A Systemic Approach to School Reforms – Reflections on practise and theory in developing comprehensive school

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In scenarios for Europe's future, high quality active learning, including the idea of a 'learning society,' is defined as one of the most important goals of schooling. Education and learning are expected to provide tools for active change management and for generation of innovations. They are also seen as means to deal with wide range of social problems such as unemployment, exclusion of minorities and women, as well as environmental hazards (e.g., European Commission, 2001; OECD, 2004; White Paper, 1995; ERT, 1996). The base for the art of self-regulated learning is created in comprehensive schools. Accordingly, further training of comprehensive school teachers can be considered as key factor in promoting high quality learning in the society.

This goal has given rise to several educational reforms in many European countries, Finland included. Hence, comprehensive schools and teachers around Europe are currently faced with a diversity of new, multidimensional school reforms. Further, these reforms are often parallel and initiated by different stakeholders. Despite somewhat common meta-premises, they often involve divergent sub-goals and aspects which may sometimes be contradictory. As main executors of the reforms, comprehensive school teachers are expected to cope with and combine the various demands and implement the new ideas in their daily work. Yet research on school reforms has shown that output of the reforms has rarely met the high expectations (e.g. Datnow, Hubbard & Mehan, 2002; Olson,1999; Slavin, 2001; Stevens, 2004).

The purpose of this paper is to reflect on practice and theory in educational reforms. First I will examine three common, and in my view central, problems in implementing educational reforms and research-based innovations. After this, a systemic, design research approach is considered as a solution for the problems in combining theory and practice of educational reforms; thus some of the general assumptions of this approach are discussed. With this background in mind, I provide an illustration on a general outline of a design-research project, as carried out within the implementation of undivided basic education [UBE]. Finally, I conclude the presentation with some future scenarios from the perspective of the systemic, design-research approach.

Why school reforms tend to fail

During the last decades, research on learning and instruction has advanced our understanding about the process of learning and the characteristics of powerful learning environments enormously. However school practices have not been innovated and improved in ways that reflect this progress in the development of a theory of learning and instruction (De Corte, 2000). Hence, there seems to be, at the same time, an ever widening gap between the sophisticated theories of learning and everyday instructional practices of teacher and schools, and growing need to reform education in order to keep up a high pace of global development (Brown, 1994).

A reason for the theory practise gap is that although the idea of active learning as the core of an educational reform (both as a goal and as a means) is not new, in practise, reforms are rarely executed adequately as active, multidimensional, collaborative and situated learning processes (Senge, 1990). In other words, a problem is that our present, research based knowledge of the characteristics of powerful learning environments is not taken as a consistent guideline in implementing the reforms (e.g. Fullan, 2006; 2002). Rather they are executed using a traditional top down model (Tyack & Cuban, 1995), a way of proceeding that is at odds with the new educational goals. One reason for this is that lay cultural theories of learning and teaching contradict current scientific

theories of them. As a result, often there is a failure to invest, e.g., in promoting teachers' professional development and a school culture that provides opportunities for risk taking and reflection among teachers about pedagogy and student learning. Yet without profound understanding of the theory upon which new practices is based, without teachers critiquing themselves, providing reflective feedback, and sustaining and extending the innovation, the practice likely will stagnate. Hence, absent knowledge about why teachers are doing what they are doing, implementation of reform will remain superficial only; innovation will collapse once reformers leave the scene. (Blumenfeld, Fishman, Krajcik & Marx, 2000; Tyack & Cuban, 1995; Milbrey, McLaughlin & Mitra, 2001) Hence, a reason for reform failure is that the new procedures are expected to provide high quality learning although the preconditions for innovative learning are not considered while conducting the process.

A second impediment for conducting school reforms, is that reforms tend to focus on parts while disregarding the way the whole structure hangs together. Though growing interest in distributed cognition, social and cultural context of learning and complex learning environments has initiated a branch of studies that focus on investigating composites (complexes) of processes, states, interactions and situations in real world school and classroom settings, the approach has not yet made its way into either the mainstream empirical educational research nor educational reforms. Hence, overall the reforms still tend to specify and study only one element at a time. The problem in focusing on isolated parts instead on systems is that the approach ignores the complex, context dependent and interactive nature of school development, and such focus is yet another predictor for failure of the reform (Sarasom, 1991; Pyhältö, Pietarinen, Huusko & Soini, 2005). Creating capacity for change requires systematic effort on several fronts simultaneously. (e.g., Fullan & Miles, 1992) For example building understanding across levels of schooling system and coordinating efforts is essential for reform to take root (Resnick & Hall, 1998) Hence successful reform requires dealing with complex entities and orchestration of elements.

If we take the idea of educational phenomena as situated composites (complexes) rather than isolated ingredients seriously, it means not only that implementation of school reforms requires a systemic approach but also suggests that educational research ought to focus more and more on studying educational phenomena as a complex of correlated events, processes, strategies, interactions and qualities (Scarr, 1985) Especially, complex composites such as learning environments need to be studied as designed composites, not as separate units reduced to their basic ingredients. This does not mean that the basic ingredient studies, e.g., motivation studies, should be replaced by composite studies, but that the latter one should complement them. The link between educational wholes and part ingredients such as emotions or traits is complex; on the other hand whole cannot exist without its parts, but neither can it be reduced to them or equated with them. (Salomon, 1995)

Another reason for the theory practise gap, and thus a cause for ineffective school reforms, is that educational research and investigators have until recently focused primarily on creating empirically grounded explanations and providing practical guidance; applications and designs based on novel theories of learning and instruction are almost solely left on teachers' concern (Brown, 1996; Resnick, 1999; ERT, 1995; Salomon, 1995; De Corte, 2000). However, moving from "vitro" to "vivo" requires the collaboration of educational researchers and professionals. The researchers are nowadays quite well aware of this challenge. Some scholars of educational psychology, for instance Anne Brown (1992) and Gavriel Salomon (1995), have suggested that in order to overcome the gap: contributing to sciences as well as advancing the field of education, two core function of educational research: *explaining and guiding* should be complemented by a third: *designing.* The function *designing* subsumes both the explanation and the guidance roles of educational research. The potential of the design function lies not only its combining mission, but also its capacity to address both how things are and how they might be. Further, designing is an important ingredient in understanding: better comprehension of a complex learning environment can be attained when one is designing the environment with emphasis on particular ingredients suggested by some theory (Lewin, 1948). Moreover, designing with professionals in

real-life school and classroom settings affords both researchers and professionals an opportunity to learn by engineering and scaling up their professional repertoire. Another argument for the design mission is that by designing, research findings on learning and instruction can be exploited for the benefit of the educational system directly, which is great advantage in rapidly changing information society.

Despite growing interest in this third mission of educational research, only a few empirical design studies have been carried out (e.g., Resnick, 1999; Rauste-von Wright, et al. 2003) Hence, the full potential of collaborative partnership between educational researchers and practitioners, for improving educational system, required by the design mission is not yet utilised.

Design research as a tool to overcome the gap between theory and practice

In recent years a design- research approach has been put forward as having a potential to overcome the theory practice gap (e.g. the Design-based Research Collective 2003; Collins, 1992; Cobb, 2001; De Corte, 2000). Design research is an emerging methodological approach, thus there are no single definition or authoritative set of criteria for conducting it. Rather there are some more or less loose characterizations of the design research approach. Further, depending of the study, the approach has bee referred either as "research as design", "design experiments" or "design based research". Common to the different design studies is that they all refer design research as an approach that focuses both on fostering learning, creating usable knowledge, and advancing theories of learning and teaching, in complex real world settings. (Brown, 1992; Resnick, 1999; Pyhältö, Soini, Eerola & Rauste-von Wright, 2003; see overview in Educational researcher, 1, 2003). This takes place through "engineering" particular learning forms based on novel theories on learning and instruction (e.g. Cobb, Confrey, diSessa, Lehrer & Schauble, 2003). Hence the power of the design research approach lies in its potential to result greater understanding of learning ecology – complex, interactive systems, "clouds of events," by designing these elements and by anticipating how these function together promoting learning (Salomon, 1995)

Figure 1, presented by the Cognition and Technology Group at Vanderbilt (1996) illustrates the relationship between the research on educational technology in the context of learning theory and educational practice. Although the original framework takes place in technology application-context, it can also be used to reflect interplay between theories of learning and educational research in general (von Wright, 2001).

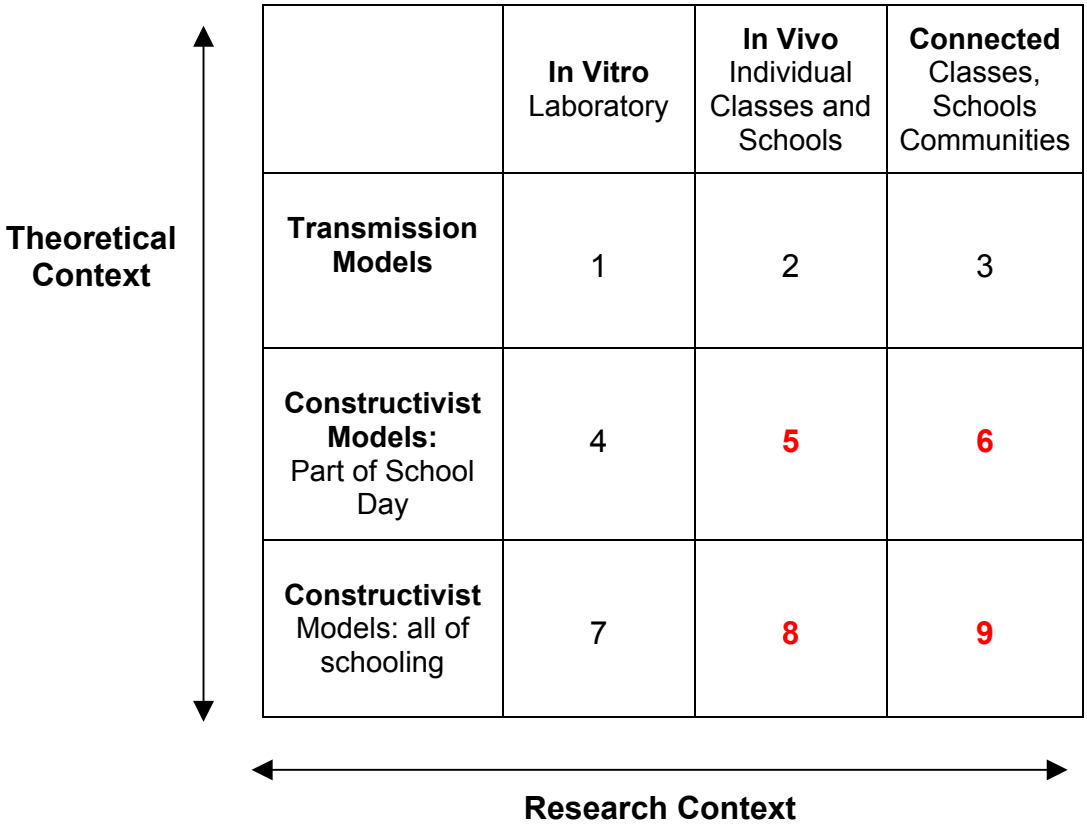

Figure 1. Looking at Technology in Context: Cognition and Technology Group at Vanderbilt, 1996

The applications of design research approach can be placed in cells five, six, eight and nine. In practice most of the empirical designs experiments carried out fit either in cells five or six (e.g. Berliner & Calfee, 1996; De Corte 2000; Verschaffel, De Corte, Lassure & Van Vaerenbergh, 1999; Scardamalia, & Bereiter, 1991; Steffe & Thompson, 2000). Cell eight or nine designs are far more unusual, mainly because the complexity, resources and effort needed to carry out this level designs is very high (e.g. Joseph,

2004; Pyhältö, Soini, Rauste-von Wright & Eerola, 2005; Rauste-von Wright, 1999; 2001; Soini, 1999; Stein, Silver & Smith, 1998).

Methodologically, a design research approach drives at designing and exploring whole range of design innovations that embody specific theoretical claims[1]. Depending on the study design approach has been characterised as process oriented, theory driven, and interventionist, co-operative and iterative as well as systemic (Bannan-Ritland, 2003; O'Donnell, 2004). Design studies can be considered process oriented in that they focus on tracing learning by understanding successive patterns in reasoning and thinking as well as the contribution of the design artefact(s) on that process. They are also theory driven and interventionist in that theory is tested and developed through series of interventions, which are based on the design hypothesis. Further, design studies can be considered collaborative because interventions are implemented in co-operation between educational professional and researchers. 'Iterative' applies to these design studies in that they involve tightly linked cycles of design-analysis-redesign that move towards improvement of design artefacts, such as curriculum or computer supported learning environment learning (Collins, Joseph & Bielaczyc, 2004; Shavelson, Philips, Towne & Feuer, 2003; Zaritsky, Kelly, Flowers, Rogers & O'Neill, 2003) Design studies are also systemic, not only in studying different aspects within the system (e.g., various elements of conceptual change in an individual); but also in that they link several levels between the systems (e.g., classroom practices to structures in the school).

Design-research process development, understanding and research takes place through continuous cycles of design, questions, and enactment, analyse and redesign. (The design based collective, 2003). The process contains many cycled phases. The first phase of design process is construction of design hypotheses in the context. This includes identifying the starting point of the experiment. In well- studied areas literature serves a good basis for drawing conjectures (Sandoval, 2004). However, in less studied areas gaining the same understanding about the context i.e., students' prior instructional

[1] The approach itself is not new; for instance, in Russian educational psychology this type of inquiry has been fairly common .e.g., Bell, 2004

history and initial interpretations and understandings often require a pilot study. (e.g. Cobb et al 2003) The design hypotheses are usually based both on current research on learning and instruction and prior research in the design context. Hence, in this part, design experiments are different from the experiments, which are initiated by educational practitioners or aim mainly at describing how learning occurs under given conditions of instruction.

The embodied hypotheses are implemented in collaboration with educational practitioners, and they constitute multilevel interventions. For example, classroom experiments typically include designs in four entwined levels of learning ecology: a) domain related problems or tasks; b) culture, e.g., norms of participation; c) instructional techniques and tools used to solve the problems, and of course, d) the practical means by which e.g., the teachers can orchestrate the relations among these elements (Scardamalia & Bereiter, 1991). Characteristic for design research is that the researcher in collaboration with practitioners constructs a learning environment, starting from a hypothesis concerning the optimal course of learning. Accordingly, the preparations for the design include preparing a good reciprocal interaction between educational researchers and practitioners based on a translation of the approaches, goals and research outcomes in such a way that they are understandable and usable both for the teachers and researchers; these are key elements in securing an even reasonable chance for successful implementation of designs (De Corte, 2000; van Veen, Sleegers, Bergen, & Klaassen, 2001).

The designed interventions are followed by multilevel analysis of learning activities as well as learning outcomes that lead to conclusions relating to the degree of confirmations or falsification of the initial hypothesis. The systematic analysis of the phenomenon under investigation requires, at minimum, data on learning and the means by which it was supported. In practise, this usually means using variety of data collection methods and sources. The first cycle of design process is followed by its revision as a starting point for second cycle of interventions. Thus, in the design process, understanding of the phenomena under investigation is deepened while the

experiment is in progress (e.g. Lobato, 2003). Accordingly design experiments constitute both prospective and reflective undertakings that are entwined in iterative process.

In the next section, as an illustration of the proposed design-research approach to research on learning and instruction, I will review a study that addresses the latest comprehensive school reform in Finland: implementation of undivided basic education (abbreviation UBE). The basic outline of this design study described here is an example of school and school district level (category eight) design.

An empirical example: Study context

In Finland three major pedagogical comprehensive school reforms have been launched since 1990's, mainly initiated by politicians and administrators. The most basic and likely most challenging reform consists of a shift from viewing the teaching-learning process primarily as a transmission of knowledge to forms of teaching focused on active and collaborative knowledge construction. For example, current Finnish school legislation and regulations emphasise that everyday school practices should be based on constructivist theories of learning. The second reform consists decentralisation of school administration, which is shown for example in the replacement of the National Curriculum by a set of fairly general goals, approved by the Ministry of Education, while the responsibility for curriculum planning has been shifted to the grass-roots level of communities and single schools. Accordingly, teachers are nowadays expected to participate more and more in school decision making and development processes outside the classrooms. Most recent of the pedagogical school reforms concerns developing inner coherence of schools by instituting curricular consistency from pre-school to ninth grade and even upper secondary school or vocational education. The aim of this reform is to support pupils in their learning path through various transitions during their school career. (Basic Education Legislation, 628/1998; Basic Education Regulation 852/1998; National Core Curriculum for Basic Education 1994; 2004.)

As a contribution to the implementation of UBE we are carrying out a research project "Learning and development in comprehensive school"; the project was commissioned by the Ministry of Education and was aimed at the design and evaluation of a powerful learning environment, which will encourage—indeed, require--comprehensive (both primary and secondary) schools to develop more coherent, unique and collaborative learning paths for pupils through comprehensive school. The project is implemented by using a design research approach, and it has been carried out since 2005 in collaboration with Helsinki, Tampere and Joensuu Universities. The general theoretical basis of the study was socio-constructivist views of learning. Altogether 87 communes and 240 schools around Finland participated to the research project. The project has a twofold aim: it intends to analyse preconditions and processes that enable schools to develop a culture of learning in which collaboration and active self-regulative learning are emphasised; it proposes, also, to contribute to the development of undivided basic education, i.e., by designing learning environments that can elicit in school communities and teachers the appropriate learning processes for acquiring the intended competence. Such competence is necessary to develop a coherent, collaborative and activating learning path; this environment being for pupils as well as other members of school community.

Two first years "Learning en development in comprehensive school"-research project

The UBE is a new research area. Accordingly, in line with the strategy described in the previous sections, the first cycle of design comprised a pre-study. It was carried out to identify problems and gaps that constituted obstacles to promotion of a collaborative and unique learning path for pupils throughout the comprehensive school; thus the basis for constructing the design hypothesis to be tested in the context. The pre-study included data collection in four levels of the schooling system: administration, principals, teachers and pupils (9^{th} graders). During the first cycle, the data were collected using various methods, such as inquiries, interviews, reflective discussion and

activating procedures. On the basis of data from the head of school district and from other sources, 9 case schools were chosen in which more detailed data were collected, and the first round of the design interventions implemented (in spring 2007). The criteria for selecting the case schools were variation and representativeness of the sample: accordingly, both primary, secondary and 1-9 grade comprehensive school were included; the schools were also in different phases in their development work, and they were situated in all around the country.

Table 1 Data collected in the first cycle

Empirical procedure: phase 1 (October – December 2005	OPEN-ENDED QUESTIONS FOR HEADS OF SCHOOL DISTRICT (n= 87, 55% answered) AND SCHOOL PRINCIPALS (n=240, 60% answered
Empirical procedure: phase 2 (January – February 2006):	SELECTION OF NINE (9) CASE SCHOOLS on the basis of the school principals' reflections. Criteria for case schools selection: variation of the school type, -size, -location and the and phase in their UBE development work
Empirical procedure: phase 3 (February – March 2006):	RECALLING OF THE FUTURE (RoF) (n= 189 teachers) and OPEN-ENDED QUESTIONS for the ninth graders (n= 518 pupils) in case schools
Empirical procedure: phase 4 (March 2006)	SELECTION OF THE TEACHERS FROM EACH CASE SCHOOL on the basis of the RoF data. Criteria for case teachers selection: variation of the different teacher groups, variation on their action orientation (how do they perceive their own role in the developmental process, and the perception of object of activity (how they perceive the object of the development work).
Empirical procedure: phase 5 (March – May 2006):	THEME INTERVIEWS FOR THE SELECTED TEACHERS IN EACH CASE SCHOOL (n= 70 teachers)

The data from the first cycle suggested that main problems in implementing UBE within the school level: in the schools and between schools, were the following: 1) teachers' as well as headmaster's perceptions about the developmental goal of UBE were unclear, fragmented and one-sided; 2) teachers' often showed lack of active agency in the developing school community; 3) lack of collaboration existed within the professional community in the school as well as between the schools that constituted the whole of

basic studies; and 4) there was a lack of active agency on behalf of pupils within school and classroom practices and tensions between pupils and teachers from the instructional point of view, caused by teacher-centred practices. (Pyhältö, Pietarinen, Huusko & Soini, 2005; Pietarinen, Huusko, Pyhältö & Soini, 2006)

The findings were translated into four complementary hypothesis 1) teachers' and headmasters' need to attain holistic understanding about first principles of UBE and its theoretical base upon which participant and activity structures are based; they would then be able to promote UBE and attain new practices as well as sustain and modify them "after the special project" status ends; 2) teachers' need to attain active agency in developing school community; 3) collaborative professional culture needs to be established both in the schools and between them to be able to promote a coherent learning path and support pupils through out comprehensive school; and 4) activating and collaborative learning environment for pupils need to be attained to be able to promote UBE. The challenge was to take and translate research findings to innovative learning environments and scale it up to systemic interventions both in the school community and between the communities. The learning environment implemented in the second-cycle of the study, was in a line with general principles on research-based knowledge of characteristics of productive learning as a constructive, cumulative, self-regulated, collaborative and situated undertaking (e.g. De Corte,2000; Resnick & Hall, 1998, Brown,1992).

The first cycle focused on teachers (including headmasters) and teachers' communities. The interventions were implemented at three complementary levels: individual level professional development, teacher community level and between teachers' communities. This cycle included three related components: (a) creation of collaborative culture (b) enhancing teachers' perceptions about the first principles of UBE and (c) promoting teachers' active agency in developing the school overall, outside the classrooms.

Collaborative culture for professional development

A collaborative culture was facilitated through the application of varied set of activating and interactive techniques. Typical aspects of the culture were as follows: (1) Scaffolding was provided for opportunities for collaborative discussions and construction of understanding of the UBE, of basic function of comprehensive school and school practices in mixed (e.g., subject, class and special education teachers) groups of teachers; (2) collective cognitive responsibility (Scardamalia, 2002) was promoted by supporting construction of common meta-goals for developing school community in line with first principles of UBE in mixed groups; and (3) teachers were helped to explicate the intellectual resources available within the teacher community. In addition preliminary strategies for exploiting and scaling up "current good practices" within and between the teacher communities were charted.

Object of activity: the UBE

Teachers' attainment of more holistic understanding of the first principles of UBE and its underlying theory was supported by the following means: (1) Researchers elicited and helped outline teachers' prior and current understanding about the UBE explicitly; (2) researchers helped to revise current understanding of UBE by eliciting new information about the reform and problems caused by the lack of coherence within the school path. The new knowledge was also processed collaboratively using various methods and considering its implications for various aspects of schooling, such as curriculum and teaching practices; (3) teachers were helped to identify problems and resources in promoting, simultaneously, horizontal and vertical coherence in the school. Teachers also processed problems-related goals of the reforms; problems of motivation were dealt with in teacher community.

Teacher as an active agent

We supported teachers in pursuing a more active role in developing the school community and participating in school decision-making by a number of means: (1) We stimulated teachers to articulate and reflect on their strategies and ideas, conceptions, beliefs and feelings developing their work and school together in the terms of UBE. 2) We promoted teachers' reconsideration of their professional role in the developing school community; for example, by reflecting on their schooling practices from different perspectives and standpoints. (3) Teachers' involvement in developing school community was promoted by organising forums in which teachers were encouraged to set forth their ideas about the developmental goal of UBE and their own role in the process. They were to negotiate a fit between personal ideas and the ideas of others, using contrasts to spark and sustain knowledge advancement (Scardamalia, 2002). The aim was to awake in the teachers questions relating to the developing the school community; such questions would promote active participation in school decision making. The teachers' ideas served as a basis for constructing common goals for developing the community. Accordingly, a starting point for the development process invoked the current worldviews of teachers, and we saw the spectrum of their skills.

In line with the standpoint taken above, this learning environment was elaborated in partnership with the case school teachers and headmasters. The model of professional development we adopted emphasized the creation of a social context wherein teachers, principals and researchers learn from each other through continuous discussions and reflection on the basic principles of UBE, teaching-learning process and schooling practices. From the perspective of contributing to the reform, the early observations are promising: it seems that, in the case schools small scale projects have been initiated, e.g., co-operation between primary and secondary schools since the beginning of the project. Further, the reflective tool which was the results of the pre-study seems to be a functional tool for self-reflection in the teacher community as well as between the school communities. Along with data produced by the intervention process itself, a large variety of instruments, such as interviews, inquiries, pre-test-post-test

combinations, observations, video-registrations and questionnaires have and will been used to collect the data**.** However, respecting the intended contribution to theory building, it has yet to be seen how the reform process turns out, because the first cycle of intervention is still going on, and hence the results cannot be summarised at this point.

Future challenges of design research approach

To conclude this presentation, I will present my reflections on a few central challenges for conducting design research. Design research is an emerging approach rather than a consistent methodology, thus there is no single definition for design research in education. Accordingly, problems with implementing design studies often relate to the great variability of studies and their implementation in complex settings.

Studying complex interactive systems, "clouds of events," and thus sustaining interventions in a messy settings gives rise to high demands on coordinating and conducting multiple levels of data collection and analysis systematically (Cobb et al. 2003). Hence it is essential that the whole of the design research process be carefully explicated, conducted and documented. Accordingly, tracing the cycled design process and capturing meanings constructed by individuals (or groups) over time often requires longitudinal methods. Reports of this kind of work usually rely heavily on narratives, both as a form reporting and as data for developing theory and design artefacts. However, design studies can also be complemented by other methodologies to test the generalizability and limits of effects (see also MacCandliss, Kalchaman & Bryant, 2003). Reliability of findings can be promoted through multiple case studies, triangulation and pre-test- post- test arrangements and so on. Moreover, studying complex systems requires that rich descriptive information be collected from the beginning of the process, using a variety of data sources and several kinds of methods as well as using and creating of measures or instruments (Cobb, 2003). At the same time, to ensure solid ground for the hypotheses to be implemented, it is important that underlying theory and research questions as well as the hypothesis are carefully

explicated (Sloane & Gorard, 2003). In well-studied areas, the hypotheses can be based on prior research; however constructing hypotheses in the context often requires pre-study, especially in less studied research fields. Validity of findings within design studies is often addressed by the partnership between researchers and professionals, and through the iteration process (Hoadley, 2004); this process is essentially a cycle of design-analysis-redesign that includes formative evaluation and revision of the hypothesis and designs, followed by retrospective analysis and possible generation of new theories or development of the underlying theory (e.g., Collins, Joseph & Bielaczyc, 2004;Kelly, 2004; The Design-Based Research Collective, 2003; Shavelson et al, 2003). If these criteria are not met while conducting design research, there is a real danger for gaining un-interpretable data and oversimplified interventions under label of the design research (Collins; Barenek & Newman, 1990).

Another significant challenge for conducting design studies arises from the interactive nature of the approach: effective implementation of design artefacts, such as learning environments puts extremely high demands on the educational professionals and usually requires drastic changes in their role and teaching practices. Disseminating the new perspectives on learning and instruction widely, requires, in practise, time and effort in collaboration between researchers and professionals (Tabak, 2004). Indeed, it is not only for professionals to adopt new instructional techniques or fundamental change in their beliefs and attitudes about their work; for researchers also there is a profound challenge in what constitutes one's expertise. For instance, if designing is considered as a strategy of scholarship, it is essential that scholars be able to take account of contextual as well as social and organisational dimensions of schools while introducing designs (e.g., van Veen, Sleegers, Bergen & Klaassen, 2001; Corte, 2000).

Benefits of engaging in design research can be summed up in three core arguments. Firstly, design research provides a productive perspective for developing theory. Secondly, at its heart, education is about designing--e.g., curriculum, learning environments and systems--and hence design research produces useful results. Thirdly, engaging in design research directly involves researchers in the improvement of

education (Edelson, 2002). In other words, the design-research approach holds much potential for overcoming the theory-practise gap. Further, some pieces of empirical work, especially classroom experiments (in categories 5 and 6), have already proved that the approach is functional in studying and implementing novel learning environments, for example in mathematics (e.g., de Corte, 2000). However, one has yet to see if this approach also provides a functional strategy for effective implementation in extensive school reforms, such as the implementation of UBE in Finland.

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