Designs for Teaching and Learning in Technology-Rich Learning Environments

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English abstract

In this paper we argue that the notion of design is conducive to analyzing and developing learning and teaching in technology rich environments. Our argument is inspired by Cultural Historical Activity Theory (CHAT). From a CHAT perspective we briefly discuss the term design, especially in connection with the advent of digital networks, increased complexity of learning environments, and Web 2.0 applications. We also draw on the German/Nordic concept of didactics as well as the Russian/Vygotskyan concept of obuchenie, often understood to possess the dialectical relationship between learning and teaching, in order to refine our notion of design. Finally, we discuss two empirical cases from our design perspective.

Keywords: Technology rich environments, design, didactics, teaching and learning, obuchenie, sociocultural theory.
Introduction

In this paper we argue that the notion of design is conducive to analyzing and developing learning and teaching and can enrich our understanding of didactics. Like Vygotsky (1978, 1986) we consider learning and teaching to be two mutually constitutive aspects of education as well as personal development. However, Vygotsky had the Russian word *obuchenie* at his disposal to capture the dual aspects, while English (as well as Norwegian and most other European languages) does not afford a similar term. When we still turn to the Russian/Vygotskyan term it is because we here see a potential for developing designs for learning and teaching, and especially so in technology-rich environments. This potential is addressed in the discussion section of the present paper.

Our rationale for a design approach is found in the increasing complexity of learning environments. While speech and writing are still major constituents of learning and teaching, the artifact level exercises increasing influence on, for example, classroom activities: how we make sense of and produce multimodal representations, how we exploit and tweak models and simulations, and how we traverse the Internet to make fragmented shards of information into meaning-making entities are but some examples of how artifacts influence, afford and constrain educational efforts. When the complexity of learning environments and, thus, learning trajectories increases it becomes difficult for teachers to plan or predict how learning activities will be enacted in class. Teachers’ creativity, subject content knowledge, and capacity to find *ad hoc* solutions to such, often sudden and unexpected, challenges are still important professional qualities, but this is not enough to turn complex learning environments into productive teaching environments. By contrast, detailed planning can become a straitjacket that does not allow sudden opportunities or serendipity to enrich the planned activity. Consequently, we use design as a term that affords the unexpected but is enacted without resorting to mere improvisation or rigid planning. Designs cannot predict or prescribe how learners actually respond to the tasks or assignments they face but offer support for teachers orchestrating tasks, activities, and resources into productive learning trajectories (Dreier, 2003; Edwards and Mackenzie, 2005).

In order to develop designs that are sensitive to *obuchenie* – learning and teaching – we draw on Cultural Historical Activity Theory (CHAT) (e.g. Engeström, 1987; Engeström, Miettinen, & Punamäki, 1999). The relational nodes in an activity system connect human agency to a community with a collective motive, mediated by cultural tools or artifacts, and regulated by rules and conventions, and a division of labor. Thus it links the individual to the collective, agency to available resources, and mind to communal and institutional contexts. Consequently, CHAT has proved to have explanatory power when theorizing and analyzing learning, development, and transformation beyond the individual as a unit of analysis (Roth, 2004). However, there seem to be few empirical studies of using CHAT as a guide for educational designs (Luckin, 2010). This should not be understood as if we consider theories of learning to be used as simple recipes for teaching. Rather, to paraphrase Marx’s observation that, “The philosophers have only interpreted the world, in various ways; the point is to change it” (1888/2005: thesis xi), we believe that for educators CHAT is not only an analytical lens for examining (and explaining) phenomena, but can also be used as a framework for interventions that can effect change in learning and teaching. Consequently, the question we seek to answer in the following sections is how we can draw on theory in order to develop educational practices for technology-rich settings.

We first briefly discuss design in connection with the advent of digital technologies, networks and Web 2.0 learning environments. Next, we summarize some recent attempts at developing the
From Instructional Design to Design in the Zone of Proximal Development

Design is a fuzzy concept in the sense that it is used in and across diverse domains (product, architecture, landscape, technology, education, etc.) but it is also closely linked to interventionist research methodologies such as Design-Based Research. All of these uses resonate to some extent with our use of the term. However, as we address educational designs in technology-rich environments and from a sociocultural or CHAT perspective, we will summarize some approaches that we argue are pertinent to this tradition.

One early but important approach is represented by Instructional Design (ID) (Reiser & Dempsey, 2007). In the 1970s, some proponents of ID began to adopt an information processing approach to the design of instruction. ID with its roots partly in cognitive and behavioural psychology and partly in educational technology would not seem to agree with sociocultural assumptions (Grabinger, Aplin, & Ponnappa-Brenner, 2007). ID focused on monitoring and controlling the learner as well as the learning environment in order to bring about learning outcomes. The design has often involved specific modules or steps that ideally should have clear effects on the performance of the learner. Cultural tools such as textbooks, pen and paper, and calculators were considered instrumental learning aids. When computers gradually became integrated in the designs, an information processing approach to learning accompanied them.

More relevant for our approach is Participatory Design (PD) which established a strong relationship between technological design and learning (e.g. Béguin, 2003; Bødker, Kensing, & Simonsen, 2004). PD principles are often found in software development and Human-Computer Interface design. In PD the focus is on design processes and end user involvement and, with its strong Scandinavian heritage, carried notions of emancipation, empowerment and democracy. End users, for example workplace practitioners, were often involved at several stages of the design processes. Although PD may not draw on a specific theoretical framework, we often come across concepts such as boundary objects, boundary crossing, and situated action – all invoking sociocultural and CHAT overtones. However, PD often stops short of following more longitudinal learning trajectories and individual as well as collaborative user practices beyond the design processes. According to Mor and Winters (2011: 69), “A major research challenge is to communicate the potential of tools developed in technology-oriented research to the pedagogy and epistemology research communities, and vice versa”. We believe that this challenge is not restricted to research but pertains just as much to educational practice.

The advent of digital networks, multimodal representations, and Web 2.0 applications has resulted in increasing complexity in the learning environment (Lund & Rasmussen, 2010; Lund, Rasmussen, & Smørdal, 2009). At the same time, the literally infinite information available makes it extremely taxing for learners to navigate, select functional and relevant information, and make productive syntheses of sometimes random, ambiguous or even contradictory fragments. Educational designs must acknowledge and meet such challenges.
In the face of such complexity and uncertainty, meaning making – in personal development or in more subject-specific contexts – does not emerge without assistance. Here we acknowledge the importance of Vygotsky’s concept of the zone of proximal development (ZPD); how interactions with peers (symmetric), more knowledgeable peers (asymmetric), and available cultural resources are conducive to development. But we also draw on more recent theorizing of the concept, extending it to hold more collective and dialectical dimensions. Daniels (2001: 67) observes:

> Multiple and possibly conflicting discourses with different sociocultural historical origins may be in play within the ZPD. This view of the ZPD as the nexus of social, cultural influences takes us far beyond the image of the lone learner with the directive and determining tutor. It provides a much expanded view of the ‘social’ and the possibility of dialectical conception of interaction within the ZPD.

This is an expansive, collective and dynamic view of the ZPD and it results in a need to constantly redefine it according to learners’ needs and opportunities. It also means that the ZPD can be viewed as inhabited by individuals as well as a collective who can create a common ZPD through their interactions (Daniels, 2001). This is a most important principle when integrating, for example, Web 2.0 technologies into education as such technologies afford extensive interaction, diverse collaborative activities, and joint production. Consequently, we argue that educational designs in the networked society (Castells, 1996) need to capture the social as well as the material support available in the participants’ ZPD.

### Three sociocultural notions of design

Some recent endeavours indicate that researchers as well as educationalists recognize a need to develop designs for high-complexity environments. For example, Grabinger et al. (2007) seek to develop a framework for instructional design from a sociocultural perspective by focusing on “critical thinking, problem solving, research, and lifelong learning” (ibid.:1). They arrive at an extensive list of characteristics emblematic of designs for sociocultural learning environments. However, they rarely move beyond well established, broad terms such as community of practice, authenticity, interaction with the environment, and tools as mediators. The authors conclude that, “This convergence of tools, practice and theory enables teachers and students to discuss, plan, create and implement unique strategies for providing instruction within a unique environment” (ibid.:6). Also, the authors point to a most important principle when they advise that, “Do not underestimate the importance of involving students in their own instructional designs” (ibid.:7). Unfortunately, this is not pursued in the paper. We return to this principle when we draw on the concepts of didactics and obuchenie.

Selander (2007) grounds his approach in a social semiotic view of learning: “Learning can thus be seen as an increased capacity to use signs in a meaningful way in a communicative context” and, “Learning consists of, in other words, a series of sign producing activities” (ibid., p. 167, our translation, emphasis in the original). He proposes a model that rests on three central concepts: interactivity, didactics, and design. Didactics is for Selander intimately linked to interactivity in physical or virtual space. Such designs can be seen from a tutor or application perspective, as preparations, but also from a learner’s perspective; how s/he negotiates her way towards understanding and how s/he tries to make sense of the signs s/he encounters on her way. Such designs hold material-technical as well as human-social qualities. Selander has made important contributions to the concepts of design as well as didactics. However, his focus on semiotics seems to obscure the
importance of practices and the role and intentionality of the actors. His model does not seem to have a collective motive, what in CHAT is referred to as the object. Thus, the direction and object of the transformations are not discussed or identified. Selander’s criticism of sociocultural approaches seems to overlook that CHAT focuses on exactly what he misses in situated perspectives: rules and conventions, division of labor, and historical development and expansion in general.

In our previous work on educational designs (Hauge, Lund & Vestøl, 2007; Hauge & Dolonen, in press) we, unlike the two efforts referred to above, have sought to link design to the CHAT construct of the object in order to capture direction, collective activity, and intentionality among actors – teachers as well as learners. The object gives direction to the activities and is continuously constructed and reconstructed by the participants involved in the activity. Also, it holds a dual nature in the sense that in addition to giving direction to the activities it also becomes manifest in the process through instantiations – versions that can be further refined (Kaptelinin & Nardi, 2006).

In the volume by Hauge, Lund and Vestøl (2007) we distinguished between two aspects of the design. Design for teaching is basically the teacher’s responsibility and emerges through interpreting curricula and competence aims, but may well involve learners in the process. However, the intentionality behind this aspect of the design is primarily that of the teacher and the larger educational policies. Thus, there is an institutional dimension to designs for teaching. Design for learning refers to the enacted design; what actually happens when teachers and learners engage in joint construction of the (learning) object. While designs for teaching delimit the activities, designs for learning are context sensitive and respond to, for example, immediate opportunities, learner initiatives and serendipity. Also, designs for learning open up for using learners’ out-of-school social and cultural experiences, their life worlds (Cope & Kalantzis, 2000). Thus, the combination of the two design aspects has the potential to build conceptual bridges between learners’ life worlds and institutional goals. We firmly placed networked technologies and social applications in such bridge building, as artifacts mediating between diverse cultural contexts and different activity systems.

However, we did not sufficiently elaborate the relationship between the two types of design because we (at the time) lacked theoretical concepts. Nor did we attempt to explicitly link the notion of design to didactics. This is partly due to the term’s – at least in the Anglo-American tradition – somewhat normative and instructional bias; partly because the term has not been much discussed from a sociocultural perspective. In this paper we seek to elaborate and theorize the link between designs for teaching and designs for learning by first adopting the Vygotskian concept of obuchenie and, secondly relate design to our notion of didactics.

Obuchenie, didactics, design

Obuchenie is a term that is vital for understanding Vygotskian approaches to development but at the same time a term that has been widely misunderstood through translation difficulties (Cole, 2009). In order to capture its essence the concept has often been translated into a dual activity term, for example as “teaching-and-learning”. It is firmly linked to the zone of proximal development as bi-directional knowledge production involving the teacher(s) as well as the learner(s). What the original term does not make explicit, but which is vital in sociocultural assumptions of learning as well as in our conceptualization of design, is the role of artifacts – how they can be conducive to obuchenie – teaching and learning as a unified and dialectic entity. This becomes evident in the following quote from Cole (2009: 292):
In general, the Russian word, obuchenie, refers to a double-sided process, one side of which does indeed refer to learning (a change in the psychological processes and knowledge of the child), but the other of which refers to the organization of the environment by the adult, who, it is assumed in the article under discussion, is a teacher in a formal school with power over the organization of the children’s experience.

This passage firmly links obuchenie to a teaching design in the sense that it refers to “the organization of the environment”. The relevance for technology-rich learning environments is obvious. However, it also emphasizes the learning aspect in this dialectic concept. For example, Luckin (2010: 22) asserts, “The important point here is that there is a sense of mutual cognitive growth within both the learner and their more able other or teacher”. Translations have struggled with this: “In other words, unlike in English, obuchenie carries the meaning of both (...) By contrast, the meaning of ‘teaching/learning’ is subtly, but clearly, different from either of the words used alone” (Tudge, 2001: 1). Consequently we struggle with awkward, hyphanted (teaching-and-learning) or slashed (teaching/learning – often perceived as the one or the other) constructions in order to denote the original concept. One interesting attempt to find ways to capture dialectical concepts is the use of the Sheffer stroke, |, “whereby two mutually exclusive but reciprocal terms are combined together” (Roth & Lee, 2007: 197). In the following we adopt the Sheffer stroke when translating obuchenie into English learning|teaching. The implication is that neither learning nor teaching can be used as a point of departure for understanding the other.

It is the reciprocity of the two aspects, the tensions and potential synthesis that we also seek to put into operation in our notion of design for complex learning environments. We distinguish between Design for teaching and Design for learning, partly for analytical purposes and partly because this duality shows how the latter might be a transformation of the former – not least as a result of using powerful cultural tools. In our approach to design we acknowledge that the two design types for all practical purposes are mutually constitutive of the learning activity, we just do not have a singular concept for this.

Just as obuchenie has informed our concept of design for technology-rich learning environments, design will, in turn, inform our concept of didactics. Didactics, at least in its German/Nordic version, holds a democratic and reflective dimension by addressing some of the pressing concerns of humanity (e.g. ecology, peacekeeping, poverty) and how confronting such issues is part of the formational aspects – Bildung – of didactics (Gundem, 1998; Klafki, 2001). But didactics has also, at least from an Anglo-American perspective, carried notions of planning for teaching, choice of methods in order to reach prescribed goals, and similar normative and unidirectional dimensions (Hamilton, 1999). The role of interaction with social, semiotic, and material resources is not always articulated.

Selander (2007) also addresses this when he expands didactics to involve interactivity in physical as well as virtual space. Contrary to conceptualizing didactics as a response to the questions of what to teach, how to teach it, and why to teach it (networked environments additionally pose the questions when to teach and where to teach) we propose a CHAT perspective of didactics. Building on Edwards et al. (2002) and Lund (2004) we therefore suggest a definition of didactics that seeks to capture our notion of design: Didactics can be understood as the design of social practices in which learners, teachers and (social and material) resources are configured and re-configured in activities that make knowledge domains and knowledge advancement visible, and that continuously create opportunities for reflective participation in such activities.
This definition links design to didactics. Also, it gives priority to agency, dynamics, and object over content (what) and method (how), although more subject specific versions would naturally place more emphasis on such aspects. Finally, the definition acknowledges the vital role of artifacts in 21st century education. In essence, it is an attempt to operationalize an interventionist CHAT approach to design for learning/teaching, cf. our introductory invocation of philosophy as action.

So far we have sought to establish and develop our concept of design by adopting the Russian/Vygotskyan term *obuchenie*. Also, we have briefly discussed how design in this sense relates to and might transform our understanding of didactics. Next, and in order to make CHAT aspects of design more visible we turn to two empirical studies. The first is an analytic account of senior high school learners engaged in understanding an act of terror and how to share this knowledge with classmates. The second study is a meta analysis of a series of cases in which senior high school learners and teachers used wikis in order to engage in collectively oriented tasks. The studies are quite different but (and therefore) selected since they make visible designs for learning and teaching in technology-rich environments. However, such designs were never explicitly articulated by the teachers involved. It is therefore important to note that what follows is a *post hoc* analysis from the design perspective elaborated in the previous sections of this paper.

**Study 1: “Beslan”**

In this case we examine a cross-disciplinary project at Hillside Secondary School in Oslo, Norway. It involves a small group of learners (four boys, age 17) going beyond the limits of their previous and existing knowledge and how they engage in processes of collective knowledge creation (Lund & Hauge, 2010). They seek to make sense of a tragic incident; the hostage situation and ensuing battle between Chechen rebels and Russian soldiers at School No 1 in Beslan where 344 people, 186 school children among them, died (September 2004).

The group pursued the question of what can be considered terrorism. The object, trying to make sense of a seemingly nonsensical event, could not be constructed by consulting authoritative sources: The phenomenon was quite new, restricted to mostly online representations, and fiercely disputed. In sum, we could say that the object of the group’s efforts was to make sense of a phenomenon at the periphery of their existing knowledge. Within this framework, we argue that it is vital for pedagogic practice to analyze and understand the relations between an activity, its object(s), the tools employed and under what conditions. In particular, we consider the object(s) of the activity as crucial in processes where learners face something new, where they have to make sense of a phenomenon that appears ill-defined, enigmatic, or impenetrable.

There are few empirical studies of young learners engaging in collective knowledge creation and innovation. In Norway, for example, project work – often used when there is no “given” solution to an assignment – made its way into the national curriculum in 1987. However, Rasmussen (2005) in her review of project work and ICT finds that problem-solving in schools still tends to focus on “solving” the task at hand more than advancing knowledge that can prove useful in and across changing contexts and new situations that emerge. This is interesting considering the fact that issues with such a “future” quality have been addressed in education as well as in working life (Cope & Kalantzis, 2000; Gee, Hull, & Lankshear, 1996; Hakkarainen, Palonen, Paavola, & Lehtinen, 2004; Hargreaves, 1999; Scardamalia & Bereiter, 2006; Wells & Claxton, 2002). One common concern
in the literature referred to above is the need to align practices in schooling with practices in modern working life as well as in research.

Hillside has a tradition of involving learners in several aspects of teaching, from task construction to the use of wikis and peer group assessment. During the school year, learners in the foundation course (three classes, age ca. 17) carried out two major, interdisciplinary projects. In the spring term 2005 the point of departure for one project was ethics. Although this general theme was decided by the teachers it was very much left to the learners to give it shape and direction.

For analytical purposes we have listed the process (Table 1, below) as stages from testing out ideas, collecting data and information (often contradictory), negotiating meaning and finally production, presentation and reflection. Also we have to some extent separated the roles of the teachers and learners in order to identify aspects of designs for teaching and designs for learning.

<table>
<thead>
<tr>
<th>Stages</th>
<th>Teachers</th>
<th>Learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1: Planning, Integration, Evaluation: “PIE”</td>
<td>Deciding on an overall, interdisciplinary theme: Ethical dilemmas. Organizing initial brainstorming group with two representatives from each of the three classes and one teacher from each class, i.e. a total of nine persons in the group.</td>
<td>Accepting the general theme. Electing two representatives from each class for the brainstorming session.</td>
</tr>
<tr>
<td>Stage 3: Promoting ideas</td>
<td>Observing negotiations, offering guidance.</td>
<td>“Selling” categories from brainstorming session to the rest of the classes. Groups of 3 – 5 deciding on issues within the general topic.</td>
</tr>
<tr>
<td>Stage 5: Integration, synthesis, production</td>
<td>Observing. Open to consultations.</td>
<td>Production of poster, PowerPoint presentation, and simulated TV debate.</td>
</tr>
</tbody>
</table>

Some comments to Table 1 are needed. At Hillside, a project is always kicked off by a so-called Planning – Integration – Evaluation (PIE) meeting (Stages 1 and 2). It is an institutionalized practice and one which can be seen as the first stage of negotiating a potentially shared (learning) object. In the PIE meeting the theme is first approached in a brainstorming session where topics are suggested in the form of keywords on post-it notes. These notes are placed on the table for all to see and in
no particular system. It is a high-paced activity that usually goes on for 10–15 minutes or until the
generation of ideas slows down. In this case about 60 ideas were jotted down and placed in front of
all. From this diverse material topics are sought, extracted, bounded, and made more visible by
organizing ideas into categories. In this phase the teachers actively help learners find a handful of
logical categories.

Next, in the three classes groups of three to five learners adopt a category and negotiate a relevant
issue they want to pursue. From this moment on the objects of the groups are developed, negotiated
and transformed over time. Mediating this process are several digital applications and practices such
as searching the Internet, consulting Wikipedia, collecting and restructuring information in Word
files, saving bits and pieces in the school’s learning management system. In this process (Stages 3 –
6) the initial, teacher-dominated design is appropriated and enacted by the learners.

The group we follow decided to produce a poster introducing their particular topic, a PowerPoint
presentation for the rest of the class, which served as an introduction to the main outcome – a role
play in the form of a dramatized TV debate between representatives from Russia and the Chechen
rebels, followed by a real debate by the whole class. Ideally, the combination of the representations
and the class debate would become the shared object for the whole class.

It is important to note that teachers did not actively intervene in the project work after the initial
phase but were mainly available for consulting. Learners were encouraged to contact the teachers
regularly throughout the project, but this rarely happened. When the teacher of the “Beslan group”
approached them in order to check whether they had encountered problems he was mostly assured
that everything was OK. At one point he cautioned them about the sensitive and complex nature
of their topic.

By observing and videotaping the group’s efforts to make sense of the tragedy and make
representations of it we saw how the group first approached the larger assignment, a somewhat loose
design for teaching, and sought to enact it as a design for learning by identifying their object and
constructing it through dialogue and artifact-mediated activity. Through material and social
mediation the object was transformed from a historical, enigmatic phenomenon into contemporary
representations that the group intended to enlighten their classmates. To grasp what happened at
School No 1 in Beslan, and why, gradually emerged as a coherent object that existed beyond the
fragmented, provoking, and seemingly irrational incident that they first encountered. In the final
stage of the project this process now materialized in different products.

A poster and a PowerPoint presentation for all classmates proved to be informative, balanced and
without unnecessary brutal content. However, the staged TV debate between representatives of the
Russian government and a representative for the Chechen rebels adopted a tabloid form where
dramatics (foul language, extrovert behavior, and use of props such as balaclava, pistol belt and
camouflage uniform) obscured the informative content that might have been conveyed. Classmates
reacted negatively and afterwards severely criticized the group for making a show of a serious and
frightening incident. The group acknowledged the criticism, and when self-assessing their project
agreed that the TV debate failed. Their teacher, who joined the group during the assessment stage,
comforted them by applauding their poster and presentation and reminded the group about warning
them about the complex and sensitive nature of the topic they set out to understand.
Findings from the “Beslan” can be summarized as follows:

- The group struggled to make sense of contradictory information beyond their current understanding.
- The use of some artifacts (props for dramatization, web-based material with affective content, etc.) threatened to replace the original object (making sense of the senseless) and become a parasitic object. Other artifacts (websites, search engines, presentation tools) proved to be conducive to knowledge advancement.
- The teacher exercised only a subtle presence, leaving major decisions and final representations of the object to the learners.
- The group, through negotiations and exploration, expanded their understanding of the object, but they failed to share it with their classmates.

The “Beslan” project shows how learning environments as well as trajectories become extremely complex and demanding when the learning object is not a “given” but has to be constructed. Also, we see how the many available resources afford as well as constrain and even disrupt learners’ activities. While this is a situation that seems to require a structured and persistent design for teaching, we see how such a design yielded too quickly for a design for learning which left, no doubt with the best of the teacher’s intentions, too much to the learners. Consequently, we see that the delicate learning|teaching balance is violated through too little attention to the configuration and re-configuration of available resources. In CHAT terms we would say that the roles of artifacts and the rules or conventions and the division of labor under which the artifacts were employed were not articulated and shared by the teacher and learners. Thus, one important insight that arose from the project was the need for teachers to design themselves into the many activities that constituted knowledge advancement, and for all involved to be aware of the power of artifacts. A persistent teacher presence also emerged as a vital design aspect in the series of wiki cases we analyze next.

Study 2: Wikis

One of the so-called Web 2.0 applications gaining ground in education is wikis. A Web 2.0 application will typically afford collaborative production of content to be shared and further refined by a community. Wikis invite participants collectively to produce content, but also reciprocally to edit or even delete contributions, make links between them, add comments or invite discussions, and sometimes add tags or labels to contributions. Such activities make it difficult for teachers to monitor, support or take part in the productive activities (Lund, 2006; Lund, et al., 2009; Lund & Smørdal, 2006).

From 2005 and into 2009 we researched several classes at two different schools using wikis for collaborative learning, the TWEAK project. The aim of the project was to examine to what extent the collectively oriented wiki was conducive to knowledge advancement in the subjects English as a Second Language (ESL) and Modern History (MH) and what constraints that emerged. The ESL class consisted of approximately 30 learners while the MH experience involved four classes of approximately 30 learners, adding up to nearly 120 learners in the wiki. Throughout the project teachers and researchers engaged in redesigning wikis according to the educational needs that arose. Thus, the TWEAK project comes across as cyclical interventionist research in which opportunities and constraints found in one iteration influenced the next, pedagogically as well astechnologically.
In Table 2 (below) we seek to give an overview of the design issues that emerged, in the order they were identified. In order to focus on the design aspects Table 2 links learners’ tasks and assignments to activities that unfolded and the issues that influenced the subsequent iteration. The row marked in italic is an exception as it represents a pedagogical-technological challenge, resulting in extensive collaboration between teachers and researchers. However, since this effort is essential to the design theme it is included in the table.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Learner activities</th>
<th>Design issues that emerged</th>
</tr>
</thead>
</table>
| a) A wiki production reflecting learners’ perceptions of the USA.  
b) A “typical” British town (history, infrastructure etc.) as a wiki production. | a) A very high number of contributions, mostly in individual and small group work.  
b) More collectively oriented work, more links between contributions. | Teachers experience difficulties of establishing a presence in a wiki. Established expertise in class management is challenged or suspended (Lund & Smørdal, 2006). |
| How Anglo-American culture has influenced various parts of the world. | Groupwork: Wiki production plus oral presentation with PowerPoint. Due to wiki breakdown learners engaged in what they referred to as “wiki way of working” by combining MSN and circulating PowerPoint files for contributions and editing. | Individual and collective epistemologies (Lund, 2006).  
Mismatch between learners’ assignments and tasks and the available cultural tools. (Lund & Rasmussen, 2008). |
| Teachers and researchers (including programmers and web designers) developing assessment features in a wiki. | Joint meetings. Teachers developing new types of tasks. Researchers responding to teachers’ needs and offering ideas for development (“mutually beneficial infringement”). | Developing assessment features in the wiki so that individual contributions as well as their relevance to the collective product are accounted for (Lund, et al., 2009). |
| a) Immigration stories as modern Norwegian history.  
b) Re-enacting the cold war through online argumentation. | a) Diversity of voices aggregated into a collectively produced account.  
b) Diversity of opinion and aggregation of contributions as a “lived” experience of historical events. Counter factual argumentation (“What if…”). | The “closed task universe” (strong relationship between task and textbook, individual orientation) challenged by the “open task universe” (invites exploration, negotiation, and large-scale collaboration, appears fragmented and even unreliable) (Lund & Rasmussen, 2010). |

As the right-hand column shows a number of unresolved design issues emerged. The first one echoes the lack of teacher presence noted in Study 1. However, as this was anticipated when introducing the wiki, the teacher in the first iteration specifically set out to monitor, participate, and assist in learners’ wiki production. Still, the sheer amount of contributions and the webbed nature of the collectively emerging products made it extremely difficult for the teacher to keep track of who did what. One consequence was that assessing learners’ contributions remained out of the teacher’s reach.

Basically, we see a contradiction between two epistemologies. Somewhat simplified, we see how a traditionally individual approach to writing linear texts and situations where learners are exposed to knowledge are challenged by a collective approach to writing hypertexts and situations where learners explore potential knowledge resources. Also, the wiki environment obscured what were the
individual contributions to a collective product and the working relations between participants. Consequently, the teacher was at a loss to follow up and give feedback to the individual learner.

Thus, a wiki transpires as a technology that transforms the learning activity; the wiki’s epistemological proclivity structures learning (and teaching!) in a way schooling has not so far cultivated. In CHAT terms we could say that the rules and conventions, community structure and division of labor develop as the cultural tools afford new practices. The collaborative and collective design aspects of the wiki meet the individual design of traditional schooling; an innovation trajectory meets an institutional trajectory. Thus, the wiki challenges traditional designs and the tensions that arise demand that new designs observing transformed learning|teaching activities are developed and enacted.

Implications and conclusions

From the studies above we see how complex tasks and a series of available resources make heavy demands on designs for learning and teaching. Collaborative participation and new cultural tools, so typical for the networked society (Castells, 1996), result in transformed educational activity. In the cases we have examined, we see how such activity involves understanding phenomena on the periphery of our horizon, analysis of the role of artifacts and how such artifacts match (or mismatch) the assignment. Also, we have drawn attention to analysis of the relations between individual and collective contributions as well as the need for instruction in the shape of informed intervention and participation. Transformed activity creates tensions between subjects and mediational means (Wertsch, 1998) but also places existing rules and conventions of the classroom under pressure. The result is that teachers and learners constantly have to assess the costs and benefits involved in a new opportunity. Uncertainty becomes a natural educational state (Edwards, et al., 2002). This is why we propose designs that materialize at the juxtaposition of teaching and learning, that is, take obuchenie as a point of departure, and which require teachers to participate with a persistent presence in learners’ trajectories. If not, we see that the delicate teaching|learning balance is disrupted as the enacted design for learning deviates from the intentions embedded in the design for teaching.

We have argued that the notion of design is highly relevant when the complexity of learning environments and learning trajectories increases. Empirically, we have demonstrated how lessons learned from case studies point to the need for conceptualizing design as a dialectic teaching|learning activity. Theoretically, we find that sociocultural activity and theoretical perspectives provide us with a framework for not just understanding designs but for producing and enacting them. Also, such perspectives may be drivers for developing didactics responsive to complex and technology-rich learning environments and trajectories, and where the learning object is not just given but jointly constructed and often in the face of uncertainty.

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