks to a fervent call for design researchers to share their emerging insights on how to maximize the potential and minimize the weaknesses of this powerful yet challenging approach. It does so by looking at a case-example of para-teacher professional development in Indian urban slums, in light of an existing model for conducting design research.

About design research

According to Barab and Squire (2004), design research is "a series of approaches, with the intent of producing new theories, artifacts, and practices that account for and potentially impact learning and teaching in naturalistic settings." The field of design research has been gaining momentum, particularly in educational studies, over the last decade. In special issues of highly respected journals, the need for attention to be given to design research was demonstrated: *Educational Researcher* (2003, 31(1)), *Journal of the Learning Sciences* (2004, 13(1)); *Educational Psychologist* (2004, 39(4)). Books devoted to the topic examine design research conceptualization (van den Akker, Gravemeijer, McKenney, & Nieveen, 2006) as well as methodological options (Kelly, Lesh, & Baek, 2008; Reinking & Bradley, 2008; Richey & Klein, 2007).

From a methodological perspective, design research is considered a 'manifold enterprise,' (Bell, 2004). While there is much variation in how different design researchers interpret and use the approach, an increasing degree of consensus is being reached on characteristics of design research. Wang and Hannafin (2005) describe design research as pragmatic; grounded; interactive; iterative, flexible; integrative; and contextual. According to van den Akker, McKenney & Nieveen (2006), design research may be characterized as interventionist; iterative; process-oriented; utility-oriented; and theory-oriented. In their book about design research in the domain of literacy, Reinking and Bradley (2008) delineate seven characteristics of design research: intervention centered; theoretical; goal-oriented; adaptive and iterative; transformative; methodologically inclusive and flexible; and pragmatic.

Several different models for design research have appeared in the literature. Some are more conceptual, and have been used to help describe differing sequences of steps in the design research process (cf. Ejersbo et al., 2008). Others emphasize a flexible but clear process, along with varying degrees of conceptual, or substantive, support. Reeves (2006) offers a model that highlights the process but is less detailed from a substantive standpoint; whereas that of McKenney, van den Akker and Nieveen (2006) tends to be more focused on core concepts and less on the process. A model put forth by Bannan-Ritland and Baek (2008) pays attention to both process and concepts, but has not been widely adopted. Based on an analysis of existing models, McKenney & Reeves (in preparation) produced a generic model that attempts to adequately represent the dynamic nature of design research, while accounting for large degrees of methodological freedom (see Figure 1).

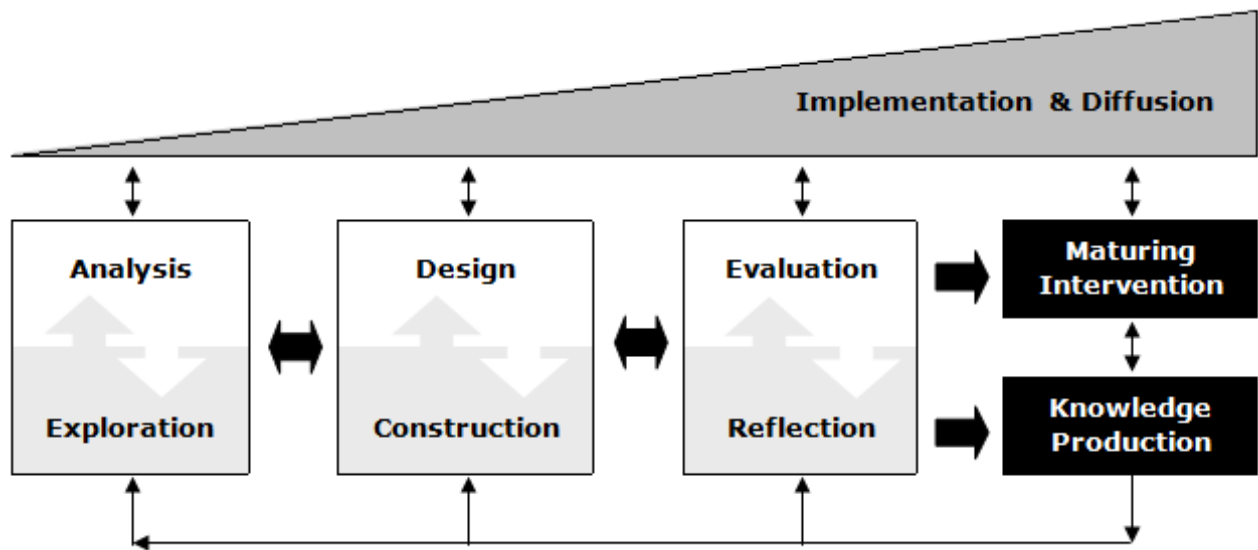


Figure 1: Generic model for educational design research (McKenney, & Reeves, in preparation)

The aforementioned literature on design research have been pivotal in garnering what has grown to be widely-held support for a research approach now considered a viable route to increasing the relevance of educational research. However, the current body of international literature contains very few in-depth examples of long-term, high-quality design research. Further, there is an extreme lack of examples demonstrating how this approach can be applied in the context of professional development. This paper describes each aspect in the generic model and illustrates its elements through a 5-year study on para-teacher professional development, conducted in India.

About the context

Studies in India echo international findings with regard to shaping teacher professional development, for example, by suggesting that teacher professional development should (cf. McKenney & Thijs, 2010):

- Address concrete questions related to daily work, with a focus on instruction;
- Be ongoing and sustained (one-off workshops are doomed to fail);
- Incorporate collaborative learning strategies, such as peer coaching and review; and
- Be largely self-directed, supporting teachers in identifying their own learning needs.

Such ideas provide useful starting points for studies on para-teacher professional development, but it must be recognized that para-teachers are quite different from teachers. Para-teachers generally lack any formal qualification related to teaching and learning, but nonetheless supplement regular classroom teaching in many countries, and especially in the developing world (Govinda & Josephine,

2004). Para-teachers usually come from the deprived communities in which they work, and are often better able to establish rapport with the local community and with the children (Desai 2003; Pandey 2006). While para-teachers have become recognized as valuable assets to the educational workforce in developing countries and especially in India, very few empirical studies have been conducted on feasible and effective ways to educate these much-needed participants in the Indian educational system. The design study featured here was conducted to inform the design, implementation and evaluation of a professional development program aimed at supporting para-teachers in an Indian educational NGO to adopt learner-centered approaches.

The study described in this paper was situated in an organization called Maitri, an educational NGO in India that provides educational support to children in under-served urban communities, most of which are best characterized as slums. While Maitri is active throughout India, this study took place in a western state of Gujarat, where Maitri implements Urban Learning Centers (ULCs) to provide remedial education for public school children. Originally Maitri implemented free remedial services for students who lagged behind in basic competencies of reading, writing and arithmetic. Later it modified its strategy and para-teachers were required to teach additional subjects including Gujarati (first language), English, Math, Science, History, Geography, and Civics, up to age 14 (which is up to about grade 7) in a learner-centered way, as well as charge fees for their services. It was Maitri’s wish to support para-teachers in delivering the remedial programs that provided the impetus for this study. Through systematic research and development, this study was undertaken with the dual aims of: (a) developing an intervention to facilitate the professional development of para-teachers in implementing learner-centered teaching strategies; and through this, (b) contribute to scientific understanding by developing knowledge about para-teacher professional development programs in settings like this one. Guided by this approach, the main question shaping evolution of professional development activities for para-teachers was framed as: *What kind of professional support can help para-teachers adopt and develop teaching strategies with a learner-centered orientation?* This question was answered through a series of sub-studies, as described in the subsequent section.

Methods

The design study on para-teacher professional development took place in several phases, as shown in the generic model (Figure 1). The generic model features three boxes, or phases, in which research activities take place: analysis/exploration, design/construction and evaluation/reflection. The strophic interaction between design/construction and evaluation/reflection may best be described as iterations of the design, informed by evaluation findings; in this study, three iterations took place. Figure 2 shows the approaches (top of box) main data sources (bottom of box) used in each of the three phases.

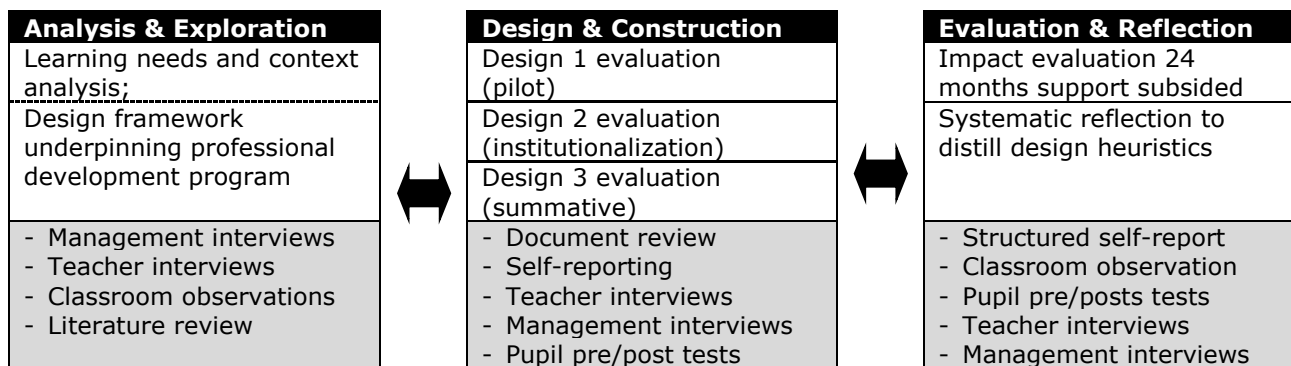


Figure 2: Methods for data collection in each phase of the para-teacher study

Detailed findings from each phase have been reported elsewhere (Raval, 2010). Toward understanding the research approach, and its affordances for contributing to theory-development while also capturing and speaking to the needs of practitioners, the basic process is briefly described here, followed by more detailed descriptions in the findings section.

Literature review was conducted to help frame the first phase of the study, which featured analysis of problems currently encountered by Maitri's para-teachers, and their managers. In addition, a strengths, weaknesses, opportunities and threats (SWOT) analysis was carried out to establish options and boundaries for a sustainable professional development program. Based on the findings from the needs and context analysis, a second, more focused literature review was conducted to inform the design of a professional development program that would speak to participant needs and also fit in the organization. This resulted in a research-based framework for design that was tailored to the context in question. The para-teacher professional development program was developed and implemented in three iterations. First, the main researcher facilitated a pilot program, which took place under circumstances that were slightly more favorable than usual. Based on the pilot experiences, the program was revised and adopted by the organization. During the second iteration, the main researcher was available as a resource, and co-facilitated with location managers. After the second cycle of implementation and studying the results, one last round of revisions was made to the program, and it was implemented again. During the third cycle, the researcher no longer facilitated during the program. A final study was conducted two years later (no additional support was given in the interim) to study any long term impact of the program. Finally, the research team reflected systematically between but also across all cycles of the design study to distill design heuristics for shaping the professional development of para-teachers in similar settings.

Findings

Needs and context analysis

The theoretical framework for the needs and context analysis study was derived from literature and centered around four main contextual factors that were considered likely to influence para-teacher learning: the (para-)teacher, the instructional setting, the organizational setting and policy. Each of these factors individually and collectively influences professional teacher learning. Using this framework, a needs and context analysis, was conducted to ascertain the learning requirements of the para-teachers in Maitri, and the contextual factors likely to foster or inhibit professional development. Data were collected to understand the current status of each of these factors in Maitri, and the fostering or inhibiting influences of their current characteristics on the intended para-teacher learning. Results revealed that there was a high level of motivation and commitment on the part of para-teachers towards their job which could play a crucial role in fostering professional development. At the time, it also revealed that the para-teachers had (by objective assessment as well as their own personal assessment) substantial gaps in their knowledge and skills related to teaching. Moreover, factors related to the other three elements in the model also posed several challenges for future professional development of para-teachers. These are presented in Table 1, below. At the end of the first substudy, after gaining a thorough understanding about the learning needs experienced by para-teachers and their supervisors and actual needs which surfaced while observing classes, a professional development objective was formulated. This objective was defined in terms of supporting para-teachers in designing and implementing systematically structured lesson plans with strategies that reflected a learner-centered orientation. Detailed information about the needs and context analysis framework and resulting findings are available (Raval, McKenney & Pieters, 2010).

Para-educator characteristics	<ol style="list-style-type: none"> 1. Lack of basic teaching skills to make enactment well structured and coherent 2. Lack of learner-centered skills 3. Low confidence about subject-matter
Institutional characteristics (classroom composition; teaching strategies)	<ol style="list-style-type: none"> 1. Large, heterogeneous classrooms with children from pre-school to Grade 7 2. Older children with lower attainment levels than their actual grade-level curricular competencies would imply 3. Coping strategies involved inefficient individual teaching
Organizational characteristics (time and opportunity for professional learning; curricular framework; leadership)	<ol style="list-style-type: none"> 1. 2-3 classes a day, marketing for collecting fees; no daily time to prepare for teaching 2. Professional support only in marketing strategies to increase fees 3. Lack of overall coherent curriculum to define 'what, when and how' to teach 4. Cluster-head role only as administrator
Policy influences (mandates/strategies for enrolling pupils; curriculum expectations and academic term duration)	<ol style="list-style-type: none"> 1. To enroll any child willing to pay fees towards fulfilling revenue targets for each month, and not based on learning requirements 2. To teach grade-specific curriculum to different pupils because of parental pressure, although their actual attainment was several grades lower 3. One academic term for three months, new children enrolled with each term 4. To enroll new children during a term to prevent losses in fee totals, leading to unstable pupil population

Table 1. Summary of needs and context analysis findings from Raval, 2010

Conceptual model

After defining the aim of professional development, a conceptual model was developed to guide the design of the professional development program. This served as a framework for design and was informed by the findings from the needs and context analysis, the craft wisdom of those involved, and especially by relevant literature. The conceptual model was inspired by critical attributes of professional development, including a situated instructional focus which connects learning to actual problems of practice; ongoing and sustained rather than isolated one-shot events; a self-directed and collaborative focus. Rather than simply pasting ideas from (largely Western) literature onto the Maitri situation, the model applies the insights from literature to the contextual realities relevant in this study. It involves tailored professional development activities that are feasible and meaningful given the educational, cultural and organizational (NGO) context of para-teachers in India. The model emphasizes development of three core cyclical practices as a part of the daily routine of paraeducators: lesson planning, lesson enactment, and reflection on the lessons. In addition each of the core activities is supported by workshops, micro-teaching and coaching, respectively. The model shows that this all takes place within an organizational context that must first create the necessary

pre-conditions (e.g. sufficient time to prepare for teaching tasks, or support of leaders and peers) for these activities to flourish. Thus the core activities, supportive strategies and appropriate organizational conditions are three main components that constitute the conceptual model used for developing the para-teacher professional development program. Additional information about the conceptual model is available (Raval, McKenney & Pieters, in press a).

Pilot study

The conceptual model described above served as a design framework, to guide the development of the intervention at hand: a professional development program for Maitri's para-teachers. The main researcher first piloted the program (in the role of facilitator, also consulting with the program-leader), in which para-teachers were introduced to the core activities of planning, enactment, and reflection of daily lessons using tailor-made templates for lesson planning and reflection. Supportive strategies were also implemented. This study took place during a summer vacation while para-teachers taught an optional subject, so only minor organizational changes were required. In addition, they were under less time constraints than usual and the accountability to parents was also less demanding for them. The formative evaluation of the one-month pilot aimed to understand if para-teachers, who had no prior knowledge or experience of lesson-planning, were able to design well-structured lesson plans with learner-centered strategies. The study also examined para-teachers' first experience with the professional development program as well as their perceptions about changes in classroom enactment. Of the 30 participants in the professional development program, nine para-teachers (three from each of the three localities involved), were respondents.

The study concluded that the participants' first professional development experience was positive with respondents citing favorable attributes of the program like demonstrations and micro-teaching, joint planning, reflection activities, and the immediate availability of ongoing support during implementation. The study also concluded that para-teachers had acquired knowledge about and high proficiency in systematic lesson-planning with learner-centered strategies. Classroom enactment changes towards well-structured teaching with a learner-centered orientation were also perceived by the para-teachers. The only area of difficulty experienced was in planning for and implementing pupil management strategies (i.e. discipline, facilitating pupil behavior for learning). The organization experienced the pilot as successful, which helped pave the way for a second phase of professional development activities. Additional information about the pilot study is available (Raval, McKenney & Pieters, in press b).

Institutionalization

After the pilot ascertained that the professional development program was helping to acquire systematic and learner-centered lesson planning skills, the second phase sought to institutionalize the core cycle and explore its value during the regular school term. The institutionalization agenda necessitated certain changes in organizational conditions for bolstering both core and supportive activities. These were led by location managers, and the location managers were in turn supported by the main researcher (e.g. through a workshop aiming to help each manager understand and determining the necessary institutional changes). Policies and practices that compromised teaching-learning quality in the centers (for instance, fee-based enrolment) were suitably modified; and the initial planning and reflection tools for the para-teachers were revised based on the findings from the pilot. With some modifications, core and supportive strategies were implemented with co-facilitation by the location managers and the researcher. The formative evaluation for this phase of institutionalization aimed at assessing the extent of systematic learner-centered orientation in lesson planning and enactment; other kinds of professional development gains experienced; and the perceived role of changed organizational conditions in supporting or hindering professional development.

The nine para-teachers from the pilot were respondents in the institutionalization sub-study. The findings from this sub-study indicate that the professional development program led to successful adoption of systematic, learner-centered, lesson planning and enactment practices even during a regular term. Professional development not only yielded greater instructional competencies, but also an improvement in related competencies like collaboration during and ownership of core activities as well as related teaching and learning concerns. Lastly, it was found that organizational changes (new realistic program objectives for the ULC, new rules for enrolling children in class to ensure more stable pupil populations, etc.) had proved to be important for the smooth and effective functioning of the core and supportive strategies. This study also showed that the abilities of the location managers to support para-teachers grew along with their coaching experience, thus indicating that para-teachers and their supervisors' learning took place interactively. Additional information about the institutionalization study is available (Raval, McKenney & Pieters, under review a).

Summative evaluation

Following the institutionalization study, a summative study was conducted on the third and final version of the program. During this study, the central facilitation role was withdrawn and the implementation of the core professional development activities was fully left to the location managers and para-teachers. The aim of this summative study was to ascertain whether the professional development program yielded desired effects (retention or improvement of skills learned in the previous two programs) even when facilitation support was withdrawn. It also assessed pupil learning achievement. The nine respondents from previous evaluations continued as respondents as far as lesson planning and enactment effects were concerned. Pupil learning achievement data was also collected from other para-teachers who had not been part of the earlier studies, but participated in the professional development activities.

Improvements in lesson planning and enactment led to the conclusion that para-teachers were able and willing to gain from lesson planning, enactment and reflection on daily lessons, through the facilitation in the organizational units alone, without additional support from the researcher. The large effect sizes in pupil learning gains clearly indicated that learning took place. No differences were found between the pupil scores of the original nine teacher respondents who had been tracked in the previous sub-studies, and those of the new para-teachers involved in the summative study, which prompted the inference that effects from the professional development program were well distributed across the NGO and not limited only to the para-teachers who were observed throughout the previous studies. Over all, the lesson planning, enactment, as well as test scores, lead to the conclusion that the professional development program was effective even in absence of the researcher's external facilitation and support. Additional information about the summative evaluation is available (Raval, McKenney & Pieters, under review b).

Impact

Two years after external support was withdrawn, a final study was carried out to assess whether and to what extent the professional development program yielded long-term impact. Long-term impact was studied in terms of (a) the existing status of professional learning opportunities within Maitri; (b) quality of teaching practices; (c) pupil learning outcomes; and (d) Maitri's capacity for organizational learning to support professional development of its para-teachers.

The impact study concluded that professional learning opportunities were readily available, and the core routine of daily planning, enactment and reflection, introduced in the earlier professional development program, was fully retained. Although the teaching practices of para-teachers entailed a mixed approach with some strategies that were more teacher-centered and others that tended more toward a learner-centered orientation, specific learner-centered practices attempted earlier and successfully evidenced in earlier studies were retained. There was substantial improvement in

both the retention of pupils, and learning achievement when compared to pre-professional development program scores. Finally, the early professional development efforts had promulgated organizational changes focused on supporting para-teacher development. These changes extended beyond the original intentions, and included: more horizontal organizational structures, participatory leadership, greater trust and collaboration between staff members, increase in greater agency and initiative amongst para-teachers and location managers and systems promoting autonomous data-driven decision-making. Maitri's capacity for organizational learning, which is necessary to support its para-teachers, had grown not in isolation but alongside and through efforts to strengthen teacher capacities. From all this evidence, the study concluded that the professional development program had indeed yielded long-term impact in terms of retaining or improving upon all the factors that it had originally invested in. Additional information about the impact study is available (Raval, McKenney & Pieters, under review c).

Design heuristics

As indicated earlier, design research strives to inform the design and development of interventions while also contributing to scientific understanding. Taking the Maitri experiences as a case example, and reflecting on the findings from this study in light of relevant literature, two sets of design heuristics have been distilled to inform the professional development of un(der) trained teachers with similar goals in poorly resourced contexts. One set of guidelines is substantive, describing salient characteristics of professional development that have emerged as desirable over the course of the study. The other set is procedural, indicating useful ways of implementing professional development programs like this one, or the procedures that contribute to the effectiveness of the program. Since the full sets of heuristics would be beyond the scope of this paper, we report one example from each set. The full set is available elsewhere (Raval, 2010).

The substantive design guidelines describe four main characteristics of professional development: (a) guided by individual as well as contextual (organizational) requirements; (b) guided by an instructional focus; (c) guided by realistic choices; (d) guided by attributes of teacher leaning and (e) a systemic approach. For each of these themes, the heuristic set presents relevant theoretical and empirical evidence (second and third columns in Table 2, below) which lead to the specific substantive design guidelines in the fourth column. For example, the first theme points to the role of individual and organizational requirements that influence the professional development agenda. The table cites ideas from previous research (Kubistskey & Fishman, 2005; Loucks-Horseley, 1998) and empirical data from the analysis sub-study, conducted to assess the needs and contextual requirements to design the professional development program. Both these validate the main substantive design guideline that plans about professional development must be informed by perceived learning needs of teachers, the actual status of their classroom practices and the strengths and weaknesses of their work context (for e.g organizational factors) must be taken into consideration.

Characteristics of professional development (PD)	Theoretical support	Empirical support	Substantive design guidelines
Guided by individual as well as contextual (organizational) requirements	PD should be informed by specific needs of the participants (Kubitskey & Fishman, 2005); that is, existing knowledge and beliefs of teachers as well as the context (Loucks-Horseley, 1998)	Learning requirements of para-educators were identified (e.g. working with heterogeneous classes) and enactment gaps identified in practice (incoherent teaching) (Section 2.5.2) Contextual characteristics, especially organizational constraints which potentially had substantial influence on professional development, were identified (2.5.2).	<ul style="list-style-type: none"> Define individual learning requirements based on what teachers express as well as what their actual classroom practices reveal. Identify strengths and weaknesses of the local context, e.g. organizational factors, that could impact teacher learning
	During PD, central importance to learning processes of teachers and the particular curricular and school contexts in which professional development takes place (Penuel, et al., 2007))	Core and supportive strategies addressed individual learning needs in different ways (4.4.1) and organizational changes played an important role in supporting para-teacher learning (5.4.4.)	<ul style="list-style-type: none"> Aim to (re)design necessary learning activities as well as meet (contextual) organizational requirements necessary

Table 2. Excerpt from substantive heuristic set found in Raval, 2010

The procedural heuristics suggest that professional development should involve, (a) promoting the plan-enact-reflect cycle; (b) supporting the plan, enact and reflect cycle; (c) use of templates to scaffold planning and reflection; (d) role of teacher-heads in designing and implementing learning activities (for the para-teachers); and (e) careful implementation of changes in the organizational conditions. Like in the table on the substantive guidelines, theoretical and empirical supports that lead to procedural design guidelines are also presented. For example, the study recommends that promoting the plan-enact reflect cycle through daily lesson planning and reflection is desirable to support teacher learning. This design guideline is generated based on theory, (E. A. Davis & Krajcik, 2005; Raval, et al., in press) as well as empirical evidence that indicated how lesson planning and reflection had strengthened para-teacher learning. An excerpt from the procedural heuristics set is given in Table 3.

Procedures during professional development	Theoretical support	Empirical support	Procedural design guidelines
Promoting plan-enact-reflect cycle	Lesson planning, enactment and reflection are powerful opportunities for learning (Raval, et al., in press); teacher learning is situated in classroom instruction, planning, lesson modification, assessment (E. A. Davis & Krajcik, 2005)	The core activities led to improved lesson planning and enactment skills (5.4.1 and 5.4.2)	<ul style="list-style-type: none"> Use lesson-planning and lesson-reflection on daily enactment to support implementation of learner-centered materials

Table 2. Excerpt from procedural heuristic set found in Raval, 2010

Discussion

Design-based research was found to be uniquely suitable for the problem that was central to this study. Several contextual factors increased the already steep challenge of designing professional support for this group, and the limited theoretical and empirical base from which to draw upon rendered it a more daunting endeavor. The design-based research approach was flexible enough to evolve alongside insights from each cycle, while maintaining focus on the long term goal of the intervention and of producing knowledge that could be valuable to a wider audience than Maitri staff alone. Besides the fact that there were direct benefits of this approach in terms of improved capacities on the ground, the approach afforded both opportunities, and challenges. We briefly discuss some of those in this section.

Inviting collaboration of different stakeholders

Collaboration per se, especially between people from different disciplines is challenging. When it concerns researchers and practitioners, the difficulties are increased, and this is even greater in contexts like India, where the boundaries between educational practice and research are still tightly drawn. The design-based research process eased these challenges in two ways, related to the nature and activities of collaboration, respectively. As the professional development program progressed, the Maitri practitioners' saw that this approach sought to realize its objective (of creating new knowledge) within the ground realities and not despite the realities that they worked in. The enactment stance (as opposed to the fidelity perspective) which is the corner stone of design based research in the field of curriculum implementation (McKenney, Nieveen, van den Akker, 2006) brings with it empathy, regard and a motive that respects actual grassroots' realities as they are. This empathy has tremendous potential to forge a sense of trust and solidarity of purpose between practitioners and researchers (in India and probably elsewhere). A reflection on the whole approach by one of the management members illustrates this positive aspect of the approach, "I have often encountered a feeling that our fuzzy ground realities are almost a botheration and a hindrance to the researchers in seeking their objective, as if it compromises their quest, as if they have to come and first clean up my kitchen to be able to work in it, and that often leaves us practitioners feeling undermined and in an unequal position with them; but this experience truly put us on an equal platform".

Trust and shared purpose are of course necessary for collaboration, but that only sets the stage. the process. The process of designing is open-ended and complex, requiring inter-dependent decisions,

extensive investigation and iterative refinement (Edelson, 2002). Through a series of interactive consultations with para-teachers and management members, facilitated by the researcher, the location managers took a lead role in re-designing the professional development. Here, collaboration was effective because everyone had a specific role in the design process. Location managers were chief designers and critical decision makers, yet they were not the sole decision-makers. Their decisions were informed by reflections, suggestions and critiques from supervisors and para-teachers, who were not the designers but acted as 'consultants and advisors'. The researcher was the facilitator and coach.

Institutional capacity building

Design research carries two intertwined functions, directly impacting educational practice through design activities, and simultaneously using the design experience to gain new understanding (Edelson, 2002); with the design and development activities taking place in intense collaboration with the participants (McKenney, Nieveen & van den Akker, 2006). Such collaboration is professionally enhancing for both parties, with new knowledge about educational practice gained by the researcher, and institutional learning gained by the participating organization. Especially when an educational institution participates so intensively in a research and development process, such as in the sub-studies described here, learning gained from participating stays with the institution even after the research project concludes. For example, in the research described here, Maitri participants said they had learned about being more thorough in their design and implementation decisions. As design research involves the practice of taking implicit design elements and making them explicit (Edelson, 2002), transfer of such learning to co-participants from the organization would be likely. Also, as is found in other studies, (c.f. (W. Kuiper, et al., 2003) design decisions in Maitri earlier tended to be predominantly inspired by intuitive ideas and were fairly unsystematic in nature. The practice of explicating and refining assumptions so that decisions guided by them are more robust and well-informed was welcomed by many members. Specific institutional learning within Maitri can be summarized as follows. Management members and para-teachers learned:

- To question their assumption that all learning happens through training;
- To afford proper time and systematic procedures in defining the problem;
- To use empirical data to assess the quality of implementation;
- To use multiple sources of data so that what they learn about ground reality is not biased or incomplete;
- To anticipate dilution in implementation and so plan for implementation support;
- To value collaboration as essential for all or most decisions.

Multiple roles

The researcher combined multiple roles throughout these studies – that of, facilitator, (co)designer and researcher. There were some natural advantages of combining these roles. By acting as a co-designer and facilitator the researcher had a direct impact on practice through development of design solutions that were both theoretically viable and responsive to the ground realities. As a member of management the researcher had an 'insider' view of the organizational reality which may not have been accessible to an external researcher. This helped the researcher influence the integration of design and data collection activities seamlessly into the ongoing program strategy development and program evaluation.

However, two substantial threats to the study's rigor must also be acknowledged. First, the researcher's position in the organization made it difficult to ascertain how genuine participant reactions actually were. Attempts were made to mitigate socially-desirable responses by promoting a climate where the participants were continuously invited to express opinions. Any form of pressure to implement activities without ensuring explicit buy-in was consciously avoided. Collaboration, which is a powerful tool in building participant trust (McKenney, Nieveen and van den Akker, 2006) was integral to the design and development process. Signs of partial willingness, lack of ownership, or feelings of pressure could surface during intense collaboration and be resolved through dialogue. Second, the researcher's biases and influence of prior knowledge about the individual participants had to be constantly minimized. Triangulation of data helped compensate for researcher bias.

Over-simplification of understanding about design-based research

In this study, the management of the organization was drawn to the potential of design-based research because it takes place in authentic settings. However, it soon emerged that arriving at a common understanding of what was a rich design and research opportunity, and what was a threat to research rigor and quality would be challenging. For instance, in the first two years between 2005 and 2007, the research and development activities could not take off, due to contextual aspects such as the instability of the basic program. For example the fact that para-teachers' roles kept changing made it difficult to identify a group of para-teachers who could potentially be stable participants in the study. However, the head of the management team expected that the research and development activities could be taken up under any amount of instability, as design research was expected to take into account authentic settings, and in this case, the 'perceived instability' was in fact the natural authentic situation. It took a long time and several dialogues to arrive at the understanding that such an unstable situation was not only unsuitable for rigorous research, but also for designing lasting and effective professional development activities.

Quick iterations

Retrospective and parallel reflection is a necessary component of design-based research (Edelson, 2002). Such reflection requires some distance from the fast pace and complexity of reality, ideally by means of some gap between two iterations. Finding sufficient time for this proved to be a constraint in this current study, mainly because (a) the on-going professional development activities which were integral and critical to the functioning of the program needed to be supported for some length of time; (b) this support could ideally be provided by the person facilitating the program on the ground which in this case was the researcher; and therefore, (c) if the researcher withdrew for an extended time for analysis and reflection, the program on the ground could be severely compromised. Hence there was a constant battle between supporting the implementation of the design and carrying out research activities such as data analysis and reflection. For instance, most of the interviews were conducted at the end of each professional development cycle, which were very insightful as para-teachers were relatively free at that time. However, interesting insights could have arisen from interviews with para-teachers at the end of the workshops which took place in the beginning of every cycle to view the first experiences of para-teachers, or detailed observations of lesson-planning and micro-teaching sessions to view how the professional learning activities took place. Because the researcher was heavily involved in orchestrating the whole program, it was difficult to find time for these appropriate data collection activities. Similarly, with more time, it would have been possible for the researcher to analyze and reflect on the lesson plans of the para-teachers to look for more subtle developments than just those that were examined (which were crucial, yet basic). The presence of a co-facilitator who could support the ongoing program while the researcher took some time away for in-depth data analysis, could have addressed this.

Closing remarks

As stated previously, a design research approach was used to gain insight into desirable program characteristics, implementation strategies and the forms of support that would be desirable while also feasible. This design study evidences the characteristics of design research, organized below according to the set offered by Reinking and Bradley (2008):

- *Intervention-centered*: Having a positive impact on para-teacher learning is central to the initiative.
- *Theoretical*: The program development was informed by research findings and theoretical works; it contributes to theory building about para-teacher professional development in NGOs.
- *Goal-oriented*: This study explores how to support the professional development of an un(der)qualified but essential population in the teaching force (especially in developing countries): para-teachers.
- *Adaptive and iterative*: The tools and supports have evolved in light of the experiences and research findings.
- *Transformative*: The intervention stimulates new practices in remedial classrooms.
- *Methodologically inclusive and flexible*: Across the cycles, qualitative and quantitative data were collected; data source decisions were influenced by contextual opportunities and constraints.
- *Pragmatic*: Research, development and implementation efforts were driven by the desire to achieve an effective, sustainable, scalable intervention.

This paper speaks to the need for more examples of useful long term design research in the field of education in general and professional development in particular. Based on the experience from this and other studies, we remain optimistic about the potential of design research to contribute to scientific understanding through robust research while also informing the development of interventions on the ground. This approach is useful in a range of contexts, where solutions are needed to complex problems.

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