Design experimentation as a theoretical and empirical tool for developmental pedagogical research

Authors: Ageliki Nicolopoulou [a]; Michael Cole [b]

Affiliations: [a] Department of Psychology, Lehigh University, Bethlehem, USA

[b] Department of Communication, University of California, San Diego, USA

Abstract

This paper contributes to theorizing about issues of pedagogy through elaborations on the idea of design experimentation as a methodological and analytical tool within the cultural-historical activity theory (CHAT) perspective. Our aim is to show that whereas it is analytically possible to separate people and implementations of pedagogical procedures from what are referred to as 'contexts' and 'learning ecologies', in practice, these moments of activity are co-constituted. To illustrate this process of co-constitution, we present five iterative studies aimed at replicating Vivian Paley's educational activity of storytelling/story-acting in a wide variety of settings. Our results highlight the dynamic complexity of the learning ecology and help us appreciate that Paley's pedagogical activity cannot be reduced to a discrete set of mechanically combined procedures. Our results also make clear that the learning ecology, as currently conceptualized by many design-based researchers, needs to be revisited in light of central concepts from CHAT.

Introduction

A continuing challenge for pedagogical researchers is to investigate learning and development in complex settings, an issue central to cultural-historical activity theory (CHAT). This perspective emphasizes the mutually constituting influences of social interaction in jointly constructed activity and the functions of mediating artifacts in this process; it also places culture at the center of human sense-making activities. Design-based research is an outgrowth of this perspective, first advocated by Ann Brown (**1992**), whose pioneering work has gained prominence as a serious alternative, or supplement, to randomized, tightly controlled, research paradigms in recent years. Our goal in this paper is to contribute to the development of this method of educational research using CHAT as our orienting framework.

Despite differences among them, proponents of design-based research are likely to agree with the following three principles that are central to our discussion. First, design-based experiments aim at understanding the *learning ecology* conceived as a complex interacting system involving multiple elements of different types and levels that function together to support learning. As Cobb and colleagues assert:

> Elements of a learning ecology typically include the tasks or problems that students are asked to solve, the kinds of discourse that are encouraged, the norms of participation that are established, the tools and related material means provided, and the practical means by which classroom teachers can orchestrate relations among these elements. (Cobb, Confrey, diSessa, Lehrer, & Schauble, **2003**, p. 9)

Second, for design experiments to achieve their goal, it is necessary to conduct iterative embodiments of the designed pedagogical activity involving repeated cycles of design, curriculum enactment, data analysis and redesign, embodying the key CHAT insistence that to understand behaviour is to understand the history of behaviour. Third, study of authentic or natural situations, the actual activities of peoples' everyday lives, are required to establish the overall utility of the design (see Design-Based Research Collective, **2003**).

We concur with these basic ideas and readily acknowledge the achievements of those who have engaged in this form of pedagogical research. This paper seeks to extend design-based research particularly with respect to distinctions between 'implementation' and 'context setting' or 'learning ecology'. Theorizing using CHAT on the 'problem of context' insists that persons acting must be understood with respect to the sociocultural situation in which they are acting. As Engeström (**1993**) argues, 'contexts are neither containers nor situationally experiential spaces. Contexts are activity systems. An activity system integrates the subject, the object and the instruments (material tools as well as signs and symbols) into a unified whole' (p. 67).

We adopt the strategy of examining the conditions under which attempts to replicate a highly successful pedagogical practice succeed or fail to various degrees across a series of iterations some of which entail major changes in what are generally referred to as contexts, settings or learning ecologies. In so doing, we highlight two points central to CHAT: first, whereas it is analytically possible to separate implementations from their contexts, settings and learning ecologies, in practice, these are co-constituted so that their separation requires that we identify the processes of co-constitution that make the analytic assumption of separation so compelling in everyday research practices. Second, a useful way to uncover the workings of this process of co-constitution is through replicating a theoretically motivated educational activity over time in a wide variety of settings.

Hence, we examine the work of the well-known preschool teacher, Vivian Paley (**1990**), who created and sustained a practice of storytelling and enactment in her classroom over a number of years. Nicolopoulou and her research team implemented and studied this educational activity for several years across a number of different settings seeking to identify the means by which the process of learning was organized and supported in Paley's classrooms. A unique feature of our research was the iterative cycles of design, development, implementation and evaluation occurring in different implementation settings, a practice that appears to be rare in design-based research. In addition, because the designer and researcher were not the same person, it helped avoid a core challenge in design-based research.

Replicating the storytelling/story-acting educational practice

Paley's storytelling/story-acting activity combines narrative and play that can be deeply engaging to children and, in the process, help them to develop strong oral language skills. As its name implies, the activity includes a storytelling and a story-acting phase. At a certain period each day, any child who wishes can dictate a story to a designated teacher, who writes down the story as the child tells it with minimal intervention. Later that day, each story is read aloud to the entire class by the teacher during group time, while the child/author and other children, whom he or she chooses, act out the story.

Paley discussed this activity and some of its effects, usually in conjunction with other aspects of her classroom environment that interested her in rich, vivid and engrossing ethnographic studies during the period she taught at the Chicago Laboratory School (e.g., Paley, **1990**). Because these accounts focused on one teacher and her classroom, various questions arise concerning the generalizability and effectiveness of this programme. Moreover, Paley did not fully articulate the theoretical underpinnings of this activity or specify the conditions for its implementation in other classrooms. Her interests lay elsewhere.

For about 15 years, Nicolopoulou and her research team have attempted to implement and evaluate this activity in classroom settings both similar to and different from Paley's (e.g., Nicolopoulou, **2002**). While a strong ethnographic dimension was always included, principles of 'evidence-based' research involving quantitative measures of treatment outcomes also guided our efforts. As our research expanded in many different classrooms, the complexities of the learning ecology could not be overlooked. These complexities brought us to reflect on our research using questions typical of design-based research: (a) What makes the necessary and contingent components of the storytelling/story-acting activity work well? (b) What is the theoretical basis of this educational activity? (c) What is the main set of outcomes, argumentative framework or qualitative shifts that give us confidence that specific effects have been achieved?

In an effort to create powerful educational activities that include principles of play, Nicolopoulou engaged in five iterative studies in the US building on Paley's research: (a) a two-year study of two middle class preschool classrooms; (b) a three-year study of two middle class preschool classrooms in a different setting; (c) a one-year study of a Head Start classroom using another classroom for comparison; (d) a two-year study of four Head Start classrooms in a large urban center using two other classrooms as comparisons; and (e) a two-year study where a total of seven experimental and seven control classrooms serving low-income families were studied. While each of these classrooms was studied for one year, the data collection was staggered over a two-year period to allow collection of detailed data for each classroom. Each of these studies is briefly described sequentially, focusing on key lessons pertinent to design-based research.

Study/replication 1. The clash of cultures between the activity and the classroom

The first and most *un*successful attempt to implement the storytelling/story-acting practice took place when we first tried to introduce it in a setting that, on the surface, looked most similar to Paley's own classrooms: two classrooms of four-year-olds that were part of a laboratory school in a small elite liberal arts college. The children came mainly from professional or academic families. A strong language arts curriculum that included regular book reading, book dramatization and free play along with weekly art/music lessons was in place.

When presented with the idea of using Paley's storytelling/story-acting activity, the teachers' initial response was very enthusiastic. But, to our surprise, they only incorporated the activity during the last three months of the year. In the second year, the activity was implemented from the beginning of the year, but only once or twice per week, at which time the teachers took down stories from at most three children each time. In addition, the teachers made sure they collected an equal number of stories from each child, apparently as a means of assuring fairness. The activity was present but not pervasive.

When the teachers permitted them to engage in the activity, the children were enthusiastic about participating. When stories were dictated, large groups of children gathered around the writing table, hoping for their turn. The teachers, however, not only limited the number of opportunities to tell and act out stories, but also limited the overall time they allowed per opportunity. In addition, we noticed that the teachers found it difficult to relinquish control to the children during the storytelling/story-acting activity and they virtually never relinquished control in other classroom activities. We concluded that a paramount goal for these teachers was to create a structured environment where children followed the classroom rules so that transitions from one activity to the next would occur with little disruption. The teachers found the activity hard

to manage because, after the stories were acted out, the children had a hard time settling down immediately into a next, quiet activity.

We hypothesized that as a result of this combination of factors, a key difference between these classrooms and Paley's was that these teachers were unwilling to allow the children to use the activity to create a shared peer group culture. By this we mean that through the repeated and regular functioning of the storytelling/story-acting over the course of the year - characteristic of Paley's classroom - children learn to listen to one another and in the process exchange story characters, themes and ideas so that they come to create their own peer group culture which spills over from one story session to the next, one child to the next and even one classroom activity to the next. This kind of culture formation did not occur in this case.

Study/replication 2. The significance of narrative peer group culture

The critical role of peer group culture was confirmed in a subsequent three-year study of two middle class preschool classrooms. The storytelling/story-acting activity had been introduced by the supervising preschool teacher, prior to and independent of our research involvement. We observed these classrooms once a week and we also analyzed the stories generated through this activity. The activity occurred almost daily and teachers took down stories from three-five children each day, resulting in yearly totals ranging from 300 to 500 stories for each classroom. Teachers and children relished the activity and in one of the classrooms, 17 children told 497 stories the entire year.

These results confirmed our hypotheses that for the activity to work well, a peer group culture must be formed. A visible aspect of this culture was that the prospect of having their story acted out by children of their own choosing offered a powerful motivation for the children to compose stories. We hypothesized that this public, peer-oriented dimension of the activity helps create a community of storytellers that is enmeshed in the learning ecology of the classroom culture and the children's everyday peer-group life. Participation in this activity helps children form and sustain a shared culture of peer-group collaboration, experimentation and mutual cross-fertilization that serves as a powerful matrix for learning and development. However, if children are not given the opportunity to tell stories when they want to with some frequency and regularity, and if this activity is strongly teacher-initiated and teacher-structured, even if other play elements are retained, the requisite classroom peer culture of narrativized engagement does not emerge.

Study/replication 3. Delineating the learning trajectory of the activity: the complex dynamic between teacher and children

We implemented and evaluated the storytelling/story-acting activity next when one of Nicolopoulou's students became a teacher in a Head Start classroom in a small economically depressed northeastern town. This time we focused on assessing whether the activity promoted children's oral language skills by administering pre- and post-tests of expressive vocabulary and narrative skills to children in both the focus classroom as well as a second control classroom in the same building.

The implementation went well and a total of 165 stories (averaging 13 stories per child) were collected and acted out during two weekly sessions. Children were enthusiastic about the activity and were eager to tell as well as act out their stories. Analyses indicated that a strong classroom culture emerged that helped promote children's narrative development. Pre- and post-test comparisons indicated that the experimental classroom improved on vocabulary and narrative skills relative to the control classroom. Critically, the close partnership with this teacher allowed a careful monitoring of the activity that helped to illuminate a complex dynamic trajectory as it took hold in the classroom. Identifying and testing this trajectory, as proponents of design-based research argue, is a critical component for future successful implementations.

However, two main difficulties became apparent during the initiating phase of the activity. The first was to find uninterrupted

time for the lead teacher to take down the stories. Arranging for this dedicated time was difficult while working with 20 children, some of them rather difficult and disruptive, and with a teacher's aide who was often preoccupied attending to other classroom logistics. The second difficulty was to make the acting run smoothly with a relatively large group of children. It was the story-acting phase that brought into sharp relief the shifting dynamics of the activity once it was initiated. Over time we noticed changes in the children's understanding of the links between different parts of the activity and, concomitantly, in their response to the activity as a whole. It became clear that a teacher must learn to strike a balance between allowing the children control over the activity and maintaining control of the classroom, even as these dynamics are changing.

For example, most children initially find the storytelling/story-acting activity appealing because it provides a structured way to play with others, even if they do not yet possess the skills necessary to do so in other settings. Their initial concern seems to involve enticing any peers to act in their stories. As children continue to participate, they come to discover the power and control over the peer group in bringing many children on stage. As a result, they begin to include a large number of characters in their stories. This strategy makes the stories not only sprawling and difficult to write down but also especially difficult to act out. Teachers must learn to regulate this tendency without suppressing or subverting the activity, a difficult balancing act. In an effort to do so, this teacher decided to limit to five the number of characters the children could include. This placed an arbitrary constraint on the children that the teacher could not use productively.

Gradually, the children are able to have specific children act out in their stories. To do so successfully, they cannot simply demand that specific children act in their stories, but must learn to listen to the other children, whether in storytelling or play, and to discover their interests so that they can include desired roles. In the process, the children gain control of the type of stories they can tell. The teacher needs to recognize this trajectory and help the children to achieve their desired goals in order to realize the activity's full potential.

We came to believe that an optimal teaching strategy is to provide many opportunities for the children to tell stories supplemented with frequent book reading activities in small and large groups. We were only partly able to help this teacher further promote all children's narrative development because of the limited number of days the storytelling/story-acting activity took place in this classroom and the limited time given to book reading activities. Despite these difficulties, children's language and narrative abilities improved over the course of the year, but we believe that given more support, they could have improved further.

Study/replication 4. Further clarifying the learning trajectory of the activity

We subsequently studied the storytelling/story-acting practice in a teacher-oriented voluntary *Learning Community* on play and narrative in a large urban Head Start programme. This group met monthly and was attended by eight dedicated Head Start teachers who knew each other well. Several of them implemented the storytelling/story-acting activity in their classrooms for various periods of time and used the Learning Community forum to discuss the difficulties they encountered. We focus here on one of these classrooms where the teacher has used the activity for about two years.

As a result of our close collaboration with this teacher, we were able to further delineate the learning trajectory and potential sources of difficulties. We also determined that the difficulties encountered during the previous iteration were not simply attributable to a novice teacher, but stemmed from a complex interaction between the teacher, the children and the pre-established routines of the classroom.

Although dealing with a different set of children (African-American) in a different setting (a large urban center), the children's stories and group dynamics reflected a progression similar to that previously identified: from including any children, to including as many as possible, to including only selected peers. This teacher was better able to curtail children's tendency to bring many children on stage, but even so, only half of the children acquired the ability to tell stories

that included special roles for their friends.

Another potential aspect of the learning ecology that was further elucidated in this study was the children's desire and, at times, ability to use the activity as a tool for entertaining the entire classroom by creating silly stories. This behaviour is a significant milestone in the development of the activity because it signals children's attempt to listen to one another and thus their first attempts toward a common culture; however, it also makes the story-acting phase especially difficult to manage because it tends to get disruptive and also challenges the teacher's authority. In this way too, the teacher must learn to guide children in ways that do not suppress the activity and the children's enthusiasm for it, while maintaining adequate classroom control.

At this point, our research efforts were not limited to making the activity work well, but were also directed towards creating domain-specific instructional theory that promotes narrative development. Through discussions with the teachers, we discovered that it was important to guide their understanding and appreciation of children's narrative development so that in turn they could guide children's developing narratives in productive ways, including their choice of books that children can understand in the story reading part of the classroom activities. Our delineation of narrative development was greatly influenced through careful analysis of stories generated through this activity.

For example, we saw that teachers became impatient with the simplicity of children's initial stories that just focus on characters' actions, include a single or, at best, few uncoordinated scenes, and typically recount daily mundane experiences in a schematic and simplified way. We came to appreciate that stories develop from first- to third-person narratives and from present to past tense. In addition, telling a story they have heard before without conversational support is difficult for children. At the same time, children's productive use of cultural frameworks to narrativize their own experience is a difficult reflective endeavour, one developed by the children through repeated regular participation in the activity.

Our attempts to implement the activity in more than one classroom and follow it through the eyes of both the children and their teacher allowed us to describe and appreciate the activity's potential trajectories as well as identify their pitfalls, both of which are critical in helping to encourage and support narrative development. One of the greatest difficulties, however, was to create the right conditions for children to experiment on their own, helping them develop strong narrative skills, while also making available new models and storylines for them to draw from.

Study/replication 5. Larger dissemination of the activity

In both study/replication 3 and 4, we realized that some aspects of children's self-regulation and social interaction skills were critical for the successful functioning of the activity and, in turn, the activity helped promote these and other such competencies. This intuition was supported both by our observations in the classroom and by our theoretical re-evaluation of this play-based activity in light of Vygotsky's theory of play. These issues became clear to us because the activity's play-based elements were allowed to blossom in the classroom, and our theoretically informed analysis of these elements helped to shape our next implementation.

Over a two-year period, we introduced the storytelling/story-acting activity in seven classrooms and used seven others as comparison. We sought to determine whether it could help promote not only narrative abilities, but also emergent literacy and social competence - three critical components of school readiness. Our results confirmed these hypotheses and in the process helped us to further appreciate the dynamic learning trajectory for a diverse set of children.

To carry out this project, we worked with classrooms serving low-income children in a large non-profit childcare programme. In contrast to our previous efforts where we created strong relations with the teachers, this time our efforts were divided: Nicolopoulou formed strong relations with the childcare administration and her research assistants with the teachers and their classrooms. Because we were now dealing with teachers who were not well paid and encountered various restrictions in their lives, it was difficult to have meetings with all of them to discuss their experiences with the

activity. This phase of implementation comes closer to what Ann Brown (**1992**) called the 'gamma stage', marked by widespread adoption of the educational activity with minimal support, which, if not attempted, calls the intervention into question.

The activity was well integrated in the classrooms and children were very eager to tell stories and act them out. The children composed and acted out 188 stories in the first and 363 in the second year. This variability reflected variation in the overall length of the intervention as well as how often teachers carried out the activity. During the second year, we decided to provide support for the storytelling to make it function regularly; mainly research assistants collected and wrote down the stories as compared to the first year when the teachers did so.

For the overall sample, more than half of the children (63%) came from families poor enough to qualify for governmental childcare subsidies and the ethnic distribution was typical of diverse classrooms in the US (48% White, 22% Hispanic and 19% African-American). Individual classrooms were more diverse with some including many poor and/or children from different minorities while others included less. These differences reflected the demographics of the community that the classrooms served. Variability in how often the activity was implemented was one of the key factors that affected the possibility of creating the type of shared narrative culture that we have argued is critical for realizing the benefits of the activity. In some classrooms, the stories were mainly first-person stories that focused on daily activities while, in others, they shifted over time to third-person stories that incorporated themes from children's books or TV shows. Some classrooms showed a higher level of borrowing of children's themes from each other than others. Overall, whereas our results indicated that children in the experimental classrooms benefited in language, literacy and social competence relative to the control children, there were also noticeable differences among the experimental classrooms. The narrative peer culture achieved, which in turn affected the number of stories told, was a key factor in the magnitude of the outcome measures observed.

Discussion

With this brief overview of our repeated attempts to implement, analyze and evaluate Paley's activity in hand, we now return to the problematic with which we began: the utility of design experimentation for understanding learning ecologies, conceived as complex systems of interacting elements. We provide new insights for analyzing Paley's own classroom practices and make explicit its complex organization that can serve to better design and implement successful pedagogical practices stemming from her work.

Re-examining the idea of a learning ecology

A useful starting point is the realization that these iterative attempts to implement the storytelling/story-acting activity revealed the enormous complexity implicit in the idea that elements of a learning ecology focus on the tasks or problems that students are asked to solve, the kinds of discourses, norms of participation and the tools in classroom involved in learning (Cobb et al., **2003**). We first consider each of these elements and then turn to their systemic interconnectedness with each other and with the institutional setting in which they occur.

The *tasks and problems that the students are asked to solve* might seem, at a first glance, the easiest aspect of the learning ecology to identify, to explain to teachers, and to implement, at least in bare outlines. In all our replications, children told stories and subsequently acted them out involving their peers. However, time and again, we observed that both the storytelling and the story-acting entailed negotiation and adjustment on the part of teachers and children alike. One line 'stories' had to be elaborated with teachers' assistance to make them performable; and long rambling event sequences with a cast of dozens had to be flexibly simplified to make them performable or to keep them from thoroughly disrupting large group time. Moreover, these 'tasks' underwent dynamic changes over time to which the teacher had to be sensitive and able to bring implementable bounds 'on the fly'. The task or problem and the modes of discourse could not be considered independently from one another; mastery of the 'task' required mastery of the forms of discourse involved in

each phase of the activity.

The *norms of participation* described in the iterations emerged in response to at least two kinds of considerations. Some concerned the relationship between this activity and other classroom activities. For example, restricting the frequency of this activity was intended to help it fit in smoothly with other classroom routines, though it may also have limited narrative cross-fertilization and the emergence of a peer-group narrative culture. Other considerations were more intrinsic to the successful implementation itself - constructing a framework that generated increasingly sophisticated narratives and drew children into both storytelling and story-acting, while encouraging manageable story lengths and numbers of characters.

Tools and related materials were in one sense unproblematic. Paper to write on or pencils to write with, and children's emerging abilities of listening to stories and of relating events might seem to be all that was needed; and they were readily available. But even this held hidden complexities. We increasingly appreciated that a ubiquitous feature of Paley's classroom was story *reading* by the teacher accompanied by many and spirited discussions, not only immediately following the story, but others that arose in the course of negotiating classroom participation. These discussions drew upon the content of the stories as a way of helping the children understand norms of classroom interaction, the meaning of friendship and obligation, and all of the many fraught questions of learning to make one's way in a social group that is an essential feature of any early childhood classroom learning ecology. This infusion of the tools and materials of storytelling, reading and dramatization into virtually all other classroom activities not only was difficult for teachers, but ran directly counter to the typical compartmentalization and routinization of activities, which many teachers had come to rely upon in maintaining an orderly classroom.

The *practical means by which classroom teachers can orchestrate relations among these elements* is present, either implicitly or explicitly in our discussion of all 'learning ecology' elements and it speaks directly to the understanding of a learning ecology as a complex interacting system. In short, Paley's curriculum cannot be mechanically introduced in a classroom or translated into a set of bulleted guidelines, such as those currently fashionable in teachers' manuals, and be expected to produce the kinds of educational effective results we have highlighted above in cases that were reasonable implementation of her practices. Such materials may serve as a training 'starter kit'. But even the manual we made for the teachers used in conjunction with videos made with Paley to introduce the activity into a classroom cannot fully capture the complex dynamics we have highlighted. In fact, an important methodological point for design-based researchers, as CHAT researchers have shown, is that the actual dynamics at work in Paley's classroom and her flexible expertise in orchestrating her classroom through storytelling/story-acting as its systemic organizing activity were brought into sharp relief for us, as analysts, precisely by the ruptures or difficulties that took place as we introduced the activity into different classroom ecologies. Through repeated sources of disruption in different learning ecologies studied, we came to appreciate Paley as a gifted teacher and the full complexity of the activity she orchestrated.

Theory development and design research

Design researchers are clear that their goal goes beyond creating 'something that works' to include the development of domain-specific instructional theory which is tested and refined through the iterative process of designed implementations. But even the theory we seek is not static or predetermined. As we appreciated the dynamics of the activity through the repeated attempts at implementation and evaluation, our theoretically motivated research goals were modified accordingly. Initially we developed and verified the idea of the importance of the formative role of peer group culture, then turned to the question of how best to promote narrative development in social context, and finally to examining ways to measure narrative development and its sequelae including a wide range of school readiness abilities (language, emergent literacy and social competence). We also became better able to theorize the crucial role of skilled teachers who can balance authority and children's creative freedom dynamically.

These experiences also created deeper understanding of Paley's own theoretical enterprise, which was not always clearly articulated through her unique book-based mode of representing her teaching. For example, we came to fully appreciate

why she argued that her goal as a teacher was to understand how to teach logical thinking and precise speech in the classroom. Paley was acting on the strong belief that rational discourse and narrative skills were closely related, which helps explain why storytelling/story-acting was central in her classroom. Not only was the activity designed to help children to experiment with the requisite skills but also provide them with much needed practice in rational discourse that becomes central to their later education. This activity was the cornerstone in how Paley could help to achieve her larger pedagogical goal of children developing the capacity to engage in rational discourse while also tapping their deepest concerns about friendship, fairness and imagination. This larger goal not only cannot be achieved in a mechanical way, but, more significantly, it is the organizing force and directing framework that imbued her hallmark activity.

Broadening the idea of learning ecology

Our efforts to implement and study the activity in various diverse settings also made us aware that other aspects of the classroom and the larger social ecology were critical for the storytelling/story-acting activity to emerge even for brief periods of time. Whereas a core element of design-based research is to investigate cognition in context, the boundaries of *context* and what constitutes *naturalistic context* have proven elusive. Some design-based researchers are vague about whether the larger classroom ecology dovetails with the design-activity under investigation. We, however, observed that the larger institutional structure of the classroom played an essential role in the very possibility of storytelling/story-acting to emerge as a classroom practice, as CHAT researchers have repeatedly demonstrated. This is particularly critical, if we accept that a research focus for educational innovations is to deal with usability and sustainability of the design-activities under construction and consideration.

For example, the administrators in the school district of Study/replication 4 helped to make possible the creation of a learning community of teachers, many of whom used the storytelling/story-acting activity in their classrooms. The discussions and exchanges that the teachers had with each other and our research team were invaluable. They allowed us to identify the difficulties that the teachers or the children had with the activity and in the process come up with productive ways to solve them. This level of understanding would not have been possible simply through open-ended and lengthy individual (or group) interviews with the teachers. On the other hand, the school administration, mainly for political reasons external to the activity, put an abrupt end to our research project in these classrooms and our collaboration with these teachers by denying support for the commencement of a federally supported research project to evaluate our efforts. Thus, the success of an educational innovation depends critically both on what happens inside the classroom as well as institutional and larger socio-economic forces that come to shape it.

Our experience also suggests that, while design-based researchers assert that the learning ecology and 'its context' are co-constituted systems, many of them tend to conceive of context as somehow distinct from the learning ecology, not an essential constituent of it. In contrast, CHAT researchers have argued that we need to be more careful in how context co-constitutes learning and that context needs to be conceptualized in terms of activity systems. In this respect, we came to appreciate that the learning ecology encompasses, among other things, teachers' preexisting routines, how well-paid and knowledgeable they are, their expertise in dealing with children, other classroom activities and their implicit as well as explicit educational goals.

We come away from this experience strongly encouraged by the utility of design-based research, but equally convinced that researchers need to carry their practices beyond 'the implementation', to embrace the notion of a learning ecology in its broadest terms as complex systems of activity, and to be ready to continue the research process over many iterations. This is not an easy task and currently favoured pedagogical research practices do not offer strong incentives for implementing the methodological principles of design research. But the rewards in terms of deeper understanding are undeniably there if one has the good luck and fortitude.

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