Expansive design for teachers

An activity theoretical approach to design and work integrated learning

Dennis Augustsson
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This work is dedicated to
the memory of
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Finally, I would like to thank Margareta Melin for pushing me out on the road in the first place and express my deepest gratitude towards my family and close friends for your support and patience throughout this journey. The future holds exciting new adventures!

Dennis Augustsson
Trollhättan, Augusti, 2020
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Populärvetenskaplig Sammanfattning

Nyckelord: Design; Aktivitetsteori; Expansivt lärande; Undervisning; Kompetensutveckling, Lärare

Introduktion

Digitaliseringen av skolan och nya krav på mediekunskap, kreativitet, entreprenörskap, samarbete och problembaserad undervisning, skapar utmaningar kring hur lärande och undervisning organiseras och genomförs. Lärarens arbete med att konstruera, stötta och underhålla elevers kunskapsprocesser kan beskrivas som en designprocess, men utan stöd blir de lämnade att själva erövra kompetens inom detta område.

Den här avhandlingen är situerad i en kompetensutvecklingskontext och ställer frågor om hur utveckling av lärares designkompetens kan förstås och organiseras. I avhandlingsarbetet genomfördes ett samarbetsprojekt mellan en gymnasieskola i Sverige och en i USA kring marinbiologi, där lärare och forskare tillsammans skapade en didaktisk design i vilken elevern undersökte, samarbetade och redovisade kunskaper med videoproduktion.

Det övergripande syftet med avhandlingen, är att bidra till förståelsen av design som begrepp och lärandeprocess för läraryrket. Mer precist syftar studien till att undersöka hur parti cipatory design (PD) och kulturhistorisk aktivitetsteori (CHAT) kan kombineras och användas som en teoretisk ram och praktisk metod i ett kompetensutvecklingsprojekt för lärare. Centralt för arbetet är huruvida aktivitetsteoretiska begrepp och modeller kan sättas i arbete och bli produktiva för design av lektionsplaneringar och nya arbetssätt. Utifrån CHAT som teoretiskt ramverk, ställer avhandlingen tre analytiska forskningsfrågor kring design-processen som besvaras i tre artiklar och avhandlingsens diskussionskapitel:

1) Vilka utmaningar och strategier utvecklas i en PD-process för kollaborativ medieproduktion i en lokal kompetensutvecklingsinsats för lärare? Denna fråga besvaras genom att observera och analysera data från designprocessens första iteration. Resultatet är redovisat i artikel 1: Collaborative media in educational settings: Teaching as a design profession.

2) Hur kan vi förstå lärande som en del av en PD-process i utvecklandet av nya arbetssätt?
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2) Hur kan vi förstå lärande som en del av en PD-process i utvecklandet av nya arbetssätt?
3) Vilka designprinciper kan formuleras för en kompetensutvecklingsinsats för lärare, när man kombinerar teorier och metoder från PD och CHAT?

Denna fråga besvaras genom en formulering av designprinciper baserade på resultaten från hela arbetet. Resultatet redovisas i diskussionsdelen av avhandlingstexten.

**Teoretiskt ramverk**

En zon för lärande, forskning och design.


Kopplingen mellan analys och design


Teoretiska modeller som konkreta verktyg

För att arbeta med både analys och design i processen använde jag en tredje princip för expansivt lärande som handlar om att skapa agens och verktyg för att analysera och förändra en praktik genom dubbel stimulering. Begreppet dubbel stimulering är sprunget från sovjetisk utvecklingspsykologi och vidareutvecklat

**Participatory design och aktivitetsteori**

I denna avhandling används begreppet expansiv design för att beskriva en kombination av perspektiv från design och aktivitetsteori. Design är ett brett fält med många traditioner, men för att fungera med principer från CHAT måste design förstås som en del av en kollaborativ process med deltagarnas intressen och villkor som centrala. Jag valde att utgå från Participatory design (PD), en etablerad forskningstradition med rötter i skandinavisk, kollektiv systemdesign från 70- och 80-talet (Bjerknes et al., 1987). I denna tradition arbetade designforskare utifrån demokratiska ideal, tillsammans med användarna i utvecklingen av nya tekniska system. Idag har traditionen utvecklats från design av teknik och artefakter till sociala innovationer och deltagarkulturer där lärande har kommit att bli en central del. PD delar perspektiv med CHAT, där lärande och innovation förstås som en kollektiv process där deltagarnas agens och ägande av processen är viktiga utgångspunkter.

**Tidigare forskning**

I detta kapitel presenterar jag och diskuterar tidigare forskning som är relevant för utvecklingen av avhandlingsarbetet. Det är exempel på forskning där CHAT och PD är ihopkopplade eller närliggande på sätt som går i linje med ambitionen i min egen studie. Denna forskningsgenomgång har varit ett stöd i utvecklandet av både arbetsätt och design principer i detta arbete. Den tidigare forskningen är presenterad under tre underrubriker:

*Kollaborativ medieproduktion*, där PD och medieproduktion kombineras för att skapa lärande och nya uttryck och där mediekunskap och videoproduktion är centrala aspekter. Denna kombination är viktig för arbetet i denna avhandling där lärare utvecklar nya undervisningspraktiker med medieproduktion

*Participatory design med aktivitetsteori i pedagogisk forskning*, där k combinationen av PD och CHAT har använts på olika sätt. CHAT har oftast använts som analytiskt redskap, före och efter en designprocess, men även i vissa fall som ett konkret verktyg för designprocessen. Forskningen pekar på möjligheterna med att kombinera CHAT och PD i ett kompetensutvecklingsprojekt för lärare och i
denna avhandling används CHAT hela vägen, som verktyg för att både planera, genomföra och analysera designprocessen.


**Designforskning som forskningsdesign – kontext, metoder och data.**


**Sammanfattning av artiklarna**

*Artikel 1: Collaborative media in educational settings: Teaching as a design profession*

Artikel 2: Expansive design for teachers: An activity theoretical approach to design-based research.


Artikel 3: Expansive learning in a Change Laboratory intervention for teachers.

I denna artikel identifieras och analyseras olika typer av lärandehandlingar (learning actions) som definierats i det teoretiska ramverket för en lyckad cykel av expansivt lärande. I de sex CL sessioner som genomfördes i designprocessen identifierades alla kategorier av lärandehandlingar och processen som helhet visade på en övergripande cykel av expansivt lärande. På sessionsnivå var däremot de olika kategorierna av lärandehandlingar utspridda och kombinerade på ett sätt som utmanar en strikt teori om linjäritet och cyklicitet där nya arbetssätt och lösningar måste föregås av grundlig analys av problemets kärna. Konkret design och teoretisk analys pågick parallellt och formade varandra på ett sätt som pekar på det motsatta. Sammankopplingen och rörelsen fram och tillbaka mellan fokus på analyser och konkret design bör förstås som motorn i deltagarnas process där både problem och lösningar kollektivt artikuleras och förhandlas.

Diskussion

Sammanfattningsvis pekar avhandlingsarbetet på behovet av designkompetens hos lärare samt mediekunskapens viktiga roll i användandet av ny teknik. Aktivitetsteorins begrepp fungerade som produktivt verktyg för lärare att analysera och förändra sin praktik och för att analysera och förstå ett arbetsintegrerat lärande i en designprocess. CL som metod kommer från en akademisk tradition med fokus på teoretisk analys medan PD kommer från en tradition av studiobaserad design med mer taktliga verktyg och processer. När designforskning förskjuts mot deltagarkulturer, sociala innovationer och lärande, är CHAT ett lämplig teoretiskt ramverk för att förstå och stöta lärande och utveckling i designprocesser. På samma sätt kan verktyg och arbetssätt från en
PD tradition, berika och göra ett CL mer interaktivt och engagerande för deltagarna genom att göra de teoretiska modellerna till materiella verktyg som inbjuder till ett taktilt, kreativt utforsknings- och begrepp och möjligheter. Begreppet expansiv design fångar ambitionen för denna kombination på ett bra sätt. Med stöd i resultatet av studierna och tidigare forskning i detta arbete har sex tentativa design pricinper formulerats för expansiv design för lärare i arbetet med gränsöverskridande samarbeten med medieproduktion. En sådan process bör innehålla:

1. En kombination av metoder och verktyg från PD och CHAT.

2. Ett genomförande av iterativa cykler av expansivt lärande.

3. Ett fokus på historiska och strukturella motsättningar och spänningar, i och mellan olika aktiviteter.

4. Ett taktilt och praktiskt arbete med teoretiska modeller.

5. Ett fokus på mediekunskap och videoproduktion som språkligt uttryck.

6. En speciell hänsyn till deltagande lärarens arbetsbörda.

Dessa design principer skulle kunna användas i kompetensutvecklingsprojekt för lärare men även prövas i större samarbeten mellan lärarutbildning, forskning och lärarprofil som ett arbetsintegrerat lärande för samtliga fält.
Abstract

Title: Expansive design for teachers - An activity theoretical approach to design and work integrated learning

Keywords: Participatory design; Activity theory; Expansive learning; Teaching; Professional development; Education

ISBN Electronic: 978-91-88847-72-0

This thesis explores how Participatory Design (PD) and Cultural Historical Activity Theory (CHAT) can be combined and used as a theoretical framework and methodology in a professional development activity for teachers. A shift in the way we view teachers, from implementors to designers who actively construct, invent, and develop the practice of schooling also calls for changes in teacher education and professional development activities. The study presented here explores teachers’ work and learning during a professional development activity conducted as a participatory design project between two K-12 schools in Sweden and the USA, using media production to create an international collaboration on Ocean Literacy. The work draws on central notions and practices based on the Scandinavian School of Participatory Design and the Change Laboratory methodology (CL) based on the theoretical framework of expansive learning. The thesis is comprised of three articles answering research questions about what challenges and strategies develop in a design process as a situated professional development approach and how we can understand learning as part of and expanding beyond a design process using activity theoretical tools.

The first article presents a description of challenges and strategies developed by teachers in the first iteration of the design process and the results of using an activity theoretical model for collaborative analysis of the process. The second article analyses a CL intervention in the second iteration of the design process, adopted after the results of the first iteration. The analytical focus here was placed on empirical manifestations of the epistemological principles of the theoretical framework of expansive learning. The third article explores the occurrences and cyclicity of the learning actions postulated by the theoretical framework in the same intervention through a detailed analysis of the participants’ discourse in the process. The thesis comes to a conclusion with a tentative formulation of design principles based on findings from the studies.
The results point to how innovative educational design can have consequences for teachers’ work with conflicting needs, tensions, and contradictions at the systemic level of the activity. PD processes in educational settings require tools and concepts to capture this complexity and create sustainable solutions. In this study, activity theoretical models served as a collaborative tool for teachers to analyse and change their practice and to describe and explain work integrated learning in the design process. The work highlighted the need for teachers’ expertise in design as well as the important role of media literacy in the use of new technology. Their active and practical engagement in the materials, based upon the tradition of PD, must be understood as an important part of the development of agency and volition, and findings suggest that the combination of PD and CL methodologies can serve as a vehicle for expansive learning and new innovative learning designs in educational settings. This approach was conceptualized as expansive design.
Appended Publications

**Paper A.** Dennis Augustsson (2018). Collaborative media in educational settings - Teaching as a design profession. Published in *The International Journal of Design Education*. 13 (2)

**Paper B.** Dennis Augustsson. Expansive design for teachers - An activity theoretical approach to design-based research. Submitted to the journal *Educational design research*.

**Paper C.** Dennis Augustsson. Expansive learning in a Change Laboratory intervention for teachers. Under the second round of review for the *Journal of Educational Change*.

I had sole responsibility for the design and planning of all three studies, as well as responsibility for the empirical field work, data analyses and preparation of the manuscripts.
Table of Contents

Acknowledgements........................................................................................................... v
Populärvetenskaplig Sammanfattning.......................................................................... vii
Abstract .......................................................................................................................... xiv
Appended Publications................................................................................................. xvi
Table of Contents .......................................................................................................... xvii

1 Introduction ................................................................................................................. 19
  1.1 Teachers’ challenges ............................................................................................. 19
  1.2 Aim ....................................................................................................................... 21
  1.3 Research questions .............................................................................................. 21
  1.4 Outline of the thesis ............................................................................................ 22

2 Theoretical framework ................................................................................................. 23
  2.1 Activity Theory – an introduction ........................................................................ 23
  2.2 Cultural Historical Activity Theory (CHAT) ....................................................... 24
  2.3 Designing in the zone of proximal development ............................................... 26
  2.4 Expansive learning ............................................................................................... 27
  2.5 The principle of ascending from the abstract to the concrete ............................ 28
  2.6 The principle of double stimulation .................................................................... 30
  2.7 Critique of Activity Theory ................................................................................ 31

3 Participatory Design and Activity Theory ................................................................. 33

4 Previous research ........................................................................................................ 39
  4.1 Collaborative Media ............................................................................................. 39
  4.2 Participatory Design using Activity Theory in educational research ............... 41
  4.3 Expansive learning interventions in educational settings ................................... 44

5 Design research as research design – setting, methods and data .............................. 49
  5.1 The setting ............................................................................................................. 49
  5.2 Double purposes .................................................................................................... 49
  5.3 ‘Wicked’ problems and adaptions of methods .................................................... 50
  5.4 Data production and analytical methods for the articles .................................... 51
  5.5 Data and methods: Article 1 ................................................................................. 52
  5.6 Data and methods: Article 2 ................................................................................. 53
  5.7 Data and methods: Article 3 ................................................................................. 53
Healthy information ecologies take time to grow, just as rain forests and coral reefs do. An information ecology begins with our own efforts to influence the shape and direction of the technologies we use and the settings in which we use them. We urge people to get involved in the evolution of their information ecologies - jump into the primordial soup, stir it around, and make as many waves as possible (Nardi & O'Day, 1999, p.54).

The citation above serves as a vignette to the work presented in this thesis. Using the concept of Information Ecologies, Nardi and O'Day suggest that technology as a network of digital tools and services is something that should grow from participation and engagement on a local level (Nardi & O'Day, 1999). They called for professionals to engage at a micro level, creating innovations that in the long run might influence the development at a macro level. This thesis concerns teachers' professional development and the challenge to answer that call. A shift in our perspective on teachers from implementors to designers who actively construct, invent, and develop the practice of schooling also calls for changes in teacher education and professional development activities (Hudson, 2008; Carlgren, 1999; Kali et al., 2015; Lewin et al., 2018).

The possibilities and visions for education due to digitalization has been expressed in policy documents and curricular demands in categories like 21st century skills and lifelong learning. (European Commission, 2013; Skolverket, 2018; Trilling & Fadel, 2009). Policy makers advocate digital literacy and media literacy as required skills, combined with creativity and innovation, social and cross-cultural interaction, collaboration, critical thinking, adaptability, communication, and problem solving. Without proper support, teachers are left with a difficult task of identifying and describing both their own and their students' need for competence and of developing methods and practices to meet the demands created by curricular reforms and digital development. The iterative construction of curricular units and the organization of resources are part of professional teachers' everyday practice, but teachers themselves might not see this as a design activity and find it hard to make time for systematic reflections and the formulation of professional knowledge, based on their practice. Participation in design activities scaffolded by researchers and professional designers has been claimed to be a

**Summary of the articles**

6.1 Article 1: Collaborative media in educational settings: Teaching as a design profession
6.2 Article 2: Expansive design for teachers: An activity theoretical approach to design-based research
6.3 Article 3: Expansive learning in a Change Laboratory intervention for teachers

**Discussion**

7.1 Challenges and strategies
7.2 Understanding learning
7.3 Design principles
7.3.1 A combination of traditions from PD and CHAT.
7.3.2 A commitment to iterative cycles of expansive learning.
7.3.3 A focus on historically accumulating structural tensions within and across activity systems.
7.3.4 A tangible and practical engagement in theoretical models.
7.3.5 Special attention to media literacy
7.3.6 Special attention to participating teachers' workload.
7.4 Concluding remarks and future challenges

**References**

**Appended Publications**

Paper A. Collaborative media in educational settings - Teaching as a design profession.
Paper B. Expansive design for teachers - An activity theoretical approach to design-based research.
Paper C. Expansive learning in a Change Laboratory intervention for teachers.
1 Introduction

Healthy information ecologies take time to grow, just as rain forests and coral reefs do. An information ecology begins with our own efforts to influence the shape and direction of the technologies we use and the settings in which we use them. We urge people to get involved in the evolution of their information ecologies - jump into the primordial soup, stir it around, and make as many waves as possible (Nardi & O'Day, 1999, p.54).

1.1 Teachers’ challenges

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successful approach to professional development (Handelzalts, 2009; Huzinga et al., 2014; Kyza & Nicolaidou, 2016). Huzinga et al. investigated challenges for teachers when engaged in curricular design activities through interviews with teachers participating in collaborative design projects. Findings indicated an important need to support and improve teachers’ design expertise. Teachers are not equipped with tools and strategies to plan and organize design processes and lack expertise in design tools and methods (Huzinga et al., 2014). Traditional professional development programs with a focus on technical skills and technology-related components, without a design element in professional teaching competence, run a risk of becoming too individualized, episodic and weakly connected to the local context and the needs of the school (Hargreaves, 2000).

Technology is an important feature of new, emerging learning environments but only part of what Cobb et al. call a learning ecology: ‘a complex, interacting system involving multiple elements of different types and levels’ (Cobb et al., 2003, p. 9). The use of digital technologies in professional development activities and change efforts should therefore, preferably, be related to the socio-cultural context of teaching and learning, embracing the educational setting as a situated complex activity system (Engeström, 2008; Greeno, 1998). Such efforts must be theoretically conceptualized and systematically investigated to be of relevance for research and everyday practices of schooling. The field of work integrated learning (WIL) is characterized by different perspectives but shares the focus on how to integrate academia and the workplace and bridge the perceived gap between theory and practice (Gellerstedt et al., 2015). For the teaching profession, which has knowledge creation and distribution as its shared object, along with educational science, there seems to be a lot to gain from cooperation with researchers and vice versa:

Educational progress is most likely to emerge from approaches to research that create an equal footing for practitioners and researchers, recognizing that though these groups accumulate and curate knowledge in different ways, they both have a role in creating tools (curricula, practices, professional development approaches) that can be used to forge lasting improvements. (Snow, 2015, p. 460)

According to Snow, the role of educational research is shifting from being an applied or translated science to a practice-embedded science addressing problems of educational practice (Snow, 2015). Apart from collaborations between universities and educational organizations, there is a growing interest in interventionist research projects in local contexts. There are many approaches used in educational research that share the view that teachers are important participants in research and development. Action research, design-based research,
and professional development research are growing practices in educational settings with different methods and theoretical approaches.

This thesis is drawing on central notions and practices based on the Scandinavian school of participatory design (PD) and the Change Laboratory (CL) methodology built on the activity theoretical framework of expansive learning (Engeström, 2015). The study explores teachers’ work and learning during a professional development activity conducted as a PD project between two K-12 schools in Sweden and the USA, using collaborative media production to create an international collaboration on Ocean literacy. Digital technology was conceptualized as media (Löwgren & Reimer, 2013) and video production as a language practice (Kress & Leeuwen, 2006) to produce and communicate knowledge.

The development of new learning designs took place in a process where the researcher, teachers, and students collaborated to plan, implement, and evaluate video production as a tool for learning and representation of subject matter. Activity Theory was used for analysis and design and a Change Laboratory process was used to expand the use of video production in the teaching practice of the Swedish school. The theoretical framework was used for promoting and analysing teachers’ development and expansive learning (Engeström, 2015).

1.2 Aim

The overarching aim of this thesis is to contribute to the understanding of design as a concept and learning process for the teaching profession. To be more precise, the study aims to explore how Participatory Design (PD) and Cultural Historical Activity Theory (CHAT) can be combined and used as a theoretical framework and methodology in a professional development activity for teachers. This will be studied by posing the following analytical questions:

1.3 Research questions

1) What challenges and strategies develop in a PD process of collaborative media production as a situated professional development approach for teachers?  
A descriptive question answered by observing and analysing data from the design process.

2) How can we understand learning as part of and expanding beyond a PD process?  
A question answered by an analysis of a CL activity springing from the use of CHAT in the design process.
3) What design principles can be articulated for a professional development activity when combining PD and CL theory and methodology?
*A question answered by the formulation of design principles based on the findings from the studies.*

### 1.4 Outline of the thesis

In Chapter 2, I present and discuss activity theoretical concepts and their relation to research in educational settings and design research. The focus is on core epistemological concepts used in interventions based on the theory of expansive learning that has relevance for the thesis. In Chapter 3, I present and discuss the perspective of Participatory Design used in the thesis and its connection to activity theoretical concepts and how I aim to combine them. In Chapter 4, I present and discuss previous research with relevance to my thesis work. Drawing from several fields, this is not an attempt to create a comprehensive overview, but to highlight research that is relevant and from which results and ideas are used and related to the design of this study. In Chapter 5, I present the setting and overall research design together with discussions about data production as well as analytical and ethical concerns. Chapter 6 is a summary of the three articles and in Chapter 7, a summary and discussion of the results will be presented under a subsection for each research question posed in the thesis. The chapter ends with suggestions for further studies and applications of expansive design as a concept for work integrated learning.
2 Theoretical framework

The concern in this thesis is how learning develops in a design-oriented process. Using activity theoretical tools, the aim is to contribute to our understanding of how a professional development initiative in the form of a participatory design project can promote learning and develop innovative new teaching practices.

2.1 Activity Theory – an introduction

Activity Theory (AT) is a theoretical framework with roots in Soviet developmental psychology research, pioneered by Lev Vygotsky and Alexei Leontiev. It is based on the notion of development as a dialectical movement and interdependency between the individual mind and the surrounding world (Vygotsky, 1978). In opposition to paradigms of psychoanalysis and behaviourism, AT explains human activity and development as a systemic and socially situated phenomena. Vygotsky (1978) argued for the importance of social interaction and mediated communication for learning and cultural development. Instead of seeing cognitive development as the transmission of abstract and decontextualized knowledge, AT focuses on learning as a social process in which knowledge is co-constructed in a situated, cultural and historical context (Engeström, 2015).

An important contribution from Vygotsky (1986) is the concept of the zone of proximal development. He argued that a child’s development is advanced through the interaction with more knowledgeable others. The asymmetry between an individual’s knowledge and their more experienced peers, creates a zone of proximal development (ZPD) where skills and new knowledge can develop through social interaction. Without this interaction, we would not be able to expand very far beyond what we know as individuals. This concept of learning is useful to highlight the importance of mediated interaction, not only between an adult and a child or between teacher and student, but also for developmental processes in more complex learning environments.

Leontiev (1978) developed the theory of activity as a system, incorporating the community and division of labour as key concepts in the framework. He made a distinction between the levels of operations, actions, and activities. Activity is formulated as a systemic and collective formation directed toward an object and motives are realized by means of actions. The object of an activity is not always clear or articulated by participants, but actions are performed, individually or collectively to accomplish intentional goals directed towards the object of the
activity. Actions are comprised by operations; they are often taken-for-granted, routine, conditioned actions using available tools. (Leontiev, 1978). These dynamic levels have been used to support and explain design processes in human computer interaction (Bödker, 1989; Kaptelinin and Nardi, 2009) and can be useful to understand the challenges and development of knowledge and practices when introducing new technology and media production in educational settings.

An important feature in developmental change efforts is to identify, negotiate, and establish a shared object of the activity. In a sense, an object becomes an object through this process of identification and negotiation. An activity can furthermore be poly-motivated and transitional. As teachers and students are developing knowledge in technology and media literacy, skills that at first consume time and resources at the activity level can become conscious actions towards educational goals and eventually function as taken-for-granted operations, making room for a deeper construction of subject matter content. Leontiev’s three levels could be an analytical tool to explore the dynamics of these processes.

2.2 Cultural Historical Activity Theory (CHAT)

CHAT is a development of AT by Yrjö Engeström, which draws on the work of Vygotsky and Leontiev. It brings together the complexity in learning environments by adding social, historical, and cultural conditions to the model for learning as a system of mediated activity (Engeström, 2015). In CHAT, the activity system is the analytical unit, conceptually depicted as a triangle with interrelated key components.

![Figure 1. The activity system (Engeström 2015)](image)

The Subject is the individual or group of individuals with a shared Object for the activity. The actions performed in the activity towards the object use Tools: the mediating resources available such as language, computers, and cameras. The activity is regulated by the explicit and implicit Rules of the activity, such as policy
guidelines, schedules, and workplace culture. The larger social group that the subject is a part of is defined as Community. Division of Labour is the sharing and division of tasks within the activity, and the actual result of the activity is the Outcome. The difference between object and outcome is important as the object is what motivates the activity, not specific goals or results. This heuristic model can be used to identify, capture, and change multi- mediational processes in human activity with a focus on tensions and contradictions at systemic levels (Engeström, 2015).

In this thesis, it serves as an analytical tool to understand complex learning environments, but also to provide the necessary means for the participants themselves to analyse and change their practice. In educational settings you can expect several conflicts of interest and tensions to emerge when engaging in a collaborative design process. To analyse and bring these conflicts and tensions to the surface is presumably important if the new designs are to be shaped and implemented in a lasting and durable way. An activity system is an analytical construction and as such it is never isolated but connected to other activity systems. You can, for example, define tool producing activity systems such as the development of digital technology or rule producing activity systems such as regional or national policymaking. Engeström proposes a minimum of two interacting activity systems as the unit of analysis in his third-generation Activity Theory (Engeström, 2001). Different activities, cultures and organizations are connected and interact with shared objects: a complexity that must be addressed in the analytical framework.

For me, this points to a challenge of defining an activity system as an analytical unit. I could claim that tool producing activities are an adjacent activity system and focus on their shared object if there are signs of tension or contradictions between them. Again, all nodes of the model could be used for this and they all have connected systems of their own. From this perspective, a seemingly well
bounded and simple activity could be expanded to a complexity impossible to handle. There is a need to set boundaries on what is being investigated, especially in networked activities. From my perspective, these boundaries are connected to a tentative definition of the object as the starting point in the efforts to frame the activity system. I need to begin there but must be open to the possibility that the object may be something very different than what I first perceive. Objects are multifaceted and poly-motivated, so this is more of an empirical or framing question: What am I studying and why? What is my research question? These are the questions that should dictate the boundaries when defining the activity system as the unit of analysis.

2.3 Designing in the zone of proximal development

This thesis explores the design process of new learning and teaching practices in an educational setting, where two interlinked activity systems emerged as a comprehensible unit: the teachers’ intentions and plan to execute a learning activity on one side and the students’ intentions and activities for reaching the learning outcomes on the other. Lund and Hauge (2011) describe the intersection of these activity systems as an interactive zone of learning and teaching in a model of design for teaching and design for learning.

![Figure 3: Designs for teaching and learning adapted from Lund and Hauge (2011).](image)

Expanding upon Vygotsky’s notion of the concept, Lund and Hauge describe this as designing in the Zone of Proximal of Development (Lund & Hauge, 2011). This interactive zone is described by Gutierrez et al. (1999) as the third space in which both teachers and students can create and expand knowledge beyond the limits of their own sphere. In a collaborative process where students contribute their own expertise and technology, this dynamic view of the ZPD becomes an important principle. This model will be used for describing and promoting the design of curricular units in this thesis project, but it will also be used to represent
an interactive zone of teaching, research and learning. A third space is created by an intervention in an educational setting where researchers and teachers collaborate to understand and develop new teaching practices and learning designs. It is in this space that the analytical focus of this thesis is placed.

![Design for research, teaching and learning](image)

**Figure 4: Designs for research, teaching and learning.**

### 2.4 Expansive Learning

The use of CHAT as a framework for participatory design research has been proposed to strengthen teachers’ agency and possibilities for transforming both practice and educational systems beyond the design process and object (Severance et al., 2016). However, there are few studies showing how to achieve this. A fundamental concept in CHAT is expansive learning (Engeström, 2015). Expansive learning is understood as a process intended to reveal contradictions and inner conflicts of an activity system, generating a zone of proximal development in which new concepts and practices can emerge.

The development of new knowledge through collective actions where participants share, articulate, and solve problems, promotes learning but also transforms the activity system from within by breaking down the boundaries of current practices. The power for change within the ZPD is conceptualized as transformative agency (Engeström, 2011). With this notion, it is important to recognize CHAT as critical theory. The focus of transformation and change efforts has its roots in dialectical materialism with the purpose of societal change, where tensions and systemic conflicts are driving forces for agency and emancipation. An intervention method called the Change Laboratory (CL) is based on the theory of expansive learning and has been developed by Engeström and colleagues (Engeström & Sannino, 2010). They propose seven steps or learning actions to achieve an ideal cycle of expansive learning: Analysing; Modelling; Examining, Implementing, Reflecting, and Consolidating (see Figure 5).
The expansive learning cycle has many resemblances with traditional, participatory design cycles, but the focus on systemic contradictions and the use of concepts from developmental psychology to understand and promote agency in the process grounds the innovation process in a theoretical framework, which enables a systematic analysis of learning and development. In this sense CHAT becomes both a descriptive and prescriptive theory. This is a desirable trait for interventionist research in an educational setting and the process of designing curricular units could benefit from adapting and using representations and models from CHAT as concrete tools for design. The identification and analysis of the different learning actions could answer questions about how learning develops in the design process studied in this thesis. Two epistemological principles are guiding the understanding of expansive learning and will also be used for both design and analysis in this work: the principle of ascending from the abstract to the concrete and the principle of double stimulation (Sannino & Engeström, 2017).

2.5 The principle of ascending from the abstract to the concrete

In CHAT, the principle of ascending from the abstract to the concrete is described as a process of moving through analytical abstractions to concepts carrying both the contradictions and their possible solution (Engeström & Sannino, 2010). It is the desirable results of an ideal cycle of expansive learning. Dialectical materialism is the core theory for this principle and V.V. Davydov
(1990), uses the concept of theoretical-genetic thinking to describe the process and its connection to modern science. To ascend from the abstract to the concrete you first need to analyse the origin and development of the concepts within a system to grasp the essential meaning. After that you can analyse and transform the particular phenomena.

Davydov applied this theory on how to teach mathematics to children by doing experiments in which the concepts of mathematics were introduced before using numbers and calculations. Findings showed that this was possible and bridged the gap between arithmetic and algebra that so many children have problems with (Davydov, 1990). In this case, the object for the students was to learn predefined mathematical concepts and models, not to invent new, previously unknown concepts or practices, which is the object of a design process and the core principle of expansive learning.

Engeström adapted Davydov’s principles to the field of professional development research as a driving force for change and innovation in work practices. In this form it is described as a process of learning what is not yet there (Sannino & Engeström, 2017). The analysis and theoretical generalizations from this process serve as tools for the identification of problems and for creating a zone of proximal development in which you can develop a solution (Virkkunen & Schaupp, 2011).

This suits a participatory design process for teachers where the possibilities and challenges when creating new learning designs and work practices are embedded in the socio-cultural context of schooling. It is not a question of understanding and adapting to an existing practice but of analysing and changing it into something new. The result of modelling theoretical generalizations into comprehensible concepts carrying both contradictions and possible solutions in CHAT is called a germ cell (Vygotsky, 1997). In CL research, a germ cell can take the form of abstract concepts like responsibility in the intervention in a surgical unit or integration in the intervention with a Home Care Unit (Sannino & Engeström, 2017). It could also be a concrete embodiment of the problem and possible solutions like standing up from a chair for elderly adults in an intervention with home care practitioners (Engeström et al., 2012).

A germ cell is not a fixed form of representation or the final step in the process of ascending from the abstract to the concrete. It is a concept that captures the problem in a simple idea that can be transformed and expanded into complex new forms of practice. Using design terminology, modelling a concept in a CL process could be described as prototyping or a design before design process (Ehn, 2008). For the design and development of new teaching and learning practices, the modelling of a germ cell through a process of analysis of the activity system
could be a way to ground new learning designs in the needs of the local context, connected to other interacting activity systems. A prototype of a learning design that addresses systemic tensions and contradictions, as well as possible solutions, might carry the potential of a germ cell and be a valuable springboard for teachers to develop other designs and practices.

2.6 The principle of double stimulation

In order to promote and analyse the design and learning process, in this thesis the concept of double stimulation has been adopted. In Vygotsky’s work, double stimulation is a theory and method in experimental psychology using two groups of stimuli (Vygotsky, 1987). The first stimulus is created through a task for the participants, directing the activity, and the second stimuli are given signs or artefacts that help organize the activity (Vygotsky, 1987). Vygotsky also found that if no second stimuli are given, participants create their own ways to solve difficult situations. When we face problematic situations, we turn to external means of support to be able to act. Vygotsky exemplifies this with the ‘waiting experiment’ (Vygotsky, 1987). In this experiment subjects were asked to wait in a room and were left there without any further instructions. This created a conflict of motives between the urge to leave and the commitment to stay:

Generally, the subject waited for 10–20 minutes. Then, not understanding what he should do, he remained in a state of oscillation, confusion, and indecisiveness for some time. Nearly all the adults searched for some external point of support. For example, one subject defined his actions in terms of the striking of the clock. Looking at the clock he thought: ‘When the hand moves to the vertical position, I will leave.’ The subject transformed the situation this way, establishing that he would wait until 2:30 and then leave. When the time came, the action occurred automatically. (Vygotsky, 1987, p. 356)

These experiments were replicated by Sannino and Laitinen 2015, observing the emergence of volitional actions with the help of second stimuli crafted or adopted by the participants (Sannino & Laitinen, 2015). As a principle in interventionist research, double stimulation has evolved from an experimental method to a theoretical generalization which characterizes human beings’ ability to transform their circumstances through volition and agency (Sannino, 2015; Sannino & Engeström, 2017).

To regard design tools as first and second stimuli in a process where teachers are engaged in collaborations on new forms of teaching and learning, could be a way to connect the framework of CHAT and developmental psychology to the design process in this thesis. However, not all tools used in the design process can be described or analysed as part of the principle of double stimulation. Only those
that create conflicts of motives are candidates for first stimuli in the framework of expansive learning. Conflicts of motives are a central aspect of double stimulation and an important concept to use when exploring connections between PD and CHAT.

Sannino and Engeström (2017) describe the first stimuli as something that creates a double bind, impossible to break without the help of mediating artefacts – the second stimuli. The concept of double bind is an interpretation of George Bateson’s learning theories in which the individual faces inner psychological conflicts, impossible to solve (Bateson, 1972). In a CL using this principle, the first stimuli are created by the researcher through analysing the current activity to make contradictions and conflicts of motives visible and tangible. This is usually achieved by representing them in the CHAT triangular model (Engeström, 2015). The second stimuli are created by giving participants tools to break the experienced bind and model new and possible solutions for the activity. In this thesis, these procedures will be used as part of the design process.

The tools provided in a CL are called mirror materials (Virkkunen & Newnham, 2013) and a key to understanding the function of these stimuli is the concept of re-mediation (Virkkunen & Schaupp, 2011). The mirror materials are intended to map and re-mediate the problems of an activity and promote agency for participants by establishing new relationships and meaning. This process of mapping and re-mediating the already known creates a vehicle for envisioning the future unknown. Using the concept of boundary objects (Star, 1989), these tools can also function as a connection between design, research, and professional discourse, a desirable trait for work integrated learning and the aim of this thesis.

2.7 Critique of Activity Theory

With a focus on the sociocultural aspects of learning, CHAT has been criticized for ignoring the individual cognitive processes and the intersubjective relations in human activities (Minnis & John-Steiner, 2001; Illeris, 2003; Wheelahan, 2007). From my perspective, it is a question of analytical focus, not about ignoring the individual processes. A principle of Activity Theory is the notion of mediatisation (Vygotsky, 1978), which states that we cannot understand individual development and learning without its cultural means. The production and use of these mediating means must be understood as a result of the agency of individuals acting in activity systems (Engeström, 2001). The subjective involvement of participants can also be explored as an important dimension in Change Laboratories. An example of that is Sannino’s work on the methodology connected with the concept of experiencing (Vasilyuk, 1988) in an intervention with high school teachers (Sannino, 2010). To understand and develop the
challenges and development of teachers’ work practice, it is necessary to focus on
teaching as part of a systemic activity. Teachers’ agency as both individuals and a
group is the driving force for change and innovative design.

Another critique of the theory of expansive learning is the lack of consideration
for power relations and social tensions (Blackler, 2011). In the teaching
professions there are many levels of power embedded in the activity of schooling
from political policy making and regulations to internal struggles in teacher teams.
The principle of agency and the focus on contradictions and tensions in the
activity system can arguably bring power relations and social tensions to the
surface and create tools for reflection and change. From that perspective, CHAT
can, and should be, a tool to address important power relations and social
tensions. Botha’s intervention in a high school in South Africa is an example of
this (Botha, 2017).

The activity system as the unit of analysis has been criticized for being too
complex to grasp (Blunden, 2010) and in the third generation of Activity Theory,
Engeström (2001) proposes a network of activity systems with a shared object,
risking a complexity too great to handle empirically (Spinuzzi, 2011). As discussed
above, this is more of a methodological question about how to set the boundaries
in the case of one’s research while being aware of the complex interaction of
activity systems on several levels. The work of teachers is entangled in several
layers and levels of society. Students, parents, school organization, policy makers,
et cetera, could all be seen as part of interconnecting activity systems, affecting
the activities and changing the object. For this thesis, the analytical focus is a small
group of teachers’ work with curricular designs. Even if the interlinked activity
system of students’ learning processes is part of the tool and design process, the
focus on professional development and teachers’ design activities sets a boundary
for the analysis of the rich empirical data gathered in the process. This might limit
the range of the change effort and results but allows for a deeper analysis of the
local, situated practice.
3 Participatory Design and Activity Theory

‘Design’ has become a buzzword in many fields and practices. To avoid an ill-defined panacea, it is important to establish definitions and discuss the concept of design used in research and development efforts. Design as a professional and academic field is far from fixed in terms of theory and practice, and the approaches and perspectives are many and diverse (Laurel, 2004; Van den Akker, 2006; Nelson & Stolterman, 2014). In this section I present the concepts of design that are used in the thesis and the way they are connected to AT.

The seminal work of Herbert Simon on design uses the definition of design as the art of the artificial. (Simon, 1996). This broad definition claims that everything that is ‘manmade’ is the product of design. This was picked up by Cole and Packer in the discussion of Activity Theory and design research in the educational sciences (Cole & Packer, 2016). They use the concept of the double artificial to point to the fact that the activity systems of schooling are as artificial as the designed curricular and technological innovations that are used.

We argue that design research must grapple with the doubly artificial, as the classrooms in which many educational designs are implemented are themselves already artificial and contingent—the products of design (Cole & Packer, 2016, p.503).

To engage in a design process of changing the ‘the double artificial’ you need a theory and methodology that can embrace this complexity. For this thesis, the notion of participatory design (PD) is used. PD is not a single theory or methodology but a mix of perspectives that share the notion of design as a cooperation between designers, researchers, and users during an innovation process. Clay Spinuzzi (2005) describes PD as a critical approach, where participation is a tool for empowerment of the users, acknowledging their creativity and skills in opposition to rationalized theories where knowledge can be totally explicit, formalized, and regulated, which reduces the users to instruments performing optimized and discreet tasks. Engeström makes the same point when describing CL interventions based on the theory of expansive learning. Participants’ agency and volition is the driving force for change initiatives and necessary if changes are to become stable and lasting over time (Engeström, 2015). This is a desirable trait in a professional development activity focusing on teachers’ learning and development of new practices. It is also a desirable trait for
the design of student learning ecology as their agency and volition in learning and development are equally crucial.

PD has its roots in the 1970s and 1980s in Scandinavia, where researchers were committed to democratically empowering workers in the face of an increasing automation of work with advanced systems that were disempowering and putting people out of work. PD was an attempt to bridge participants’ tacit knowledge and researchers’ abstract, analytical knowledge by cooperating in the design of these systems (Bjerknes et al., 1987). Interaction Design with this perspective has developed into a field of design research recognized as ‘the Scandinavian School’. In the early days, the object of design was digital artefacts and systems. Today the research has turned from the design artefact and individual user to participatory practices and social innovation (Ehn, 2008; Björgvinsson et al., 2012a; Löwgren & Reimer 2013). In the city of Malmö, Sweden, a series of ‘Living Labs’ have been conducted, engaging residents in PD processes for democracy and innovative use of ICT with a focus on societal tensions and conflicts:

This shift towards publics is a movement away from design projects and towards processes and strategies of aligning different contexts and their representatives, where differences between current issues and how the future can unfold and be made visible, performed and debated as a kind of ‘agonism’. (Björgvinsson et al., 2012b, p. 127)

This is very similar to the description of a CL intervention grounded in the theory of expansive learning. Using CHAT terminology, different contexts could be described as different interacting activity systems. Issues and possible futures made visible and debated as a kind of agonism could be described as a desired expansive learning cycle where conflicts and tensions are made visible and analysed to model new concepts and practices. The proponents of this perspective of PD use the concept of ‘things’ to describe the shifting object of design:

…the term thing goes back originally to the governing assemblies in ancient Nordic and Germanic societies. These pre-Christian things were assemblies, rituals, and places where disputes were solved, and political decisions made. It is a prerequisite for understanding this journey that if we live in total agreement, we do not need to gather to solve disputes, since there are none. Instead, the need for a common place, where conflicts can be negotiated, is motivated by a diversity of perspectives, concerns, and interests. (Telier, 2012, p. 34)

The description of a thing as a socio-material assemblage, gathered to resolve tensions and ideate new futures is to me, very close to a description of a CL
intervention and could be described in CHAT terminology as interacting activity systems with inherent cultural and historical tensions as well as contradictions meeting in an effort to make changes in a shared object of an activity. The concept of a thing depicts the shift from designing artefacts to facilitating changes in objects of activities where the common space to negotiate them could be described as an intervention for expansive learning. The primary role of the designer in this form of PD is to promote agency for participants. Pelle Ehn describes this as a shift from design for use to design-for-design in which the designer’s key role is to build an infrastructure that makes this possible (Ehn, 2008). DiSalvo and DiSalvo summarize this perspective in a concrete way and argue for this form of design activities in educational settings, as it places focus on teachers’ and students’ agency:

That is, rather than the end goal being the design of an operational system, the end goal is an experience or event that develops the agency of participants. This may involve a technical system, but more as a prop or process. The activities of participatory design become activities of infrastructuring, that is providing the resources necessary to prompt, support, and sustain, this collective and collaborative inquiry through design (Disalvo & Disalvo, 2014, p.795).

This broad definition of infrastructure and the role of the designer to facilitate it is well aligned with the concept of design for learning and teaching, discussed above. In a collaborative intervention in an educational setting, I can identify three spaces (or activity systems) where participants are engaged in design activities:

1. The space of research, where the researcher as a designer facilitates and supports the infrastructure for an intervention
2. The space of teaching, where
the teachers as designers facilitate and support the infrastructure for students’ learning activities, and 3: The learning space where students participate as designers of their own learning experience. These interconnected spaces could be represented in both a Venn diagram showing the different collaborative spaces or zones of proximal developments in a PD intervention or as three interconnected activity systems with partially shared objects. This shows the possibilities but also the complexity of the collaboration between researchers, teachers and students. CHAT can be used to describe and analyse this complexity.

In this thesis, the analytical focus is placed on the work of a small group of teachers, but it is important to recognize how these connecting activity systems operate on several institutional levels. Institutions and institutional practices and their historical development are seen as important for the understanding and innovation of teaching practices and a core principle of the CHAT tradition (Engeström, 2001; Engeström, 2015).

When combining the framework of expansive learning with a design activity, embedded institutional practices and categories will surface in the analysis of tensions and contradictions. Sensemaking and negotiations of these categories and practices are part of participants’ discourse but require knowledge and familiarity on the part of the researcher to serve as productive tools for analysis of institutional change (Mäkitalo & Säljö, 2002).

In this sense, a design process, adopting the framework of expansive learning, is a way to create a zone for renegotiation and transformation of everyday practice. The metaphor of the thing as a design space facilitating these processes fits very well from my perspective.

The concepts in PD and CHAT are similar, focusing on the design object as an activity system but they use a different grammar to explain these concepts. CHAT can provide a grammar for participation in design processes grounded in research in psychology and social development, which would strengthen the core of PD concepts.

Engeström has put forth criticism towards traditional Design Based Research (DBR) in the educational sciences due to the lack of focus on participants’ agency and an overemphasis on learning technologies rather than on activity systems (Engeström, 2009; 2011). A perspective on PD as described above would not ignore these important principles, and other PD researchers have used and promoted CHAT as a theoretical framework for design processes (Bödker, 1989; Barab et al., 2002; Kapetelini & Nardi, 2009; 2018; Penuel, 2014). Not all proponents are using CHAT as a critical theory, but this is, from my perspective,
an important factor when designing for educational change. Penuel (2014) formulated three key features to incorporate CHAT in a design process:

1) a focus on historically accumulating structural tensions within and across activity systems,

2) use of double-stimulation as a method of intervention, and

3) expanding agency as the object of intervention (Penuel, 2014, p. 97)

These features are important contributions in an effort to frame participatory design principles based on activity theoretical concepts and methods. CHAT can be used for both analysis and as tools for design where participants’ agency and volition are at the centre of the process. Kapetelini & Nardi (2009) pointed to the possibilities of three levels for CHAT in design research: as a descriptive theory used to identify key concepts and variables, and as an explanatory theory that reveals processes and relationships, but also as a generative theory that facilitates invention and change (Kapetelini & Nardi, 2009). The aim of this thesis is to use CHAT at all three levels. The object of the design is to innovate and change activities of teaching and learning: designing ‘things’ for educational activity. Engeström used the notion of expansive design when discussing Interaction Design from a CHAT perspective (Engeström, 2006), which can be a useful concept for the ambition in this thesis to connect the tradition of participatory design and the framework of expansive learning. How to use these features in the research and make them a part of the empirical studies will be presented in Chapter 5.
In this section I will present and discuss previous research with relevance to my thesis work. Drawing on several fields, this is not an attempt to create a comprehensive overview, but to highlight research that is relevant and from which results and ideas are used and related to the design of this study. The criterion for the review process was to find examples from CHAT and PD research where the different traditions were connected or adjacent, but not fully integrated as described above. In that sense, the review was part of the formation of the theoretical discussion and the effort to find common concepts and methodological approaches fitting the notion of expansive design. The content of the review process was also used to find support and examples for the development of design principles connecting the traditions of CHAT and PD.

4.1 Collaborative Media

The Participatory Design research developed in the research environment in Malmö, Sweden is the result of a long collaboration between the fields of Media and Communication Studies and Interaction Design (Löwgren & Reimer, 2013). Within the field of media and communication studies the notions of collaboration and participatory productions are focused on convergence cultures, remediation and hypermediacy (Bolter & Grusin, 2000; Manovich 2001; Jenkins 2006) as well as on the way narratives are expanding and changing in the landscape of new media technologies. Media production is now possible for everyone with access to a smartphone or a laptop, and a culture of collaborative media production has grown with the development of digital technology. Löwgren and Reimer (2013) point to the challenge of following these new practices for Interaction Design and the need to shift from design for use to design for design as discussed above. They argue that a focus on the use of digital technologies as a set of digitally mediated practices is needed to understand and develop new practices as communicative perspectives take precedence over instrumental ones (Löwgren & Reimer, 2013).

The contribution from the field of Media and Communications Studies has relevance for the use of digital technology in educational settings and points to the necessity of media literacy as an important feature of educational design. In their work, Collaborative Media: Production, Consumption, and Design Interventions (Löwgren & Reimer, 2013) they have collected ten PD interventions from the research environment that all share characteristic features:
4 Previous research

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1. Collaborative media are forms for practice, oriented towards action, open for interaction.

2. Collaborative media offer a framework with components to combine and appropriate in different ways.

3. Collaborative media entail close links between media infrastructures and media texts, essentially blurring the traditional media distinction between means of production and distribution on the one hand and content on the other.

4. Collaborative media are cross-medial and increasingly material, catalysing convergence between traditional media channels and extending into the physical world beyond screens and loudspeakers.

5. Collaborative media prioritize collaboration, thus actively promoting the engagement of the people formerly known as the audience in not only consumption but also production and design. (Löwgren & Reimer 2103, p. 135-138)

An example of relevance to this thesis is the KLIV project (continuous learning in health care), reported in Hillgren’s PhD thesis ‘Ready Made Media Actions’ (Hillgren, 2006). Hillgren places himself in the tradition of Participatory Design research as an explorative and practice embedded endeavour. The thesis does not have a clearly predefined research question, as questions and reflections evolve throughout the process. The purpose was to explore how audio-visual media can support and change the work practice in an intensive care unit in southern Sweden using the concept of communities of practice (Wenger, 1998). An ethnographic approach with observations, interviews and video recordings was used, not primarily as data collection for post analysis, but as tools for the design process combined with design games and tools for workshops and development. The result of the process was a new work practice where the staff of the intensive care unit exchanged experiences by producing short video films on different work activities. The videos were produced and used to share common experiences and context to articulate and describe how these activities were performed. Hillgren (2006) emphasizes the importance of collaborative articulations and the videos produced were intended to remediate and build on the oral tradition and were used for reflection and discussion of activities in constant change. In the analysis, the concept of communities of practices (Wenger, 1998) was used to understand the design process and results with a focus on informal and peer-to-peer learning. Hillgren suggested that self-produced learning materials in the form of short videos promoted and enhanced peer-to-peer learning. The use of video as a common reference point for learning and collaborative production made the
work practice visible and gave opportunities to reflect on, learn from, and develop it. As evidence of success, the project continued and evolved after the design team left the project and the practitioners developed new iterations of the concept. Hillgren (2006) points to the necessity of participants’ agency and gives examples of how resistance and cultural tensions are an important part of the design process.

From my perspective, the concept of communities of practice does not provide a sharp theoretical framework and tools to address these issues. The focus on tensions and contradiction at systemic levels in the CHAT framework does and would arguably be a valuable tool for targeted parts of the design process. KLIV and the other projects described by Löwgren and Reimer (2013) are not situated in an educational setting, but the key features derived from them could be used to discuss educational design as teachers create curricular activities with media productions and collaborations with other schools. The role of the researcher/designer in a professional development effort that is explored in this thesis would be to facilitate, support and sustain the process for the teachers. It would be an example of design for design (Ehn, 2008) and that notion would also apply to the teacher’s role in facilitating, supporting and sustaining the process for the students.

Löwgren and Reimer (2013) haven’t used the framework of CHAT but suggest that it could be a very good fit for collaborative media. I would argue that a CHAT framework for these processes in educational settings could help by being both a descriptive, explanatory, and generative theory for design and development. In their research they also argue for the importance of interdisciplinary research, in their case between Media and Communication Studies and Interaction Design. As the object of design shifts towards social practices and design as knowledge production, the field of the learning sciences in general and CHAT in particular, would arguably be important to incorporate in these research efforts.

### 4.2 Participatory Design using Activity Theory in educational research

The combination of PD and CHAT in educational research can be performed as CHAT analyses on design processes or implemented designs (Yamagata-Lynch, 2007; Vennbo, 2015) but the focus in this thesis is the use of CHAT inside the process, both as tools for design and analysis. Voogt et al, report on co-designing projects from three settings that differed both geographically and in terms of scale (Voogt et al., 2015). They explored the levels of individual teacher learning, team learning and system learning (Borko, 2004) in three different sites in the USA, Africa, and Canada. By combining concepts from theories on situated learning
was meant as a support to design new curricular units based on a new policy. The process was not initiated due to problems or crises within an activity system but for use to design for design. A difference from a CL intervention is that this focus on organizing for agency could be described as making the shift from design and they used the principle of double stimulation to facilitate the process. The CHAT, the researchers’ aim was to make teachers’ agency the object of the design, student-centred approaches to teaching and learning. Using concepts from called the Inquiry Hub (iHub) and focused on supporting teachers in developing implementation, and reflection on their
demands on teachers is important to avoid a backlash in the process. It also points to the necessity for giving these processes time to develop lasting changes in a project has a similar scale to the one in this thesis and the relevance of reasonable
Another example is a report written by Severance et al. (2016) about a co-design work practice and is probably an important feature when formulating design principles for PD processes for teachers.

Another example is a report written by Severance et al. (2016) about a co-design project where CHAT was used for both design and analysis in the development of curricular science units in Denver, USA. Sixteen teachers and six researchers participated in the process of designing curricular units based on the newly constructed standards for K-12 science education in the USA. The project was called the Inquiry Hub (iHub) and focused on supporting teachers in developing student-centred approaches to teaching and learning. Using concepts from CHAT, the researchers’ aim was to make teachers’ agency the object of the design, and they used the principle of double stimulation to facilitate the process. The focus on organizing for agency could be described as making the shift from design for use to design for design. A difference from a CL intervention is that this process was not initiated due to problems or crises within an activity system but was meant as a support to design new curricular units based on a new policy. The
process was not initiated due to problems or crises within an activity system but for use to design for design. A difference from a CL intervention is that this focus on organizing for agency could be described as making the shift from design and they used the principle of double stimulation to facilitate the process. The called the Inquiry Hub (iHub) and focused on supporting teachers in developing work practice and is probably an important feature when formulating design demands on teachers is important to avoid a backlash in the process. It also points project has a similar scale to the one in this thesis and the relevance of reasonable implementation, and reflection on their to be followed by reasonable demands on teachers' time for design, be an important principle. As the project demanded extra time and effort, it had another example is a report written by Severance et al. (2016) about a co-design project where CHAT was used for both design and analysis in the development of curricular science units in Denver, USA. Sixteen teachers and six researchers situated practices into curricular designs with experts and peers in the context of learning community. A cyclical approach to both design and professional researchers gradually stepped back and the teachers began to form a professional their own classrooms. They developed agency through the process as the situatedness, agency, and cyclicity. Voogt et al. (2015) concluded that the teachers learned to integrate the modules. The analysis was focused on manifestations of situatedness, agency, together with formal interviews before, during, and after the implementation of designing and teaching four new online courses in English Language Arts for high user centred design projects from the Aarhus University graduate HCI program. The assignments were to design nature tours, municipal services, shared nature experiences, and anxiety treatments. They gave the students a simple model of...insufficient to guide design; we needed to bring in specific concepts and tools developed as part of other traditions of design-based research in the learning sciences to accomplish our aims. (Severance et al., 2016 p.558)

This points to a difference in perspective between CL interventions and PD processes. Even if the focus was on promoting agency and design for design, the primary objectives and desired outcomes were concrete curricular units and lesson plans. To reach that goal, Severance et al. needed tools from the field of design. CL interventions have a primary focus on work practices and changes in the activity systems, but even if there is a difference in perspective the two are arguably connected. A new lesson plan can change many things in the activity system (division of labour, tools, community, etc.) in a way that disrupts or challenges current practices on a systemic level. When this happens, CHAT models could be used to analyse and promote necessary changes to the activity system when the results of the design are being implemented. Severance et al (2016) do not discuss the implementation of the design, but when a design is iteratively implemented in a school setting, the use of CHAT and CL methodology could be used to understand and reshape both design and the teaching practice at a systemic level. In such a scenario tools from both CHAT and PD are desirable.

Another example of interest for this thesis is Bødker & Klokmose’s use of an AT model as a design tool for design students (Bødker & Klokmose, 2012). The article is a discussion based on the description and comparison of four cases of user centred design projects from the Aarhus University graduate HCI program. The assignments were to design nature tours, municipal services, shared nature experiences, and anxiety treatments. They gave the students a simple model of...
the three levels of operations, actions, and activities (Leontiev, 1978), connected to users and artefacts called the Human Artifact Model (Bödker & Klokmose, 2011). The students were introduced to the tasks through brief lectures on activity theoretical concepts, but the model was primarily a tool for design:

In other words, they were given activity theoretical tools rather than being taught Activity Theory. Through these tools, we suggest, designers are equipped to act skeptically and systematically, supported by theory (Bödker & Klokmose, 2012, p 99).

This tool was used for analysis and reflection by students in the design projects. The authors suggest that AT concepts could be used without a full, complex understanding of the theoretical framework if they gave students a structured method of systematic questioning and reflection beyond the students’ own idiosyncrasies and biases. These suggestions have relevance for the intervention in my thesis. To bring CHAT models and concepts to a design process with teachers could be considered too complex and abstract, hampering both agency and engagement, but as Bödker and Klokmose (2012) pointed out:

With this, we have illustrated that we can move the use of Activity Theory in design beyond singular concepts towards quite precise and simple tools, frameworks for systematic reflection, and teachable, interconnected high-level ideas. (Bödker & Klokmose, 2012, p 110)

Bödker and Klokmose used the operations, actions and activities for their model, but other models like the activity systems triangle and the ZPD could very well be used in a similar way. The use of CHAT models inside a participatory design process is still to be developed in educational settings but they are used in CL interventions. These do not claim to be Participatory Design processes but developmental change efforts sharing the notions of agency and volition of participants and focussing on changing (designing) practices and activities.

### 4.3 Expansive learning interventions in educational settings

Change Laboratory interventions based on the framework of expansive learning have been successfully conducted in many types of settings, such as hospitals, agricultural organisations, libraries, and schools. (Vänninen et al., 2015; Engeström & Sannino, 2010; Virkkunen & Newnham, 2013; Sannino et al., 2016). With a focus on a small group of teachers and the design of curricular units, this thesis draws on smaller scale interventions connected to teachers’ work practice and learning.
Sannino (2010) reports on a CL intervention in an Italian school where formative and summative evaluation and management of the classroom was problematic due to contradictions between individual assessments and group contexts. Teachers were frustrated with policy directives that contradicted traditional practices. This has relevance to my thesis since the creation and implementation of collaborative media production will probably create similar tensions. The CL engaged 12 teachers over a period of three months and all the sessions were video recorded for analysis. In Sannino’s study, teachers’ initial resistance was transformed into agency and volition to change their work practice based on the historical analysis and reflections provided in the CL.

Using the concept of experiencing, (Vasilyuk, 1988), Sannino (2010) analysed how individual teachers faced and worked out critical conflicts related to their teaching, arguing that resistance can be the vehicle for agency and volition for participants if the intervention can externalize conflicts and create a supportive opening to dialectical discourse.

Botha initiated a CL intervention in a high school in South Africa laden with problems of power relations, academic achievements, and conflicts among teachers (Botha, 2017). The school’s problems were perceived as symptomatic of a school system crisis on a national level. Botha argues that even if a small-scale intervention cannot change the structure on a macro level, it could change it on a micro level and start a bottom up movement that can affect the system in the long run:

…the it avoids the difficulties associated with a sudden restructuring of the system because it progressively alters the participants’ relationships to existing actors and artefacts within the system by expansively developing concepts and modes of activity that are practically and theoretically able to embrace the envisioned goals for change. (Botha, 2017, p. 79)

All CL sessions were videotaped for development and analysis. With a focus on agency and addressing conflicts and systemic contradictions, participants were able to understand and grasp their own practice and activity in relation to the macro level and to make changes on the local level. Contrary to the critique of CHAT, Botha’s intervention also addressed the imbalance in power structures and created agency and volition to deal with them. A concrete solution gained from the intervention was to organize and facilitate better staff meetings to address these issues. This bottom up approach in a local context is what Engeström et al. called a possible ‘Trojan horse’ (Engeström et al., 2002b) which could potentially change the activity system on a larger scale. But an intervention may not become the desired ‘Trojan horse’.
In an intervention reported by Sannino (2008) on a new innovative 5D initiative (Cole, 1996) the new implemented practice didn’t prevail after the interventionists left the site, despite the success. The new practice didn’t succeed in breaching the dominant activity and died out. This points to the complexity of conflicting motives and interacting activity systems, showing the risks of local initiatives becoming isolated bubbles or simply fading as the support of researchers and interventionists disappears. Sannino (2008) suggests that a metacognitive layer of documentation and reflections of transitional and hybrid activities on a longitudinal level could help sustain and understand changes after the intervention has ended. This becomes important when engaging in a small-scale activity system, as my thesis does. To follow and support the long tail of the project is important, especially if the activity system is not under acute crisis and the dominant activity doesn’t create large open conflicts. Tensions and dilemmas on systemic levels during a design process are important to address to secure a lasting change in the work practice.

An example of a longitudinal study of this kind is the research and intervention in a middle school in Finland done by Engeström et al. (Engeström et al., 2002a; 2002b). The school is situated in a socially and economically disadvantaged area of Helsinki, facing issues with motivation and academic achievements. The first study in 98/99 began with a CL intervention which was followed by a design process in which a curricular unit was designed, implemented, and evaluated. The CL intervention was documented with video for development and analysis and discovered conflicts in teachers’ perceptions of students as being apathetic versus competent and the connected conflict between the need to control and trust the students, and several spearheads for future practices were developed. One of them was the design of a cross-curricular final project for graduation students. The design process was followed by the researchers and analyses showed a significant shift in teachers’ perception of students as competent and trustworthy. Addressing systemic issues with autonomous classrooms and individual practitioners, traditional tests, exams and grades, the final project was perceived as a ratchet that could step by step transform the school as an activity system:

In other words, while expansive learning in this case is manifested in, and possibly carried forward through, teachers’ words and speech genres redefining their object (the students) as competent and energetic, it is initiated by and grounded in the practical actions and material artifacts of the final project. Without this material and practical anchoring, the ratchet effect would not be achieved. (Engeström et al., 2002a, p. 221)

This suggests that a concrete curricular design could be the germ cell or springboard for systemic change in the long run. In this case, the design process was preceded by a CL intervention, but turned around, a PD design process could
be the starting point or first stimulus for exploring and engaging systemic tensions and contradictions with the CL methodology. Notably in this first intervention, the researchers gave the participants the CHAT triangular model as a home assignment to use as a tool for reflection and analysis of current and future visions of their practice. There were no further comments on this but in line with Bödker and Klokmose’s (2012) arguments this is an example of the use of the concepts as concrete tools for analysis without the full understanding of the complexity of the theoretical framework. The visions from this assignment were used as the foundation for the development of new innovative teaching practices.

In the second intervention at the school during 00/01 the team helped the teachers to further develop new cross-curricular practices with the use of computer supported collaborations. The contradictions in previous interventions were still there and were described as prevailing myths about student behaviour. Despite this, teachers had engaged in the design of new curricular units, challenging these myths and again, as the process continued the way teachers described it, their students changed. This suggests that conflicts of motives and systemic contradictions are deeply rooted and take time and effort to resolve. Engeström et al. (2002b) suggest that the movement away from the perception of students as apathetic to energetic and engaged went hand in hand with the concrete expansion of new practices. They used the ratchet metaphor to describe this motion forward in step-by-step innovations and reproduction of new curricular units that changed both practices and perceptions.

These findings caution a researcher to follow an intervention and its aftermath for a long period of time to analyse and bring evidence of sustainable change in a tangible way. The design process for the new curricular units in these interventions (Engeström et al., 2002a; 2002b) are not described in any detail, but the use of CHAT concepts and models is evident, and actions of ideation, planning, implementation, and evaluation were identified.

The representations and description of these and other CL processes suggest an academic approach where analysis and ideation are done in a conference-like setup, where researchers are leading the process and participants are gathered around the scene, participating in a seminar-like format, using speech as the primary conduit for the work (Virkkunen & Newnham, 2013; Botha, 2017; Bal et al., 2018). In PD processes there is a tradition of emerging participants in tacit and physical exercises or design games, based on a design studio approach (Löwgren & Reimer, 2013). This perhaps reflects the different traditions from which the intervention methodology has developed. Here I think that CL could benefit from the use of tools from a PD tradition to enhance engagement and agency in participation, while at the same time PD would benefit from the CHAT framework for tools and concepts from developmental psychology.
5 Design research as research design – setting, methods and data

5.1 The setting
This thesis explores teachers' work and learning during a professional development activity conducted as a participatory design project between upper secondary schools in Sweden and the USA using collaborative media production to create an international collaboration on Ocean Literacy. The empirical setting is one upper secondary school in Sweden and one in the USA. Three teachers from Sweden and one from the USA were part of the design team and I followed them for two iterations of the design. In the design process I was engaged in both sites but after the first iteration my focus shifted towards the Swedish school and their teachers involved in the project as the teachers took full ownership of the process. For a period of two and a half years I spent 107 hours spread out over 23 days in the field. For the design process, an ethnographic approach was used. Interviews, observations, workshops, and meetings were either video recorded or summarized in fieldnotes. This data was used by the design team to analyse and promote the design process. The post-analyses were done on a selection of this data to answer research questions of relevance for the thesis.

5.2 Double purposes
The study concerns teachers' learning and development of innovative learning designs with the aim to be a practice-embedded research project addressing challenges of local educational practice. Design research or Design Based Research (DBR) in the educational sciences has become a tradition that combines a design process and empirical research with analytical focus on questions of relevance for the field (Cobb et al., 2003; Barab & Squire, 2004; Anderson & Shattuck 2012). Barab and Squire (2004) described this double purpose as:

…design is conceived not just to meet local needs, but to advance a theoretical agenda, to uncover, explore, and confirm theoretical relationships (Barab & Squire, 2004, p. 5).

This 'theoretical agenda' can be a number of things. The diverse types of data accumulated could be used to exemplify and illustrate processes and theoretical discussions, but in the cases where they are empirical carriers of epistemological principles they can be used to discuss and formulate theoretical generalizations. If so, it is important to remember the highly situated context in which the data...
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has been generated. In this thesis, the same dataset was used for articles 2 and 3 for this purpose. The identification and analysis of empirical manifestations of epistemological principles and learning actions aims to contribute to the discussion and development of CHAT.

My role as a researcher in this process has two key components: (1) to support and promote the teacher’s development of new practices and (2) to conduct research through a systematic production, analysis, and presentation of empirical data. Even if these are two different processes they are linked and interdependent. The empirical data is accordingly not merely collected but co-created by me as a researcher and the participating teachers in the process. This poses challenges to the validity and reliability of the research results (discussed in the reflections section below).

5.3 ‘Wicked’ problems and adaptations of methods

The design process in this study combines methods of PD and CL interventions. Being situated and particular makes design processes indeterminate and ‘wicked’ (Buchanan, 1992). The many different activities, interests, stakeholders and conflicting motives makes design problems impossible to pre-define (Buchanan, 1992; Nelson & Stolterman, 2014). As I entered the project, I had some ideas about problems, solutions, and methods but following the principles of PD, the needs and circumstances of the participants dictated the direction of the process. In this thesis, this ‘wickedness’ also shaped the search for appropriate research questions and methods of analysis - a process of exploration from open questions to more and more precise formulations of research questions and how to answer them.

At the outset of this project as a research effort, the focus was on the design process and the development of new learning designs. CHAT was not extensively used as a framework from the start but as tensions on systemic levels emerged, the need to address these issues grew more apparent. The CL approach was not initially planned and part of the research design. This process is partly connected to my own process as a doctoral student as my understanding of the theoretical and methodological framework grew, but mainly because the situated need in the design process called for it. My theoretical and methodological toolbox has accordingly been assembled throughout the process by the studies incorporated in this thesis but also through the discoveries and needs emerging in the design project. This could be described as the ‘wickedness’ of design challenges (Buchanan, 1992), but it could also be explained as an abductive research process: the theoretical framework has been developed and deepened through the interaction with the empirical material.
The use of CHAT in the design process opened up for the need and possibility to combine PD and CL methods, and the choice to adopt a CL approach provided an opportunity to try out the foundational principles and concepts of expansive learning as part of a design process and to examine the learning actions in the process systematically. Figure 7 is a visualization of this shift of focus and methods. The two iterations that were carried out during the time period differed in the sense that the first iteration was a PD process focused on the practical design, where CHAT was used to inform and analyse the process, and in the second iteration using the CL methodology, the focus was set on the activity system and general practices parallel to the design process.

![Figure 7: A visualization of the shift of focus and methods](image)

**5.4 Data production and analytical methods for the articles**

Different methods of analysis were chosen for the different research questions in the three articles. The first article was produced after iteration 1 and the second and third article after iteration 2. In Table 1, the three articles with research questions, data and methods are summarized. The first article is connected to the first overarching question of this thesis on the challenges and strategies that develop in the design process. The second and third articles are connected to the second overarching question of the thesis to understand learning as part of and expanding beyond a design process.
Table 1: A summary of the three articles with research questions, data and methods.

<table>
<thead>
<tr>
<th>Article</th>
<th>Aim and research question</th>
<th>Data</th>
<th>Method(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Collaborative Media in Educational Settings: Teaching as a Design Profession</td>
<td>What challenges and strategies develop in a participatory design process of producing collaborative media among teachers using CHAT as a design tool?</td>
<td>documentations made by the design team, field notes, videotaped interviews, workshops and observations.</td>
<td>A. Thick description generated from collected data. B. Thematic analysis of data from CHAT workshop supported by interviews.</td>
</tr>
<tr>
<td>2. Expansive Design for teachers: An activity theoretical approach to design-based research.</td>
<td>What manifestations of the epistemological principles behind CL interventions can be found and how are they related to concepts from design traditions?</td>
<td>Transcribed video data from 6 Change Lab sessions.</td>
<td>Identification and analysis of key characteristics of CL interventions and their relation to concepts from design traditions.</td>
</tr>
<tr>
<td>3. Expansive Learning in a Change Laboratory intervention for teachers</td>
<td>How can the seven learning actions posited by the theory of Expansive Learning and CL methodology contribute to and/or limit an analysis of teachers learning in a design-oriented process?</td>
<td>Transcribed video data from 6 Change Lab sessions.</td>
<td>A. Identification and analysis of learning actions posited by the theory of expansive learning B. Analyses of their linear and cyclic relationships.</td>
</tr>
</tbody>
</table>

5.5 Data and methods: Article 1

This article summarizes the design process and is the result of the first iteration using ethnographic data collected during the period in the form of documentation produced by the design team: field notes, videotaped interviews, workshops, and observations. These were iteratively reviewed to inform a relevant description of the process and results. The aim and analytical interest were to explore teachers’ challenges and strategies when CHAT was used as a design tool and analytical framework. To focus on these issues, two sets of data from the process were used for post analysis: an evaluation workshop using the CHAT model for activity systems and follow up interviews with two participating teachers with reflections on the process. These were videotaped and transcribed verbatim for further analysis. The workshop lasted three hours and the interviews 40 minutes each. The data from the workshop was coded and analysed using thematic analysis (Braun & Clarke 2006). Using open coding strategies, a coding scheme was
developed by identifying meaningful units of text, grouping them in categories and giving them tentative definitions. The same units of text could be included in more than one category. After this, the data was reviewed twice, and the initial 18 categories were grouped into eight key themes. Ninety percent of the data was allocated to one or more themes. The remaining 10% was categorized as social interactions and discussions not related to the design process. The relationship between the themes was then analysed and the transcripts of the interviews were read and reread to identify themes that had to do with the way the teachers reflected on the process. These readings resulted in marks on the transcripts, which functioned as a guide for further analyses and deeper understanding of the data from the workshop.

5.6 Data and methods: Article 2

This article explores the empirical manifestations of the epistemological principles behind CL interventions with the aim of contributing to the discussion and understanding of CHAT, connected to and used in a PD process. The CL was conducted as part of iteration 2 of the design process. The raw data consists of video recordings of the six Change Laboratory sessions. The total length of the recorded material was 418 minutes. The length of the sessions varied between 57 and 96 minutes. The introduction to session 4 was not captured on video and left out of the analysis. The video material was transcribed verbatim by the researcher and analysed to identify five key characteristics of CL interventions connected to the epistemological principles: contradictions, conflicts of motives, first and second stimuli, zone of proximal development and germ cell, and emerging concept (Sannino & Engeström, 2017). The identification of these characteristics in the CL discourse had the purpose of understanding how the epistemological principles operated in the process. In the results section, a description with excerpts from the process is presented, divided into subsections for the key characteristic followed by a discussion of the connections with Participatory Design traditions.

5.7 Data and methods: Article 3

The study explored how the seven learning actions posited by the theory of Expansive Learning and Change Laboratory methodology contributed to an analysis of teachers learning in the CL intervention done in the second iteration of the design process. The analytical focus is placed on the identification and relationship of Expansive Learning Actions and Non-Expansive Learning Actions as well as the cyclicity and evolution of expansive learning at the level of the whole intervention and at session level. To achieve this, a more detailed analysis of participants’ discourse was needed. The raw data in this study is the
same as that for article 2. Following the method used by Engeström et al. (2013),
the first step of the analysis is to identify learning actions and the frequencies of
these in the Change Laboratory process. Learning actions were first identified in
the material by discerning episodes based on their substantive contents. Analysis
of the conversations within each episode was performed to specify actions and
formulate a preliminary description of these actions. Using the framework of the
seven expansive learning actions, the epistemic functions of the actions were
determined and non-expansive actions were identified.

The script for the CL was focused on theoretical modelling, but the participants’
need for continuing the design of concrete solutions created a parallel process of
theoretical modelling and concrete design of learning sequences, not one
following the other. This challenged the criterion and boundaries of some of the
expansive learning actions. In the analysis of learning actions there was a need to
distinguish between actions towards theoretical modelling and actions of
designing concrete solutions. This was done by creating new subtypes of learning
actions in the next step of the analysis. The last step in the analysis was to explore
the characteristics of possible cyclicity of the expansive learning actions on the
level of the whole Change Laboratory process and on the level of each session to
find what kind of smaller scale cyclicity there might be within the overall process.
For this, the criterion of at least four expansive learning actions in a meaningful
order to identify an expansive cyclicity was used (Engeström et al., 2013).

5.8 Reflections

The interest and focus in this thesis are on teachers’ professional development
and work integrated learning. In DBR the focus is most often on the ‘end users’
- the students and the testing of the design for their learning and development
(Anderson & Shattuck; 2012). In order to maintain my focus, a division of labour
was agreed upon in the design team. The responsibility for evaluation of the
design from the student perspective was given to the teachers and was left out of
the research conducted for this thesis. Apart from giving the teachers ownership
of their design, it enabled me to focus on their learning and development. The
drawback of this approach is that the design is not systematically tested in terms
of students’ learning. Being the single researcher in this study also has other
implications. The interdisciplinary aspects of drawing on the fields of interaction
design, media studies and educational sciences become a challenge when done by
one person. The performance of CL interventions is normally done by at least
three persons and filling all the roles as a single researcher was demanding. From
the outset, one would be discouraged from trying this, but there is a reason for
this approach. A large apparatus involving several researchers and designers
creates a design space very different from the normal work practice of
participating teachers. The aim of supporting teachers and developing their own design skills is, from my perspective, best done with a setup closely resembling their normal, everyday practice.

A central question for DBR and other interventionist research is whether the results are valid and reliable. As Barab and Squire (2004) put it:

> if a researcher is intimately involved in the conceptualization, design, development, implementation, and re-searching of a pedagogical approach, then ensuring that researchers can make credible and trustworthy assertions is a challenge. (Barab & Squire; 2004, p.10)

The intimate involvement is a strength in the sense that it makes for a better understanding of situated needs and problems, but it also carries a risk of the researcher’s bias. The dilemma of being both involved and detached can arguably be the trademark of DBR:

we argue that this inside knowledge adds as much as it detracts from the research validity. Good research demands ‘scepticism, commitment and detachment’ (Norris, 1977), but DBR also requires comradeship, enthusiasm, and a willingness to actively support the intervention. Thus, a certain wisdom is needed to walk this narrow line between objectivity and bias. The personal skill to hold all of these attitudes simultaneously is a challenge and a defining feature of quality DBR. (Anderson and Shattuck; 2012 p.18)

These concerns are also valid for CL interventions. To actively ensure the credibility of the research, I have used the following methods: Maintaining all documentation of records and data stemming from the study makes it possible to revisit the material and the process, what Halpern calls leaving an audit trail (Halpern; 1983 in Onwuegbuzie & Leech; 2007). Throughout the process I used Member checking/Informant feedback (Guba & Lincoln, 1989) by continuously allowing participating teachers to provide feedback on my data, interpretations, and conclusions. As a PHD student I have also had the benefit of using many instances of peer debriefings by senior researchers, supervisors, and colleagues who pose difficult questions about the procedures, meanings, interpretations, and conclusions of my work, which is a factor for the reliability and validity of the research (Lincoln & Guba, 1985).
5.9 Ethics and consent

The head teachers of the participating schools were informed beforehand and gave me permission to conduct the project. In the work reported on here, all participating teachers and students were given oral and written information about the aims, and all volunteered to participate in the study.

The project was documented through video, not only for empirical use but also for the possible making of a documentary film for a wider audience and the students published their own videos on the internet. This means that the research was not able to guarantee anonymity of the participants and that parts of the material will be spread outside the research framework which requires explicit consent. A written consent was signed by all the participants with the ability to withdraw from the project at any stage without further explanations. None however did.
6 Summary of the articles

6.1 Article 1: Collaborative media in educational settings: Teaching as a design profession

Digital Literacy and Media Literacy are part of the notion of 21st century skills, claimed to be necessary and taught in schools along with creativity and innovation, social and cross-cultural interaction, collaboration, critical thinking, adaptability, communication, and problem solving. New curricular demands challenge teachers in planning and conducting their work. A change in the way that teachers are seen, from implementors to designers who actively construct, invent, and develop the practice of teaching and learning calls for professional development activities that provide tools, competencies, and ideas to embrace this complexity.

This article reports on a participatory design project, conducted with K-12 schools in the USA and Sweden to create an international collaboration on Marine Biology using video production as a tool for learning and representation. The focus of this study was to explore challenges and strategies developing in the process, using Activity Theory (CHAT) as a design tool and analytical framework.

The design process followed the stages of a participatory design methodology adapted to the special circumstances of the collaborative media (CM) framework with an initial exploration of work, discovery process, concept development, and detailed design. In the enactment, the design process continued as an emergent property of the collaboration through situated activities driven by teachers’ and students’ intersecting interests and demands. An evaluation workshop using the CHAT model for activity systems was conducted for the next iteration and follow-up interviews with participating teachers. These were videotaped, transcribed, and analysed through the method of thematic analysis.

Findings showed that the design tools promoted transformative agency among participants since the intervention was organized as an open-ended process in which teachers’ ownership of the process was a central part. The CHAT model enabled them to analyse their work practice beyond the design object and address issues at systemic levels, expanding knowledge and ideas for future work practice. Issues of time management, organisation of cross curricular activities, and conflictual curricular demands were made visible and addressed.
This was achieved by bringing the CHAT-model inside the process as a tool for teachers, not just for analysis by the researcher. When sharing and articulating experiences and ideas, the process enabled teachers to externalize inner conflicts and mirror these in contradictions and tensions at a systemic level. The design process created a zone of proximal development where some of these contradictions could be resolved through producing new ideas for the design, and some were identified as challenges on systemic levels outside of the work group. Working with new technologies was burdensome in the process, but the use of video as a mediating, semiotic resource was an underestimated issue posing the greatest challenge that needed to be addressed at a school organization level. To recognize the notion of digital technologies as media of everyday practice, also means to recognize these practices as a complex language activity. In educational settings, there is a need to develop competence among both teachers and students if these resources are to be used as effective tools for learning and representation. The process allowed for important reflections on participant roles as designers of complex learning experiences in accordance with students’ needs and competence, media infrastructure, school organization and rules, and policies that frame goals and outcomes.

6.2 Article 2: Expansive design for teachers: An activity theoretical approach to design-based research.

Innovative learning designs have implications on the teaching practices and the system in which they are created, often with conflicting motives and tensions on systemic levels. PD processes with teachers require tools and concepts to grasp this complexity to create durable changes. This article explores the epistemological principles behind the CL methodology used as part of a PD process for teachers. Traditionally CL interventions are initiated in larger activities in acute crises, but it is interesting to explore the potential relevance of these principles in a smaller setting where the conflicts and tensions are not so aggravated and part of an ongoing design process.

By exploring the empirical manifestations of the epistemological principles behind CL interventions in the process this paper aims to contribute to the discussion and understanding of CHAT, connected to and used in a PD process. The CL methodology is built on two epistemological principles: the principle of ascending from the abstract to the concrete and the principle of double stimulation. These principles were used to script the CL intervention and a post analysis was done to identify five key characteristics for a successful cycle of expansive learning: contradictions, conflicts of motives, first and second stimuli, zone of proximal development and germ cell, and emerging concept.
A description with excerpts from the process is presented in the article, which is divided into subsections for the key characteristic followed by a discussion of the connections with PD traditions. The findings of the study suggest that Activity Theory and Change Laboratory methodologies used in a PD process can serve as tools for expansive learning and new innovative learning designs. Contradictions and conflict of motives in curricular demands between 21st century skills and specific subject matter were made tangible using the CHAT triangular model. A four-field representation of a ZPD was used as a second stimulus for the development of solutions of hybrid formats where the abstractmovie emerged as an idea capturing both contradiction and solution in a simple concept. In this format, video production as a collaborative learning process for documenting and representing science experiments was combined with individual reports to accommodate assessment of specific subject matter. The theoretical framework enabled tools for a collective analysis of the origin and development of systemic contradictions as well as a model to represent a zone of proximal development for future practices and concrete designs. There are many similarities between CL and a PD process with their common focus on participants’ agency and volition. The combination of PD practices and CL methodologies can be a way forward to develop both traditions.

### 6.3 Article 3: Expansive learning in a Change Laboratory intervention for teachers.

The theory of expansive learning and the Change Laboratory (CL) methodology have been developed and applied in a large number of studies on workplace learning and educational change, but few studies have been done on a micro-level intervention, exploring the longitudinal development of expansive learning at a systematic and detailed level. This article examines a CL intervention in a K-12 school in Sweden carried out as a professional development activity for a small group of teachers involved in a participatory design project on media production in an international collaboration. The study explored how the seven learning actions posited by the theory of expansive learning and Change Laboratory methodology contributed to an analysis of teachers’ learning in a design-oriented process. The analytical focus is placed on the identification and relationship of expansive learning actions and non-expansive learning actions as well as the cyclicity and evolution of expansive learning at the level of the whole intervention and at session level. All CL sessions were documented with video and transcribed for the analyses.

Findings showed that the Change Laboratory intervention enabled teachers to analyse and reflect upon their work practice as well as change it and design new innovative learning tasks for their students. All seven learning actions proposed
by the theory of expansive learning were identified and the planned intervention upheld the overarching cycle of expansive learning.

![Figure 8: Evolution of the frequencies of different expansive learning actions over the course of the Change Laboratory sessions](image)

At session level, learning actions were dispersed with odd combinations and deviations and were disrupted by practical design activity throughout the process. The vital actions of questioning and analysis on a systemic level connected the design process to the activity system, addressing contradictions and tensions crucial to solve for a successful implementation and development. Likewise, actions of ideating concrete designs triggered analysis and modelling of general concepts.

At the session level, there were few examples of linear evolution or cyclicity of learning actions and many disruptions of practical design and movements back and forth. Cyclicity might be desirable but not necessary for expansive learning and the findings challenge the need to first grasp the problem at a conceptual level before generating concrete solutions. The results of this study suggest the opposite: that the entanglement and parallel movement between the abstract and the concrete were a driving force for the teachers’ expansive learning and the creation of new learning designs.

The seven expansive learning actions functioned as tools to map and analyse this process. To see one type of learning action as a trigger or stimulus for another type of learning action could be a way to analyse expansive learning without being locked into finding whole, disrupted, or non-existing cycles which could limit the analysis. Instead, the analysis would create a map of interconnecting learning actions that shows different, contextual landscapes of learning, expanding as the process continues. The paths and turns on these maps are held together by the script of the intervention securing the overarching cycle of expansive learning.
The Change Laboratory intervention enabled teachers to analyse and reflect upon their work practice as well as change it and design new innovative learning tasks for their students. All seven learning actions proposed in the theory of expansive learning were identified in this study but were dispersed with odd combinations and deviations. The theory of expansive learning is dependent on dialectical movement between learning actions. The expansive movement is not inherent in the different epistemic actions themselves, but in the relation between them.
In this chapter, a summary and discussion of the results will be presented under a subsection for each research question posed in the thesis. The three articles are primarily connected to the first two questions and the third question concerning design principles will be discussed and summarized based on findings throughout the process. The chapter ends with suggestions for further study and applications of expansive design as a concept for work integrated learning.

7.1 Challenges and strategies

The first question posed for this thesis was: What challenges and strategies were developed in the participatory design process of collaborative media production as a situated professional development approach for teachers? The question of challenges and strategies is twofold in this thesis: The development of the research as discussed above on the one hand and the development of participating teachers' knowledge and work practice on the other. For participating teachers, the crossing of curricular and international borders and the use of media production in a teaching activity created many challenges. Cross-curricular teaching models didn't always fit the school's organization of schedules and time management; language barriers, cultural differences, and technological issues were all part of the difficulties experienced. Practical solutions for some of these problems were created in the process, such as better documentation of expected outcomes, clearer guidelines for students, and workshops in media production for teachers as part of the professional development program.

The strategy deployed by using CHAT models in the process allowed for important reflections on the participants' role as designers of complex learning situations. The collective sharing and articulation of experiences and ideas was an important feature for learning and development. One of the important findings presented in article 1 is that engagement in media production in cross-curricular activities without core competence in media literacy can create high thresholds, limiting the object of the activity and even creating a backlash in the development of new teaching and learning practices. The excerpt from the CHAT workshop illustrates this very well:

"If everybody had knowledge of it (video production) as a language practice beforehand like writing or talking or things they have done and practiced…They don't know how to write a report when they come here…We train four or five times to get them to master that. Then the technique to..."
7 Discussion

In this chapter, a summary and discussion of the results will be presented under a subsection for each research question posed in the thesis. The three articles are primarily connected to the first two questions and the third question concerning design principles will be discussed and summarized based on findings throughout the process. The chapter ends with suggestions for further study and applications of expansive design as a concept for work integrated learning.

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If everybody had knowledge of it (video production) as a language practice beforehand like writing or talking or things they have done and practiced…They don’t know how to write a report when they come here… We train four or five times to get them to master that. Then the technique to
write a report becomes unproblematic and you can focus on the research question and the hypothesis to make a good report with good content. But for many this (video production) is to start from scratch with a whole new language. Then we have a parallel learning process as they learn and present subject matter knowledge…It’s two different things. That’s why it’s important that many subjects work with this… (Augustsson, 2018, p.15)

Using the activity theoretical model for different levels of operations, actions and activity (Leontiev, 1978; Bödker & Klokmose, 2012), I would like to highlight this challenge and the need for competence at all three levels, with the textual aspects of video production being a key factor for success. Video production is a complex form of multimodal communication – a language practice. Technologies are constantly developing and though teachers in the project found it hard and time consuming to use and support students’ use of different technologies, this operational level of the activity was not the most complex problem. The use of video production as a language practice was perceived as an underplayed aspect when connecting subject matters to video production and the skills required to achieve good results. I propose the concept of intermediate objects to describe the different layers in the process. The activity of teaching and learning a subject – in this case marine biology – was part of a shared object of ‘cross curricular learning with media production’. To explore and represent content through video production, one needs to master the language of moving images. To be able to do that it is necessary to understand and be able to use the technology it involves. The process explored in this thesis showed an initial lack of competence in technology and media literacy – a prerequisite for the process to take off and develop in the first place. In some instances the activities were only tool-producing activities, as teachers and students struggled with technological aspects of media production and the object of teaching and learning subject matter content was not reached at the desired level. Technology became the main object of the activity. To understand and make use of the different levels of operations, actions and activity as a strategy for exploring professional development needs, I have made a tentative matrix:

<table>
<thead>
<tr>
<th>Levels</th>
<th>Oriented towards</th>
<th>Questions on</th>
<th>(Intermediate) Objects</th>
<th>Desired outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTIVITY MOTIVES</td>
<td>WHY?</td>
<td>Content</td>
<td>Teaching and learning Subject matter content</td>
<td></td>
</tr>
<tr>
<td>ACTION GOALS</td>
<td>WHAT?</td>
<td>Literacy</td>
<td>Teaching and learning Communication, narratives, genres</td>
<td></td>
</tr>
<tr>
<td>OPERATIONS CONDITIONS</td>
<td>HOW?</td>
<td>Technology</td>
<td>Teaching and learning Cameras, Editing software, publishing tools</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Leontiev’s levels of activity adapted to the activity of teaching and learning through media production.

The activity of using video production in Marine Biology is motivated by the object of teaching and learning subject matter content. It answers the questions
of why the activity is performed. Video production on the level of actions is a question of goal-oriented actions towards a functional representation or narrative with moving images. This answers questions about what is done in the activity. These actions are dependent on literacy skills. The operational level of the activity is oriented towards conditions for the actions and answers the question of how things are done. In this case the use of digital technologies, such as cameras, editing software, and publishing tools. In the best of worlds these would be handled smoothly and without much reflection. In the matrix above, the activity level should perhaps not be limited to subject matter content, but for a marine biology teacher, the subject matter content is the main motivation for the activity. The matrix describes the connection and dependencies of the different levels in the process. You can also describe it as a sequence of connected, intermediate objects. In Figure 8 they are represented as interconnected circles.

![Intermediate objects in the teaching and learning process.](image)

There is no clear boundary between the different levels and in the project that is this thesis, actions towards all intermediate objects were in motion simultaneously, which caused frustration and backlashes. This model could make the different levels visible and tangible, enabling an analysis of professional development needs while making the necessary connections between technology, media literacy, and subject matter content in the design process. It also highlights the importance of media literacy. If media production is to become a fruitful endeavour in schooling, there is a need for teachers to develop media literacy competencies and ways to integrate them in their teaching. The competence to understand and create communication with multimodal representations and moving images is based on knowledge of their historical development, genres, and semiotic affordances. The notions of creativity, innovation and individual expression must not be explored without a focus on the textual aspects of media production (Callow, 2005). Facilitating learning actions towards media literacy is therefore an important part of the design principles sought after in this thesis.
7.2 Understanding learning

The second question posed for this thesis was: How can we understand learning as part of and expanding beyond a design process? The notion of expansive design proposed is a concept capturing the ambition of facilitating learning as an integrated part of a design process. Combining PD and CL methodology was an effort for both professional development, transformation of the activity system, and the development of new curricular units. How learning and development in such processes takes place is from my perspective of particular interest for the field of work integrated learning as the actions of participants have an impact on their individual development as well as the activity in which they act.

The new designs of curricular units are in themselves an indication of a work integrated learning process but learning as an integral aspect of a design process needs to be made explicit and analysed. From a CHAT perspective, learning is understood and studied as a collective process where learning actions transform the activity. To understand how learning expands in a such processes, empirical data must be examined in detail with the help of concepts from the theoretical framework.

In article 2, the empirical data from the CL process was explored and five key characteristics for a successful cycle of expansive learning were identified: contradictions, conflicts of motives, first and second stimuli, zone of proximal development and a germ cell. These characteristics show how the epistemological principles behind the theory of expansive learning are implemented and made concrete. This helps to understand the learning process as well as the expansion of the activity and its object. From this perspective, learning must be understood as a process that generates what Engeström and Sannino call actionable knowledge:

In contrast with stabilization knowledge that fixates phenomena into static categories, actionable knowledge is understood here as a collaborative and generative possibility knowledge intertwined with transformative action. (Sannino & Engeström, 2017, p.80)

Possibility knowledge should be understood here as knowledge about possible new forms of practices for teachers and actionable in the sense that they open up for agency and volition. The practical use of the ZPD model and the development of new concepts in the CL of this thesis are examples of this. The collaborative analysis made by participating teachers, through double stimulations, revealed systemic contradictions and conflicts of motives that became a driving force for transformative actions and innovative learning designs.
In article 3 the different learning actions postulated in the theory of expansive learning were examined in more detail. This confirmed the overarching cycle of expansive learning but also showed many disrupting actions of practical design activity throughout the process and deviations from the linear process of ascending from the abstract to the concrete. This causes a question about the cyclicity and linearity as fundamental concepts for expansive learning in the framework. The analysis showed a map of entangled and parallel movements between the abstract and the concrete that were a driving force for the teachers’ learning process and the creation of new learning designs. Learning on this level is perhaps best understood as non-linear and non-cyclic even if the script of the intervention secured the overarching cycle of expansive learning.

The case explored in this thesis was not an activity system in an acute crisis and was conducted with a small group of teachers. There is a limitation in this approach and there were no visible changes on an organizational level which is usually the case with CL interventions. But changes for participants’ practices and new curricular designs were visible and tangible. The small scale and strong connection to an ongoing design process makes the CL approach in this case a tool for design, rather than for organizational change. Despite that, the theoretical framework offered tools for both change and analysis of how learning developed in the process. This is, I would argue, an important feature for the concept of expansive design.

### 7.3 Design principles

The third question posed for this thesis was: What design principles can be articulated for a professional development activity when combining PD and CL theory and methodology? Design principles are oriented towards production of knowledge of a generalizable nature and can be articulated on many levels such as heuristic statements, criteria of particular intervention types or how others might benefit from the findings of a particular design research effort (Herrington, Herrington & Mantei, 2009). According to Van den Akker (1999), design principles should be articulated at a substantive, procedural and argumentative level:

The major knowledge to be gained from development research is in the form of (both substantive and methodological) ‘design principles’ to support designers in their task. Those principles are usually heuristic statements of a format such as: ‘If you want to design intervention X [for the purpose/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do
that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R’. (Van den Akker, 1999, p.9)

In simple terms, design principles should answer questions about what, how, and why. The articulation of such principles works as a summary of findings expressed as concrete suggestions for practitioners. In this thesis, the focus is on how to design a professional development effort for teachers and therefore, the principles are targeted for researchers engaging in similar interventions. Six tentative principles were developed in an abductive process where the design process, analysis of the empirical data and review of previous research, together shaped the results. The principles are presented in a table below, followed by a discussion under a headline for each one.

<table>
<thead>
<tr>
<th>Characteristics (what?)</th>
<th>Procedures (how?)</th>
<th>Arguments (why?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A combination of traditions from PD and CHAT.</td>
<td>By combining tools for theoretical analysis from CL with appropriate tools from the field of professional design.</td>
<td>Because a design-oriented process for teachers needs tools for both collaborative analysis of the activity and concrete designs.</td>
</tr>
<tr>
<td>A commitment to iterative cycles of expansive learning.</td>
<td>By scripting and promoting the seven learning actions postulated by the framework of expansive learning inside the design process.</td>
<td>Because an analysis and change of the activity system is important for new curricular designs to be developed and implemented in a durable way.</td>
</tr>
<tr>
<td>A focus on historically accumulating structural tensions within and across activity systems.</td>
<td>By facilitating collaborative articulations and analysis of systemic tensions and contradictions through the principle of double stimulation.</td>
<td>Because the agency and volition of participants is important and a key feature for change and participatory design efforts.</td>
</tr>
<tr>
<td>A tangible and practical engagement in theoretical models.</td>
<td>By using mirror materials and conceptual models as interactive canvases – as 'hands-on-tools' for both analysis and design.</td>
<td>Because complex theoretical models can function as boundary objects between design, research, and professional discourse.</td>
</tr>
<tr>
<td>Special attention to media literacy</td>
<td>By facilitating learning actions for media literacy for teachers.</td>
<td>Because media literacy is a key aspect for the design of curricular units involving media production.</td>
</tr>
<tr>
<td>Special attention to participating teachers’ workload.</td>
<td>By placing reasonable and balanced demands on time and effort for participating teachers</td>
<td>Because this is necessary to promote agency and a sense of ownership of the process.</td>
</tr>
</tbody>
</table>

Table 3: Design principles for expansive design processes with teachers involved in collaborative media productions.
7.3.1 A combination of traditions from PD and CHAT.

This thesis uses the concept of expansive design to connect design practices and traditions with CHAT as they move from ideation and production of artefacts to social change and innovation, where learning is becoming a central aspect of design processes (Löwgren & Reimer, 2013; Hillgren, 2006; Ehn, 2008). Not only can CHAT be an analytical tool for all parts of those processes, but also a tool for the systematic analysis of learning processes.

As observed in this thesis project, curricular designs are dependent and have an impact on the activity of teaching and learning which requires both analytical tools for collaborative articulations of important issues and tools for concrete designs. The tradition of PD provided tools for the design process, but CL methods were needed to address tensions and conflicts on a systemic level. To grasp the complexity of teaching and learning in educational settings, CHAT provided a framework as a descriptive, explanatory, and generative theory for the process based on research from developmental psychology.

Severance et al. (2016) argued that the use of CHAT tools and models was not sufficient for the development of concrete design and in this thesis tools from both traditions were used.

The combination of PD tools and CL methodologies can strengthen both traditions as CL comes from an academic field with a focus on theoretical, analytical reflections and PD comes from a studio-based tradition with practical tools for innovation processes.

7.3.2 A commitment to iterative cycles of expansive learning.

This and the next principle are connected to the key features of CHAT to incorporate in a design process formulated by Penuel (Penuel, 2014). PD and CL share the same view on the importance of an iterative process for design and development. The special focus on questioning and analysis in the CL method for promoting expansive learning was an important feature for the development of new practices and curricular units in this thesis project. By scripting and promoting the seven learning actions postulated by the framework of expansive learning, a collaborative analysis and change in the activity was made possible. The CL intervention was made as part of iteration 2 of the design process which enabled development of stable and durable changes. It is possible that a CL intervention could be the first step in the design process – a design before design activity (Ehn, 2008), mapping systemic tensions and contradictions connected to a future design of curricular units. In this thesis however, the first design iteration
pushed the process as tensions emerged which prompted the CL approach. Either way, expansive design as understood in this thesis is dependent on iterations of collaborative analysis, innovation and implementation based on the framework of expansive learning.

7.3.3 A focus on historically accumulating structural tensions within and across activity systems.

The analysis of historically accumulating structural tensions and contradictions is part of the expansive learning cycle but needs to be articulated as a key principle for expansive design processes. The reason for this is the importance of tensions and contradictions at systemic levels in the CHAT framework (Engeström et al., 2002a; 2002b; Penuel, 2014; Sannino, 2010). The collaborative articulations and analysis of systemic tensions and contradictions were very important for development and design in this thesis project and the use of double stimulation as a tool made these issues explicit, analysed, and addressed. The joint formulation of challenges and possibilities enabled by the theoretical models promoted agency and volition for participating teachers and resistance was an important feature in this as it pushed them into collective actions. An example of this was the reoccurring discussions in the process on assessment in relation to 21st century skills. Participating teachers were forced to articulate their conflict of motives and collectively renegotiate the meaning and experienced contradictions in the curricular demands. This was a necessary process for the innovation of new learning designs.

7.3.4 A tangible and practical engagement in theoretical models.

Mirror materials in CL are predominantly used as tools for theoretical, analytical reflections (Sannino, 2010; Botha, 2017). Previous research has pointed to the possibilities for participants to engage with complex models and concepts in a tangible, studio-based way, without a deeper understanding of the theoretical framework (Van Amstel et al. 2015; Bödker & Klokmose, 2012). In line with these observations, this thesis treated the mirror materials more like canvases on which participants could actively and practically interact with the framework in the collaborative analysis.

The models and mirror materials functioned as a boundary object between design, research and professional discourse, re-mediating issues and challenges in the design process, and the active and practical engagement must be understood as an important part of the development of agency and volition. As a principle of expansive design this is the result of combining the approaches from the traditions of PD and CL.
7.3.5 Special attention to media literacy

As Löwgren and Reimer (2013) pointed out, the development of digital technology has enabled most of us to become producers and media production is becoming part of our everyday practice (Löwgren and Reimer 2013). When engaging in a professional development effort involving media production, there is a need for special attention to media literacy and to facilitating learning actions for teachers in the process. Media literacy and the production of multimodal representations are becoming part of the syllabus and practices in more school subjects, and if these practices are to become a fruitful endeavour there is a need for teachers to develop competence and ways to integrate them in their teaching. The model discussed above, using the different levels of operations, actions, and activity (Leontiev, 1978), can be a useful tool to analyse and promote this in a collaborative design process of new curricular units. This was the case in this thesis where teachers and students grappled with challenges of both technology and video production as a language practice.

7.3.6 Special attention to participating teachers’ workload.

A challenge expressed by participating teachers in this thesis project was the difficulty of time allocation and management for the project. A professional development effort embedded in the everyday practice of teachers can be a strain on their workload and new theoretical concepts and methods can become overwhelming. On several occasions during the process, teachers expressed worries about how much time and energy was spent on the project, going beyond their ordinary tasks and workload. Following Voogt et al. (2015) as discussed above, I would claim that the extra time and efforts demanded of teachers must be reasonable and balanced over time to facilitate agency and volition. Teacher ownership of the process can only be achieved by giving special attention to situated needs, previous experiences, and workload.

7.4 Concluding remarks and future challenges.

The ambition of this project was to combine theories and tools from PD and CHAT possibly to enrich both traditions, using the concept of expansive design. In this effort some challenges and results need a final highlight. Both traditions have developed over time and as the field of design is moving from ideation and production of artefacts to social change, where learning is becoming a central aspect of design processes, theories and tools from the learning sciences are essential. Not only can CHAT provide tools for design in complex learning environments, but also tools for systematic analysis of how learning develops in
the process. This has relevance for design research in general, and design research in educational sciences, in particular.

The development of CHAT has been described as generations of Activity Theory adapting to the demands of different times. Globalisation and digitalization have created complex networks of activity systems and runaway objects where transformations in well-specified activity systems no longer are sufficient to deal with urgent societal issues (Yamazumi, n.d.). The development of the theoretical framework requires re-conceptualisation of core principles. The view and use of ZPD has been transformed from Vygotsky’s original conception, and in this thesis it is understood and used as a design space in which multiple actors in collaboration can explore systemic tensions and contradictions in the process of learning what is not yet there. In the development of a fourth-generation Activity Theory, Engeström and Sannino suggest the concept of heterogeneous coalitions to capture the need to connect multiple activity systems and actors at different levels of organisations and institutions (Yamazumi, n.d.). This is essentially the same approach as the conceptualisation of ‘things’ in the field of PD.

The notion of ascending from the abstract to the concrete seems to be a fitting metaphor for describing and promoting an overarching cycle of expansive learning in an intervention but not at the level of learning actions in participants’ discourse. Here, a strict interpretation of Davydov’s (1990) dialectical process, which requires analysis and clarity before ascension, is not applicable. Findings in this thesis suggest a shift of perspective on expansive learning from being linear and cyclic to relational and ubiquitous in the ongoing process. This requires a great portion of agility on behalf of both facilitator and participants. Nonetheless, a systematic analysis of the learning actions in these processes, can be vital to the understanding of how learning develops and expands in the process.

Learning as a dialectical process which develops new, previously ‘unknown’ knowledge and practices are from my perspective of special relevance for WIL. It has the potential not just to bridge the gap between different activities, but also to create intentional change of them.

A key feature in the CHAT framework and CL methodology is learning performed as actions. The production of knowledge is studied and promoted as individual and collective actions in an activity system. This can be used to study and promote learning in interacting activity systems such as education, workplaces, and other organizations and activities. This thesis is situated in a professional development context rather than the intersection between education and profession and limited to a narrowly bounded activity for a small group of teachers.
An interesting development for the future would be to conduct expansive design processes at schools with educational science students and in-service teachers facilitated and run by researchers and designers as part of the training program. This could be beneficial for all stakeholders, functioning as a professional development activity for teachers and training for students in real, situated contexts to create a deeper understanding of the situational and general challenges for the profession. It also has the potential to create specific, innovative learning designs and changes for teaching and learning as an activity on a general level. It would also provide opportunities to deepen the understanding of possibilities for and limits to the connection between CHAT and PD perspectives. As an effort of work integrated learning which integrates research, professional development, and in-service teacher training it is a challenge and possibility worth exploring.

And in a future where teachers have developed competence in expansive design processes, there lie possibilities to explore and support these processes for the students in their classrooms.
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81


Appended Papers
Collaborative Media in Educational Settings: Teaching as a Design Profession

Dennis Augustsson

Published in the International Journal of Design Education. Common Ground Research Network, 2018
Paper A

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Published in the International Journal of Design Education. Common Ground Research Network, 2018

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Collaborative Media in Educational Settings
Teaching as a Design Profession

DENNIS AUGUSTSSON
Collaborative Media in Educational Settings: A case study on teachers' design-based research

Dennis Augustsson, University West, Sweden

89
Collaborative Media in Educational Settings: Teaching as a Design Profession

Dennis Augustsson, University West, Sweden

Abstract: This article reports on a participatory design project, conducted with K-12 schools in the US and Sweden to create an international collaboration on Marine Biology using video production as a tool for learning and representation. The aim of the project was to explore teachers’ challenges and strategies due to digitalization and new curricular demands through a lens of sociocultural perspectives. Cultural Historical Activity Theory (CHAT) was used to understand and support participating teachers’ development as well as the design process. Using the CHAT model as a design tool enabled teachers to grasp a complex learning environment and frame contradictions and tensions in the activity. Challenges in terms of curricular demands and media literacy could be identified and addressed as part of interacting activity systems, and the process enabled expansion of knowledge and ideas for both design and future work practice.

Keywords: Activity Theory, Educational Design, Collaborative Media

Introduction

In contemporary society, our perception and organization of work and learning are changing. Digitalization brings about new challenges for the professions and the organization of work in fundamental ways (Susskind and Susskind 2015). This becomes particularly clear in education which has knowledge creation and distribution as its object. Digital Literacy and Media Literacy are part of the notion of 21st century skills, claimed as necessary, to be taught in schools along with creativity and innovation, social and cross-cultural interaction, collaboration, critical thinking, adaptability, communication, and problem solving (Trilling and Fadel 2009). As these terms are being implemented in educational policies (European Commission 2013) and have an impact on new curricular demands, teachers are challenged in planning and conducting their teaching. They are left with the task of identifying and describing both their own and their students’ need for competence, and developing methods and practices, suitable for the ever-changing demands digital technologies entail. As a response to such concerns, design competence for teachers has emerged to meet the challenges posed (Hudson 2008; IDEO 2012; Noel and Liub 2017; Kurokawa 2013; Laurillard 2012). It has been argued that design research is a bridge between the descriptive and analytic nature of science and the need for an innovative change in teaching practices (Barab and Squire 2004; Sloane 2006). Design-based research has become a field of its own in educational science (Anderson & Shattuck 2012) and co-designing learning technology with teachers, designers and researchers has been claimed to be a successful approach for teachers’ situated professional development (Kyza & Nicolaidou 2016). The participatory framework of design-based research in education is predominantly occupied with the design and use of technological artefacts. It brings participating teachers closer to research, knowledge about technology and to some extent design methodology, but there is a need for educational design as a concept to expand beyond the design object and students’ learning, embracing the growing complexity of learning and teaching in educational settings due to
digitalization. Specific technological skills or handling of predesigned digital artefacts is not enough to prepare teachers for creating and facilitating teaching and learning activities in twenty-first-century education. Due to the expansion of available digital tools, environments, and arenas for communication and collaboration, learning and teaching practices are not confined to systems and practices on a macro level but can be built on flexible strategies and open source technologies on a micro level (Nardi and O’Day 1999). It is left up to teachers to develop such strategies in their everyday practice. They need tools to develop competence and ideas that embrace this complexity, and there is a need to conceptualize them theoretically.

This article is a description of the first iteration of a participatory design process, where schools from Sweden and the US collaborated in the creation and enactment of a learning design on Marine Biology and English. The aim was to develop tools and theory to integrate the fields of design, educational science, and media and communication studies for the creation of a learning environment based on Collaborative Media production (CM). A sociocultural perspective framed the study and Cultural Historical Activity Theory (CHAT) was used to understand and support participating teachers' development as well as the design process. The question posed for this research project is:

What challenges and strategies develop in a participatory design process of producing collaborative media among teachers using CHAT as a design tool?

First, the article discusses the theoretical framework of CHAT and CM and how they are connected. Second, the design process is presented with the results from a workshop using CHAT, evaluating and preparing for the next iteration of the design. Third, a post analysis of data from the workshop and two follow up interviews are presented and discussed in relation to the research question. The article ends with a summary and a short discussion of implications for professional development and teacher training.

Theoretical framework: Sociocultural perspectives on learning

When exploring the challenges of education and the teaching professions it is important to begin with a discussion on the fundamental concepts of learning and knowledge. In social science and educational research there has been a turn from behaviorism and cognitive theories, focused on the individual mind and behavior, towards social and cultural interaction (Gee 2000). This is mirrored in design research as the turn from the design object and individual user to participatory practices and social innovation (Jonas et al. 2015; Löwgren and Reimer 2013; Krippendorf 2006). Sociocultural perspectives are an umbrella term for theories that focus on the social and cultural aspects of learning with its roots in the works of Lev S. Vygotskij (1978). Vygotskij argued for the importance of social interaction and mediated communication for learning and cultural development, and according to this perspective, learning

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1 Vygotskij was a Soviet psychologist active in the 1920s and first half of the 1930s. Much of his work was not available to the Western research community until the 1960s but has made a major impact on psychology and educational research through different versions and interpretations (John-Steiner and Mahn 1996).
cannot be viewed as simply the transmission of abstract and decontextualized knowledge, but a social process in which knowledge is co-constructed. Learning is situated in a specific context, embedded within a social and physical environment, and mediated through tools (language, computers, screwdrivers etc.) which are part of our cultural history (Säljö 2014). One of Vygotskij’s contributions to theories of learning is that of the “zone of proximal development” (Vygotskij 1986). The asymmetry between what individuals can achieve on their own in relation to their more experienced peers, creates a zone of proximal development (ZPD), one in which the individual can develop knowledge and skills through interaction with others. This argument for a social, dynamic view of learning resonates quite well with the ideas of participatory design processes and can accordingly be of use to describe the idea and the desired outcome for teachers when engaged in a project with researchers and designers. The idea of a zone of proximal development is, in its generic sense, useful to highlight the importance of mediated interaction for developmental processes, not only between an adult and a child or between teacher and student, but also in more complex learning environments.

**Cultural Historical Activity Theory**

The development of Cultural Historical Activity Theory (CHAT) from the Vygotskijan legacy (Engeström 1987) has become a useful framework in both education and design research (Yamagata-Lynch 2010; Nardi and Kaptelini 2009; Severance et al. 2016). Engeström’s development of CHAT recognizes the complexity in learning environments by adding social, historical and cultural conditions to the model for learning as a system of mediated activity. Represented as a triangle with interrelated key concepts this model can be used to capture and change multi-mediational processes in human activity (Engeström 1987).

![Figure 1 The activity system](Source: Engeström 1987)

In this model, there are seven nodes in the activity system that are used for analysis. The **Subject** is the individual or group of individuals with an **Object** for the activity. **Tools** are the mediating resources used in the activity (language, computers, screwdrivers etc.). **Rules** are explicit and implicit regulations of the activity (curriculum, schedules, workplace culture etc.) The **Community** is the social group that the subject is a part of and the sharing and dividing of tasks within the activity is labeled.
**Division of Labor.** The *Outcome* of the activity system is the actual result of the activity. Using this model to map out tensions and contradictions within an activity helps to analytically understand complex learning environments, but also provide the necessary means for participants themselves to analyze and change their practice, which makes it a useful tool for participatory design. An activity system is never isolated but connected to other activity systems. In his “third generation activity theory,” Engeström proposes a minimum of two interacting activity systems as the unit of analysis (Engeström 2001). This addresses the complexity of different activities, cultures and organizations and how they are connected and interact.

![Figure 2: Two interacting activity systems](source: Engeström 2001)

In an educational setting, many activity systems could be identified and used for design and analysis. In the design described in this article two interlinked activity systems emerged as a comprehensible unit and were used in the process:

1. The teacher’s intentions and plan to execute a learning activity and
2. The students’ intentions and activities to reach the learning outcomes.

The model of design for teaching and design for learning as proposed by Lund and Hauge (2011) describes the intersection of these activities as an interactive zone of learning and teaching, creating both tensions and possibilities for all participants. (Object 3 in Engeström’s model).

![Figure 3: Designs for teaching and learning](source: Adapted from Lund and Hauge 2011.)
This interactive zone is similar to what Gutierrez calls the *third space* in which both teachers and students can create and expand knowledge beyond the limits of their own sphere (Gutierrez 1999). Lund and Hauge describe this as *designing in the Proximal Zone of Development*, expanding upon Vygotskij’s notion of the concept (Lund and Hauge 2011).

This dynamic view of the ZPD becomes an important principle when exploring hybrid information ecologies (Nardi and O’Day, 1999), where students bring their own expertise and technology to the table and the design process of the learning intervention continues as the design is enacted. This points to the necessity of engagement and participation in the teaching profession outside one’s core knowledge and comfort zone and the challenges in this approach are very similar to the “wicked” problems of a design process (Buchanan 1992). As Buchanan points out: “…design is explored throughout the world by professional designers and by many others who may not regard themselves as designers” (Buchanan 1992, 9).

The use of CHAT as a framework for participatory design research has been proposed to strengthen teachers’ agency and possibilities for transforming both practice and educational systems beyond the design process and object (Severance et al. 2016).

A fundamental concept is that of mediating means as stimuli for learning and development, giving participants concrete resources to collectively share, articulate, and solve problems as well as transform the activity system. This process is described as *expansive learning* (Engeström 1987), in which the collective action of breaking the boundaries of current practices and developing new concepts and practices is conceptualized as *transformative agency* (Engeström 2011). Severance et. al. (2016) analyzed design tools as mediating means in a co-design intervention for teachers and found that if the design process is properly organized it can facilitate these processes.

**Collaborative media**

The concept of collaborative media (CM), defined by Jonas Löwgren and Bo Reimer, as “a design-oriented mode of knowledge production, integrating analysis and intervention” (Löwgren and Reimer 2013, 43) integrates ideas from the fields of interaction design and media and communication studies. The identified challenge for interaction design when shifting focus on computers as tools to mediums² of everyday practices and that communicative and meaning making perspectives takes precedence over instrumental ones are clearly in line with the challenges of twenty-first-century education (Trilling and Fadel 2009).

Media literacy as an important aspect of digitalization calls for treating media consumption and production as a communicative practice in which we understand, negotiate and produce meaning (Koltay 2011) beyond the technical skills involving digital tools. These multimodal forms of representation have a richness of semiotic resources that must be understood and used as a complex language practice. (Selander and Kress 2010). Media production as a means for knowledge production and

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² The concepts of tools and mediums in CM differs from that of CHAT. In CM, tools are used to describe computers technical functionality and mediums to describe their communicating and meaning making aspects.
emancipation in education has been researched and documented ever since affordable technologies entered the schools (Lindstrand 2006; Danielsson 2002; Drotner 2001) but collaborative media, as discussed by Löwgren and Reimer, are approached differently. They have a focus on media production in a digital landscape where the boundaries between consumption and production are blurred and design and re-design occurs on several levels throughout the process. CM, according to this notion, are characterized by the following traits:

1) Collaborative media are forms for practice…
2) Collaborative media offer a framework with components to combine and appropriate in different ways…
3) Collaborative media entail close links between media infrastructures and media texts…
4) Collaborative media are cross-medial and increasingly material…
5) Collaborative media make possible three forms of practices: design, production and consumption…
6) Collaborative media prioritize collaboration. (Löwgren and Reimer 2013, 135-138)

These traits were found desirable for the design of the collaboration between the schools in the project and answers to many challenges of 21st century education. The CHAT model is well suited to capturing and analyzing such complex activities but can also be used in supporting the process. Several zones of proximal development between peers and people from outside school contexts are expected to come into play. To make students engage in real life issues through video productions could be described as a form of practice, oriented towards action and open for interaction. Using CHAT terminology, this could be expressed as several interacting activity systems potentially opening up for expansive learning. Components to be used would be different technologies but also semiotic resources for communication with video. These can be understood and analyzed as mediating tools in the CHAT-model. Engaging in collaborative media production not only produces multimodal media texts but can also be understood as modifying and shaping the infrastructure that carries them. Infrastructure then, is basically what needs to be in place for media texts to be produced and shared. Having an open structure would allow students to be co-designers of the learning intervention. The collaboration between students could open for and create a dynamic, media infrastructure on a micro level, promoting the engagement of students as reflexive, collaborative producers of video and knowledge. The fact that these practices are open-ended makes them hard to mold in a traditional design cycle of investigation, design, implementation and evaluation. Collaborative media share the desire to promote agency and expansive learning within a CHAT perspective. Implementation should not be considered as a phase following design but as an integrated aspect of the design process (Engeström 2011; Severance et al. 2016).

The Design Process

The following is a description of the collaborative media project conducted between August 2016 and May 2017, which explored the potential and challenges of using media production as a teaching tool in an international collaboration. A class of
Swedish upper secondary school students collaborated with students in an American high school to communicate and produce videos to create and present knowledge within the subject of Marine Biology. A team of three Swedish teachers (one English teacher and two science teachers), one American science teacher and a researcher (the author of this article) were responsible for the design and enactment. The Swedish school, Öckerö Seglade Gymnasium, has a special interest in international collaborations since students spend a total of six months on the school’s ship T/S Gunilla, travelling around the world and meeting students in schools from many countries during their education. The first phases of the design process were conducted before the American participants were connected to the project. The aim was to develop knowledge and competence for both students and teachers using video as a tool for learning and representation and to deepen international relations by building an infrastructure for collaboration on subject matter.

The design process followed the stages of a participatory design methodology (Spinuzzi 2006) adapted to the special circumstances of collaborative media production as discussed by Löwgren and Reimer (2013) with an initial exploration of work (1), discovery process (2) and concept development and detailed design (3). In the enactment (4), the design process continued as an emergent property of the collaboration through situated activities driven by teachers’ and students’ intersecting interests and demands. After the enactment, evaluation and analysis were carried out for future iterations of the design. An ethnographical approach to the design process was taken, and interviews and workshops were documented on video for analysis and complemented by field notes and the collection of digital communication between participants. Together with the design itself and all the video produced by teachers and students, this provided rich empirical material that was used for both the design process and post hoc evaluation and theoretical analysis.

**Stage 1: Initial exploration of work**

At this stage, the researcher met the teachers to become familiarized with their practice. This exploration included getting to know teachers, students, and the technologies in use, but also an introduction to work procedures, routines, and organization. Preliminary interests in terms of learning outcomes for participating students and teachers were explored through semi-structured interviews (Kvale 1996). The focus on internationalization and the need for basic skills in media production for both teachers and students emerged as two main themes, and Marine Biology and English as the subject matter of the first iteration was decided upon.

**Stage 2: Discovery processes**

During the first month of the project, the team had three sessions, exploring the possibilities and challenges of the project through affinity diagrams and mind mapping to construct a basic conceptual model of the design and assess risks and opportunities. These sessions were video recorded for reflection and future analysis. Possible components, media-texts and infrastructures were discussed as being relevant to the curricula of Marine Biology and English and able to generate learning activities for students (and teachers), consisting of different kinds of interactions and productions, all documented and presented as moving images. The project was discussed with the
students and a survey of their previous experience and attitudes towards video production was conducted.

**Stage 3: Concept development and detailed design**

At this stage, the team shaped the didactic solution envisioned in Stage 2 to fit into the workplace and timeframe for both participating schools through design meetings and continuous, asynchronous communication between participants. Adapting to policy documents required learning outcomes and available resources, and a blueprint for the framework was constructed and visualized (Figure 4).

![Figure 4: Framework for the collaboration](Source: Augustsson 2017)

**Stage 4: The enactment**

**Local activities**

In Sweden, the teacher and students listened to basic lectures on media literacy and video production and the students made two short practice videos as part of the Biology and English curricula. The American participants had previous experience with video production and focused their local activities on traditional teaching in Marine Biology and plastic pollution, listening to the lectures just before the videoconference. Teachers were assigned the task of documenting the process with video to enhance their own production skills.

**Video conference**

The videoconference was meant to be a presentation of the students’ different Marine topography and habitats and a discussion of plastic pollution. The conferences were held in different groups and lasted for almost an hour, but much of the time the students spent socializing and comparing popular culture interests outside of school topics. Seeing the importance of this as a part of the foundation for collaboration, teachers only interfered when the subject of plastic pollution was neglected altogether. This
resulted in a shallower discussion on the subject matter but empowered the students to connect and build relations. After the session, some students exchanged contact information on social media, extending the infrastructure of the project beyond the school framework. This could be described as an instance of design activity by the students using Löwgren and Reimer’s definition.

**Video production**

After the video conference, students initiated a video production on plastic pollution with the international partners as the target audience. The aim was to have the students engage in and investigate local activities around plastic pollution, but the form was relatively open for interpretation. In Sweden, the students had done an exercise in a journalistic genre with interviews and coverage footage which shaped their choice of form, while the American students, who had previously made digital storytelling projects using mash up techniques, integrated interviews and footage with images and videos collected from web sources. This could be described as an example of blurring the distinction between production and consumption, where learning is an emergent property of participation.

Students visited research facilities and politicians, explored the shores for evidence of pollution, and engaged in cleaning activities, all documented with video. This is an example of a cross-media production extending into the physical world beyond digital technology and the school environment, creating new zones of proximal development. When no other experts were available some groups in both countries interviewed their teachers on the subject, changing the roles of student/teacher to that of researcher/expert. Low-end technology was used, and most films were made with the students’ own smart phones, edited on freeware editing platforms of their own choice. The groups worked independently without much tutoring from teachers, forcing students to scaffold each other in the process. Some students had video equipment of their own, bringing knowledge and components into the process. One of the Swedish students had a drone with a camera that could produce high-end footage of the Swedish archipelago, which was used in several of the Swedish films, while others had very little experience with video production and faced several problems with video format and transfer issues between smart phones and editing software. Teachers and students both learned from each other throughout the process, but difficulties arose when technical problems occurred since neither had any experience. All these issues were solved by collaboration, but sometimes at the cost of busting the timeframe and drawing focus from communicative aspects of the productions. This is an example of how both teachers and students developed new knowledge in the interactive zone of teaching and learning (Lund and Hauge 2011).

**Publishing, viewing and evaluation**

The intention was that students would publish their results on a common platform as part of learning and exploring the infrastructures of web-based publications, but due to a short timeframe and various format issues, all videos were gathered by the teachers and published by the researcher on a designated YouTube channel. The Swedish students watched the American videos onboard the school’s ship T/S Gunilla from a local hard drive since the school’s ship did not have an Internet connection at sea.
Feedback was given as short video clips with students commenting on each other’s films. These films were handed over by the teachers, bypassing the possibility to create a live conversation online. As the students got together in Charleston there was no need for using the Internet for communication on the project and the YouTube channel became a “silent” publication site for the student films. The desired dynamic online community was therefore not achieved but replaced by face to face meetings and personal networking on other platforms.

Meeting IRL

When the Swedish students reached Charleston and met the American students they went on an all-day, joint excursion, taking part in Marine Biology activities, visiting the Department of National Resources, conducting a lab on microorganisms, and taking part in the reconstruction of an oyster reef project, in addition to sharing experiences on the video project. This was documented by the American teacher on video. Post hoc evaluation interviews were made by the teachers with students and by the researcher with the teachers. A workshop was conducted with the Swedish teachers using the activity theory model as an analytical tool for mapping out challenges and the potential for future iterations of the design.

Figure 5: Left: Teachers in early design workshop. Right: students in video conference.  
Source: Augustsson 2017

Figure 6: Left: Image from student film, engaging local politician on plastic pollution. Right: Image from student film engaging in local clean-up activity.  
Source: Augustsson 2017

Activity system analysis in the design process

Activity systems analysis can be approached in many ways and at many levels. It can be a way to make sense of complex real-world data and of finding a representation that opens a discussion and serves as a tool for analysis to inform local practice, but it can also be a complex theoretical analysis moving between individual, group and societal levels, finding systemic tensions and contradictions on a macro level (Yamagata-Lynch 2010). In this project, the model was brought to the teachers, inside the process to introduce it as a tool for reflection in the design process, grounded in sociocultural theory. The purpose was to evaluate the outcomes and prepare for future interventions, but also to organize teachers’ agency for work practices beyond the design process (Severance et al. 2016). The teachers’ roles as stakeholders are not as future users but as future designers and analysts of their own and their students’ activities. This section presents the results of the collaborative analysis done by the teachers and researcher in a two-hour workshop after the enactment.

Figure 8: Image from video documentation of workshop using the activity theory model for evaluation  
Source: Augustsson 2017
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Figure 7: Left: Image from student film with student using smart board to explain plastic pollution. Right: Image from teacher film: Joint excursion in Charleston engaging in the Oyster reef project
Source: Augustsson 2017

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Source: Augustsson 2017
Looking for tensions and contradictions on a systemic level means finding issues that are not just instances of problems in the process due to different circumstances, but problems built into the activity as tensions between the different nodes in the model (Engeström 1987).

Students’ concerns with working as a team and being assessed individually on a group effort when one of their objects was to achieve good individual grades created a tension between the division of labor and individual objects of passing with good grades (marked with red arrow A). This was mirrored by teachers’ concern with individual assessment on group activities and finding appropriate learning outcomes. The Swedish curriculum requires assessment of learning outcomes at a basic level for goals such as communicative skills, different forms of representation, social skills, such as teamwork, and democratic values. These kinds of learning outcomes were well suited to map and assess on to a collaborative media production, but specific subject matter outcomes were harder to map and assess on to the produced material by the students. This tension between Rules and Objects of the teacher’s activity (marked with red arrow B) was also represented by contradiction between cross-curricular activities and the school’s organization of schedules and classes. In the American school, the fact that the student did not take the same classes made cross-curricular activities hard and the project ended up with activities in the Marine Biology class only. Another level of systemic tension was created by the lack of experience in media production with the teachers. The idea was to let teachers attend lectures given by the researcher on media literacy and video production and then to have them produce their own videos as a means of learning and documenting the project as a division of labor. Teachers found it hard to find time and energy to do this as their focus was on organizing the project and scaffolding the student process. The technical issues encountered were all resolved through collaboration between students and teachers. This could be interpreted as an example of learning in the “third space” (Gutierrez 1999) or a result of being in the “Interactive zone of learning and teaching” (Lund and Hauge 2011), but video as a language practice was tutored by the researcher. The lack of expertise among the teachers was too great to breach inside the process (marked with red arrows C).

All of this was part of a third contradiction between Rules and Objects: the time allocated for the project for both teachers and students was consumed by media production issues leaving too little time for exploring subject matter content. Media production takes more time and energy than conventional representations (writing essays and standardized tests) raising the question of whether it is worth it in relation to specific subject matter among both students and teachers (marked with red arrows D and E). Since the Swedish students made two videos before the collaboration, the teachers saw a potential development that could decrease this tension over time if both students and teachers got to develop their skills.
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Figure 9: Representation of results from teacher workshop using the activity theory model for evaluation.

Source: Augustsson 2017

Four major challenges in the teacher activity system were described as:

1. Contradictions between cross-curricular teaching models and the school’s organization of schedules and time allocation of resources.
2. Contradictions between allotted time in the classroom and the complexity of media production.
3. Tensions between media production and curricular demands on specific learning outcomes and individual assessments.
4. Tensions between division of labor and the goal to learn how to communicate with video while scaffolding the students in the same process.

An important issue, though not deemed as a systemic tension, was the short timeframe between the different activities before the Swedish students re-boarded the school ship. This had an impact on the intentional use of a web platform for publishing and communicating the results. It became part of the physical meeting, with good results, but made the intentional on-line collaboration between the schools less developed. No final solutions for these issues were found during the workshop, but the discussions will be used as input for re-design sessions in the next iteration. These are suggestions from the list produced by the workshop:

1. A better documentation of expected outcomes and guidelines for students.
2. Individual testing of students on specific learning outcomes after completed project.
3. Reconstructing schedules to better accommodate peer learning between student groups and formative assessment by teachers.
4. A better adaption to the schedule of the school ship to accommodate a better interaction on digital platforms.
5. Workshops in media literacy and production for teachers as part of the professional development program.
6. Incorporate media production in additional classes to increase experience among students, making it easier to use and the students more focused on content matters.

Post analysis of empirical data

The CHAT workshop was followed up by semi-structured interviews with two participating teachers reflecting their personal experience on the design process. Together with the video recordings of the workshop these were used as data for a post analysis by the researcher to explore the challenges and strategies from an analytical perspective.

The workshop was entirely transcribed and coded using thematic analysis (Brown and Clarke 2006). Using open coding strategies, a coding scheme was developed by identifying meaningful units of text, grouping them in categories and giving them tentative definitions.

To avoid predefined categories such as concepts from the CHAT-model, categories were based on reoccurring topics in the discussions. The reason for this approach was to compare the outcome of the workshop with the content of the discussions. The same units of text could be included in more than one category. After this, the data was reviewed twice, and the initial 18 categories were grouped into eight key themes. 90 percent of the data were allocated to one or more themes. The remaining 10 percent was categorized as social interactions and discussions not related to the design process. The interviews were transcribed and analyzed through a lens of sociocultural perspectives to deepen the understanding of the process.

Results

Table 1: Thematic Analysis of CHAT Workshop

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curricular issues</td>
<td>7.1%</td>
</tr>
<tr>
<td>Subject matter</td>
<td>7.8%</td>
</tr>
<tr>
<td>Administration</td>
<td>8%</td>
</tr>
<tr>
<td>Student analysis</td>
<td>15.6%</td>
</tr>
<tr>
<td>Assessment</td>
<td>17.8%</td>
</tr>
<tr>
<td>Media Production</td>
<td>21.1%</td>
</tr>
<tr>
<td>Design</td>
<td>44.7%</td>
</tr>
<tr>
<td>Pedagogy</td>
<td>67.7%</td>
</tr>
</tbody>
</table>

Source: Augustsson, 2017
In the thematic analysis, an overarching theme of Pedagogy (issues of learning and teaching) covered 67.7 percent of the data followed by Design issues (44.7%) and Media production issues (21.1%). Issues of assessment covered 17.8 percent, analysis of student activities and the learning process 15.6 percent administrative issues 8 percent, subject matter 7.8 percent and curricular issues 7.1 percent. The amount of overlap and inclusion of many units of text in several themes indicates that the CHAT model enabled the teachers to integrate pedagogy, subject matter, and media production in the design process as well as analysis of their own and students’ activities and strategies.

The use of a theoretical model for learning as a design tool was perceived as an effective way of discussing both learning and teaching. In the interviews, teachers expressed the benefits of a more systematic reflection of their work practice enabled by the design process and CHAT model:

We reflect too seldom on what we do and why. You don’t take the time and sometimes you just take an available material and go for it… to actually clarify why and what problems there can be. It’s good to sit together and help each other to nuance everything a little, finding pros and cons so I think this (points to CHAT model) in relation to (the design) … It’s fantastic to sit down and actually have a design process on a learning module at all. We don’t do that too often, not in a structured way, reflecting on the teaching and planning. (T1)

This can be understood as a sign of agency enabled by the process and the CHAT model being a stimulus to transform both design and general work practice. The need for structure when planning and enacting a complex learning module was accommodated by the design process and it also grounded design decisions in a theoretical framework by using the CHAT model.

Assessment and Curricular issues

Assessment and curricular issues were reoccurring themes and are connected to the contradictions that were experienced between curricular demands of specific learning outcomes and collaboration and media production. In the workshop, teachers discussed the difficulties of working with both collaborative media processes and individual assessment of subject content matter:

I find it hard to grade… I can find central content because they are working with central content in the subject area (Marine Biology) but to grade students individually is hard. Partly because they are working in groups. It’s always hard when they work in groups… When they talk (in the video) you have something to assess, but since it’s in English there is a limitation to the knowledge… well not necessarily in their knowledge but in the… (T1)

…ability to express themselves…(T2)
…their ability to express themselves in English is limited…we must work around that. The English is assessed this way, but we can have a test on plastics in the oceans afterwards. They have learned a lot and we can combine it… The moviemaking becomes the learning process… a different way to learn. (T1)

In the subject of English, the Swedish teachers found it easier to assess content matter since the students wrote and spoke English in their videos but in Marine Biology the use of English debilitated the depth of content. This illustrates the tension between cross-curricular teaching and content specific demands. On one level, the curriculum prescribes both collaborative skills and different forms of representation and on another level, it demands individual assessment of specific content matter. This problem must be understood as a contradiction on a systemic level and could be described as a double bind (Engeström and Sannino 2011), where participants are locked between to incongruent demands with seemingly no way out. When the teachers were faced with this in the workshop, they were forced to find suggestions or strategies to solve the issue. This could be interpreted as stimuli creating a zone of proximal development in which future designs could potentially transform the activity. The idea of regarding the video production as a learning activity and having individual written tests after the process created an opening for such developments. The excerpt above also illustrates the movement from a double bind experienced on a personal level (“I find it hard to grade”) to a necessary collective action (“we must work around that”). The tensions and contradictions found in the workshop could be expected in a school practice embracing the demands of twenty-first-century skills, but the activity theory model made them visually represented and functioned as mirror material that gave participating teachers agency and ownership of the process.

Media production

Issues of media production stood for 21.1 percent of the data. The data coded in the theme of subject matter were predominantly connected to media production issues, basically making this theme a subtheme to media production (7.8%). Technological issues stood for 3% of the data, showing that these were important challenges but the most interesting subtheme in media production was the topic of media production as a multimodal form of representation and language practice (media theory, 4.8% of the data). The process enabled teachers to combine pedagogy, content matter and technology, but the lack of experience in using video as a semiotic resource and narrative tool was perceived as the greatest challenge. In the interview one teacher reflected on video as a language practice:

If everybody had knowledge of it (video production) as a language practice beforehand like writing or talking or things they have done and practiced…They don’t know how to write a report when they come here… We train four or five times to get them to master that. Then the technique to write a report becomes unproblematic and you can focus on the research question and the hypothesis to make a good report with good content. But for many this (video production) is to start from scratch with a whole new language. Then we have a parallel learning process as they learn and present
Here the teacher compares video productions with traditional forms of representation. The acknowledgment of media literacy as something that must be practiced and the way computers mediate content rather than being a technical tool is in line with Löwgren and Reimer’s notion on collaborative media. From a CHAT perspective, video production could be interpreted as a mediated activity connected to its cultural and historical context. Video production has a history of norms and rules that dictate effective communication in different genres just as other forms of representation do (in this case the scientific report). It’s not just a creative multimodal form of expression but must be treated as a complex language practice within cultural and historical contexts. This requires skills beyond the use of digital technology and specific content. The notion of spreading this practice to many subjects points to the necessity of lifting this challenge beyond the workgroup and design process. It’s not a problem that can be solved in single projects or small teams. Expressed in Activity Theory terminology, the contradiction manifested in the activity system on the micro level must be addressed on a higher level involving the whole school organization. The suggestion of implementing media literacy workshops as part of the professional development program came out of these discussions.

**Design**

The amount of data coded for design issues indicates that the CHAT workshop enabled teachers to develop future interventions grounded in the theoretical framework. The use of theoretical concepts in the process was only 1.1 percent in Design and 2.8 percent in Pedagogy. This indicates that the process was very practice oriented, but it also indicates a lack of knowledge and experience in using these concepts. Participating teachers drew from previous experiences and practices rather than appropriating new theoretical concepts and language. Below are four excerpts from the interview with one of the teachers reflecting on some of the design tools:

This mapping of the system (affinity diagram) with all the circles...I think it’s great when you are on different sides of an organization. Instead of having individual “to do” lists you can see what is what and who is responsible. What happens in the different spaces. I like the arrangement with these circles. It’s easy to follow. (T1)

Visual representations as part of a design process were conceived as a good way to grasp complex learning environments. The process of collaboratively generating and evaluating ideas through design thinking methods (IDEO 2012) was perceived as a creative and effective process:

Well, the first one (design workshop), when we used post-it notes, was a really good way to make everyone’s voices heard. And the open structure, that everything is possible, and all ideas are allowed to be broached instead of sitting in a conference room and raising your hand to speak. This to write down in a short time, post and categorize and all that, was really good! (T1)
The design workshops were conducted with the teachers only, but they saw the possibility of using the tools together with the students, both for the next iteration but also as a general approach to student influence and engagement in their work practice:

That is a general problem: how do you get all the students’ voices heard? To make them want to or dare to share? This (design tool), to give time for… I think in my everyday practice it would be easier to use this creative process in the classroom than in my collegial practice. (T1)

This was also connected to the curricular demand on student influence:

That is exactly what we are supposed to do, it’s part of our job, to make them part of and have influence on how teaching and assessment are done. (T1)

This can be interpreted as evidence of transformative agency promoted by the design process in which teachers appropriated new tools for development of their work practice. The idea of bringing the design tool to the students was not planned or anticipated by the researcher. The object of the activity functioned as a first stimulus and the different design tools that were offered and used functioned as a second stimulus, enabling agency and expansive learning by transforming the activity. A teacher must have competence to design and redesign complex learning experiences in accordance with students’ needs and competencies. This is especially important in collaborative media processes where students bring their own expertise to the activity. In a zone of proximal development between teachers and students where the role of the more competent peer is sometimes shifting, there is a need to involve students early in the process and design thinking methods can facilitate this.

Conclusion and discussion

Design tools promoted transformative agency with participants since the intervention was organized as an open-ended process in which ownership by the teachers was a central part. The CHAT model enabled them to analyze their work practice beyond the design object and address issues at systemic levels, expanding knowledge and ideas for future work practice. This was a fundamental desired outcome in both Collaborative Media and CHAT interventions (Engeström 2011; Löwgren and Reimer 2013), and it was achieved by bringing the CHAT-model inside the process as a tool for teachers, not just for analysis by the researcher. When sharing and articulating experiences and ideas, the process enabled teachers to externalize inner conflicts and mirror these in external contradictions and tensions on a systemic level.

The collective actions created a zone of proximal development where some of these contradictions could be solved through producing new ideas for the design and some were identified as challenges on a higher level of the activity system. Working with new technologies was burdensome in the process, but the use of video as a mediating, semiotic resource was an underestimated issue posing the greatest challenge that needed to be addressed on a school organization level. To recognize the notion of digital technologies as mediums of everyday practice, also means to recognize these practices as a complex language activity. In educational settings, there
is a need to develop competence among both teachers and students if these resources are to be used as effective tools for learning and representation. This poses challenges on a macro level and teacher education must facilitate processes for future teachers to develop these competencies as part of their training. In the collaboration presented here, the needs and circumstances of educational design borrow traits from both interaction design and service design. For teachers, the challenge is not merely to adapt to pre-defined technologies or services. A teacher needs to design and redesign complex learning experiences in accordance with students’ needs and competence, media infrastructure, school organization and rules and policies that frame goals and outcomes. This can be better achieved if professional development strategies and teacher education programs acknowledge the profession of teaching as a design profession grounded in relevant theories of knowledge and learning. Developing design principles and practices could be the key strategy when digitalization and new curricular demands are changing the profession in fundamental ways.

Acknowledgement

All participants in this study have signed an informed consent and given the permission to use footage from the process for publication.
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https://ojs.lboro.ac.uk/DATE/article/view/2198


https://doi.org/ 10.1080/10508406.2016.1207541


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Expansive design for teachers

An activity theoretical approach to design and work integrated learning

This thesis explores how Participatory Design (PD) and Cultural Historical Activity Theory (CHAT) can be combined and used as a theoretical framework and methodology in a professional development activity for teachers. A shift in the way we view teachers, from implementors to designers who actively construct, invent, and develop the practice of schooling also calls for changes in teacher education and professional development activities. The study presented here explores teachers’ work and learning during a professional development activity conducted as a participatory design project between two K-12 schools in Sweden and the USA, using media production to create an international collaboration on Ocean Literacy. The work draws on central notions and practices based on the Scandinavian School of Participatory Design and the Change Laboratory methodology (CL) based on the theoretical framework of expansive learning.

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Photo: Magnus Denker

ISBN 978-91-88847-73-7 (Printed version)
ISBN 978-91-88847-72-0 (Electronic version)