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Foundations of Sneak Teaching Game Design

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Learning games can contribute to a positive learning experience, but students seem less positive when the learning content is prominent in the game. This paper proposes sneak teaching game design as a design solution to address this issue.

Keywords: Learning Games, Stealth Learning, Sneak Teaching Games

INTRODUCTION

To make learning a meaningful experience for students, educators employ methods to gain and hold their students' attention. For example, when instructors/teachers use "non-traditional tools, such as games, to encourage students to have fun and learn" students are engaged in stealth learning; "students think they are merely playing, but they are simultaneously learning" (Sharp, 2012). One form of educational game use is *learning through games*, where educators employ games that are specifically developed with a focus on teaching skills or knowledge (Egenfeldt-Nielsen, 2010). Learning games can contribute to a positive learning experience, but students seem less positive when they feel the learning content is prominent in the game (Ke, 2008).

How can a game be designed so that the student player does not know he/she is being taught? In order to answer this question, the perspective shifts from the student to that of the designer/developer who has the responsibility to incorporate what is to be learned into the game. This paper introduces sneak teaching game design (Barendregt, 2014) for learning games that teach without the players noticing.

Foundations

Learning game design is seen as two-folded as it comprises game design and didactic design (Schwartz & Stoecker, 2012). On the one hand learning games should have elements that make them fun to play, and on the other hand the games should have substantial educational content.
In game design, developers try to create a certain flow in their games, which makes the games easy to play. The term flow describes a 'state in which people are so involved in an activity that nothing else seems to matter' (Csikzentmihalyi, 1990). In a perfect flow, the challenges presented and the ability of the player to solve them are in perfect balance, which leads to great satisfaction and pleasure. Flow can be related to the educational concept of the zone of proximal development (ZDP) (Vygotsky, 1978) which describes the difference between what a learner can accomplish by himself and what this learner can accomplish with help from a more knowledgeable peer or tutor. Instruction should aim at the ZPD and use scaffolding through instructional strategies to provide sufficient support for the learner to achieve the next competence level.
The challenge for a well thought-out learning game plan includes keeping flow during the whole game by increasing the difficulty of the game itself on the one hand, and increasing the difficulty of the educational content on the other hand, while keeping in mind the player's ZPD.

When linking **instructional design** specifically to learning games, researchers seem to agree that it is important to have a strong connection or balance between the educational elements and the game elements of learning games (Schwarts & Stoecker, 2012; Dickey, 2005; Egenfeldt-Nielsen et al., 2008; Foley & Yildirim, 2011). The lack of integrating the learning domain into the game mechanics may result in games that are not very playable (Egenfeldt-Nielsen et al., 2008), and thus have a high chance of being rejected by the learners.

Meaningful and skilled teaching requires (Technological) **Pedagogical Content Knowledge**: knowledge about what teaching approaches fit the content, how elements of the content can be arranged better for teaching (Shulman, 1986), and how technology can be of aid in this (Koehler & Mishra, 2009). Transforming subject matter into a learning game involves deep understanding about the learning domain as well as the specific opportunities game play can offer to the learners of the specific domain. The end result should be a transformation of the learning domain that fits game play, fits the intended target group, as well as be a suitable way to teach the subject matter.

Scaffolding (Sawyer, 2005) is used to teach game mechanics or provide new information. Utilising the game interface and structure to transmit information and feedback related to educational issues can result in embedded scaffolding that does not interfere with the natural game play, which benefits the game flow. Modelling the learning domain in an organic way (Bos, 2001) can be a good way to build on the players intrinsic motivation, which occurs when a player is honestly intrigued by the challenges presented, not just by the reward they will get when performing well.

Information acquired by **monitoring and assessing** players during their gameplay provides useful information about which scaffolding or feedback individual players need and can help to decide which tasks the player will face next. Learning games that can adapt to learners of different levels of initial knowledge offer a higher quality educational experience than games that are not adaptive (Moreno-Ger et al., 2008).

Sneak Teaching Games

A *Sneak Teaching Game* is a type of learning game where the pedagogical content of the game is completely hidden within the game mechanics, so that players perceive the game as an entertainment game (Barendregt, 2014). Designing a learning game where the players will not notice that they are learning takes a refined approach towards learning game design. *Sneak teaching game design* is characterised by searching for solutions that will allow the embedding of all learning aspects into the game. In this perspective, sneak teaching games can be seen as a type of learning game that strives to bridge the gap between learning games and stealth learning.

Figure 1 clarifies the relationship between the game mechanics and pedagogical content in learning games and sneak teaching games. Where in learning games the pedagogical content might be partly embedded and partly visible, sneak teaching games strive to have all the pedagogical content embedded within the game mechanics.

Figure 1: Visual representation of the relationship between the game mechanics and pedagogical content in learning games and sneak teaching games.

Sneak Teaching Game Design

Achieving a full embedment of the pedagogical content in the game mechanics requires a well thought out plan that starts with a clear overview of which subject matter is to be learned. From there, ideas about how to model the learning domain for game play can be explored, working towards an organic way of presenting challenges. This phase also includes searching for ways to transform pedagogical elements into game elements, and how to scaffold and present feedback.

It can be useful to see sneak teaching game design as three dimensional: the pedagogical dimension, the game dimension, and the sneak teaching dimension in which the first two come together.

The **pedagogical dimension** addresses the need for a solid educational foundation. The main objective in this dimension is to structure the learning domain to suit game design, working towards an organic way of presenting challenges. Designers search for ways to structure the subject matter so that it can contribute as scaffolding by itself. An instructional design method can be a useful guide to achieve this. During the development of the instructional environment it should also be considered how and whether the domain content should adapt to the learner. An adaptive environment will benefit the zone of proximal development of individual players, as well as contribute to the game flow.

Although invisible to players, the back end of the instructional design should offer teachers the possibility to assess the progress of the students. An assessment function can help to quantify the educational value of Sneak Teaching Games and play a positive role when trying to integrate them into educational settings.

The **game dimension** draws attention to creating an engaging game environment that suits the learning domain. Tactics used in game design such as player positioning, narrative, interaction, a fantasy environment, giving the player a sense of control and challenge, and collaboration and social interaction can also support the entertainment value of learning games (Foley & Yildirim, 2011; Dickey, 2005). The game dimension also includes the design of a user

interface with elements that make the game visually and audibly attractive, while making use of usability guidelines.

Essential to the **sneak teaching dimension** is finding ways to present the pedagogical content as a game, and so establishing a seamless merge between game design and didactic design. The structuring of the learning domain plays a large role in this, but it might also be possible to transform the learning domain to look like game elements. This creative process forms the core of sneak teaching game design. Designers have to investigate how to make optimal use of the game environment so that the educational scaffolding gets translated by game elements and game mechanics.

Designers need to think out of the box and make smart use of the learning domain structure. It will be a challenge to make optimal use of game elements to provide instructional scaffolding and feedback.

Existing Examples

Although there are no games available yet that carry the literal stamp ‘sneak teaching game’, DragonBox Algebra 5+ (dragonbox.com) and Fingu (tinyurl.com/zzapoou) are games available that are very close to matching the requirements.

Conclusion

Sneak teaching game design as described in this paper addresses the issue of how to design a learning game that teaches without the players noticing. The proposed design approach and methods of modelling the learning domain to contribute to the scaffolding by itself and transforming the learning domain to look like game elements have the potential of being a useful contribution to the field of learning game design.

More research should be carried out to refine the proposed design approach and to learn more about the potential benefits and possible disadvantages of sneak teaching games. None the less it is likely that the ideas proposed in this paper offer a refreshed look at learning game design and will be seen as welcome tools that can contribute to the design of engaging learning games.

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Ecologies of ‘upcycling’ as design for learning in Higher Education

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Abstract

As society changes, new ways of understanding and using existing semiotic resources are needed. This study looks at artefacts from a social semiotic perspective in order to explore the concepts of ‘recycling’ and ‘upcycling’ and their relevance for pedagogy in Higher Education. We look at recycling in terms of ‘texts’ and employ methodological tools from multimodal discourse analysis. ‘Recycling’ involves converting materials from one product to create a different product with a different function, without necessarily adding any type of value. In ‘upcycling’, economic, aesthetic or functional value is always added. ‘Upcycling’ can thus be understood as a process of recontextualization of semiotic resources, in both spatio-linguistic and sensory terms. This paper looks at how resources are recontextualized as part of global ecologies of production and consumption. Then, we explore these insights in the pedagogical domain, looking at possible implications of the principles of ‘upcycling’ and value adding through design as a means for educating global critical citizens.

Keywords

‘upcycling’, higher education, recontextualization, social semiotics

Ecology can be described as an ever-changing flow of inter-connected instances. The concept of ecology in the humanities and social sciences points to dynamic perceptions of, for example, design, meaning-making and learning (cf. Barton, 2007). One global ecology of production and consumption of artefacts is that of ‘upcycling’ waste and the movement of materials between places and spaces in the developing and industrialised world (cf. Hetherington, 2004). ‘Recycling’ involves converting materials from one product to another without necessarily adding any type of value. In ‘upcycling’, on the other hand, economic, aesthetic or functional value is always added that, for instance, makes it possible to export a re-designed metal bottle top from South Africa and sell it as an earring in a high street shop in Scandinavia (see figure 1).

Figure 1: South African ‘upcycled’ earrings in a shop in Stockholm

In figure 1 the earrings are represented as material artefacts displayed for sale in a specific place and at a specific time. However, within an ecological perspective on artefacts, these earrings can be seen as instances in a chain of recontextualizations in which meanings and functions have been continuously and creatively worked upon, changed and transformed. The provenance in the material of bottle tops (the metal) is still recognisable, and so is the brand name of the original soft drink, but both the function and the value of the original artefact is transformed.

Pennycook (2007) discusses recontextualization and creativity more broadly as re-design and renewal rather than original production and individual creation of newness. He relates recontextualization to student writing and student texts.

> An understanding of recontextualization allows us to appreciate that to copy, repeat, and reproduce may reflect alternative ways of approaching creativity. We may therefore need to look at student writing practices not as merely deviant or overly respectful, but rather as embedded in alternative ways of understanding difference: to repeat a text in another context is an inexorable act of recontextualization and it is only a particular ideology of textual originality that renders such a view invisible. (Pennycook, 2007: 589.)

We share Pennycook’s interest in recontexualization as an intersemiotic and transmedial remix. We approach ‘upcycled’ artefacts in terms of ‘texts’ and employ methodological tools from social semiotics and multimodal discourse analysis in order to interrogate the phenomenon (Kress, 2010; van Leeuwen, 2005). Firstly, we look at how resources are recontextualized in global contexts, then we explore how these insights can be relevant in the pedagogical domain of Higher Education.

Recontextualization of resources in 'upcycling'

An example of how resources are recontextualized in 'upcycling' is the 'upcycled' plastic curtain made to hang across a doorway represented in figure 2. Displayed in a Stockholm shop, the plastic curtain is made from cut up plastic bottles. The fact that the curtain is 'upcycled' through the use of rubbish is a sales argument that is communicated through the design of the product.

Figure 2. South African upcycled plastic curtain in a shop in Stockholm

Viewed as a 'text' the curtain can be analysed in terms of how *semiotic resources* – "the actions and artefacts we use to communicate" (van Leeuwen, 2005: 3) – are used and recontextualized. The material (parts of plastic bottles) that form the substance of the curtain have largely had their logos removed, except the bottle tops containing the logos of 'Minute Maid' and 'Coca-Cola'. The brand names point to a provenance in everyday consumer goods, but so do the semiotic resources of shape, pattern, colour, materiality of plastic. Experiential, sensory provenance is significant here as the shapes of the fragments of the bottles, just like their plastic materiality, remain highly recognizable. In terms of connotation, plastic is the material of "chemistry, not of nature" (Barthes, 1972: 54) and it is detrimental to the environment. Plastic is also the preferred material of mass-production and modernity. The most down-to-earth and practical, cheap plastic objects, described by Barthes (1972: 54) as "at once gross and hygienic", have been 'upcycled' for aesthetic and commercial purposes. The 'upcycling' process goes from South African mass-produced everyday plastic objects of various shapes and functions into rubbish which is then re-designed into a curtain of significantly higher value.

Even a condensed multimodal analysis of an 'upcycled' artefact such as the plastic curtain can yield a tentative typology of recontextualizations in 'upcycling'. The recontextualization of brand names and logos can be described as *spatio-linguistic* recontextualization. Writing and other inscriptions, including the shapes of logos, are manifestly recontextualized from the original product through the state of being rubbish into the 'upcycled' product where they become signifiers (Kress, 2010) of 'upcycling' generally rather than of, for example, 'Coca-Cola' or 'Toilet Duck'. The curtain is also characterised by *sensory* recontextualization where there is a manifest recontextualization of specific materials and shapes from an original product to an 'upcycled' artefact. Although the shapes and material of household plastic are maintained from the original artefacts and remain productive signifiers in the recontextualized, 'upcycled' curtain, they express other meanings (cf. Björkvall and Archer, forthcoming).

'Upcycling' as designs for learning in educational contexts

If connected to student interest in meaning-making processes (see Archer, 2008), the analysis of 'upcycling' and recontextualizations in global and commercial contexts can offer relevant parallels to learning through design in (Higher) Education. Three notions are critical here: learning as *transduction* of meaning across modes as a means for learning (Kress, 2010), citation as *remix,* and the development of a *metalanguage* of critical commentary. Stein (2008), for instance, looked at how students drew on 'found resources' in an impoverished area in Johannesburg to re-construct meaning in a classroom environment. This entailed fashioning figures in the tradition of 'fertility dolls' using 'upcycled' materials from the rubbish dump nearby, including bubble wrap, cloth, plastic bags. Here, learning can be understood as students' active transduction of meaning across modes using the semiotic resources available to them at a particular moment in a specific socio-cultural context.

In a similar example, students in a second year project, entitled 'Recycling and Art' at an art school in Cape Town were required to create three-dimensional sculptural objects using waste materials. Figure 3 below represents a student art installation made from, among other things, cables and CDs.

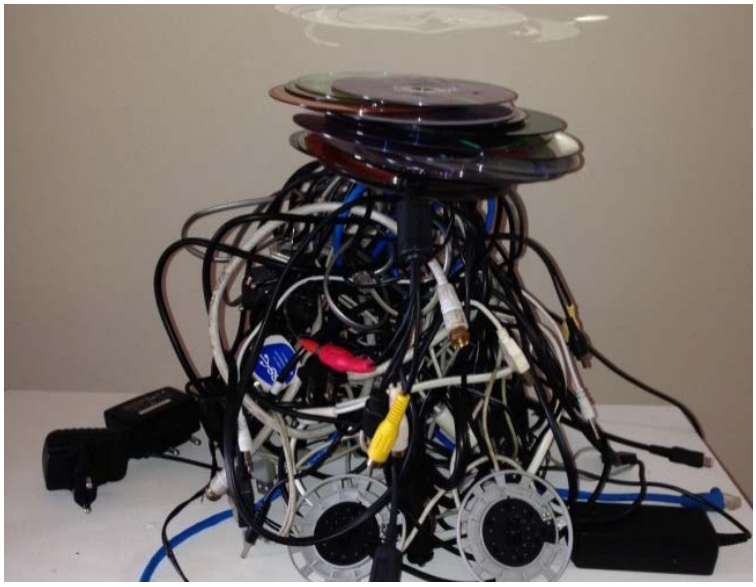

Figure 3: Art installation from mobile phone chargers

There is an explicitness of the sensory provenance of the material of the wire and the discs. The installation points to the fact that in a 'wireless' and mobile world, wire and CDs are becoming somewhat obsolete and more showpieces than functional objects. These are the kinds of objects that one keeps at the back of your drawer, because they were once important and useful. The entanglement of the wire can be interpreted as *critical commentary* on modernity and consumption. Where there is such a proliferation of electronic goods, the act of disposal is the ultimate act of consumption.

Another important area that the semiotic construct of 'upcycling' can illuminate is that of citation practices in a range of texts and contexts, including academic discourse. Here the concept of intertextuality is of paramount importance. It is possible to cite in all modes, but with different constraints and possibilities. In music citation is called 'mixing'; in the fine arts, citation could be seen as 'collage'. Design or original work can use precedents which do not necessarily have to be referenced. Given our globalized, technologized contexts, downloading from image banks, the use of free music and open sources has become the norm, raising questions around copyright and 'originality'. Citation in both verbal and visual modes involves appropriating a source into your own argument and thus creating a 'new' composition.

Last, but not least, ways of talking about 'upcycled' artefacts and the recontextualization of semiotic resources could form the basis of a multimodal metalanguage of critical commentary. Of interest here is how one object can pass critical commentary on another object through 'upcycling'. How do 'remix' texts leverage referential meaning to create new meanings? By critical commentary

we mean the ways in which the dominant discourses of the primary object are highlighted and imploded in order to critically reflect on some aspect of society. Some of these differing discourses may complement each other, and others may compete with each other or represent conflicting interests or ideologies. This is Bakhtin's (1981) notion of dialogism, the recognition of the polyvocality of any sign. To refer back to the plastic curtain in figure 2, we see a concoction of irony, humour and irreverence in this artefact which encourages critical reflection on the over-consumption of plastic goods coupled with a desire to sell good design. The craft-like patterning of shapes and colour of the plastic parts function as a critical commentary towards mass-produced and highly transient plastic. The rationale for developing a way of recognizing and talking about critical commentary is to feed this back into educational curricula in order to develop critical citizens in a global world.

Conclusion

We have outlined some of the possible ways of utilizing the principles of 'upcycling' and value adding in designs for learning. This has included notions of transduction and student interest, interrogating citation practices, and possible multimodal metalanguages. Here it is useful to end on Pennycook's notion of creativity: "Taking difference as the norm, rejecting a model of commonality and divergent creativity, viewing structure as the apparent effect of sedimented repetition and bringing a sense of flow and time into the picture have radical implications" (Pennycook, 2007: 588) for the way we view texts and the pedagogies associated with them. In thinking about 'upcycling' as a semiotic construct, we are forced to "question assumptions about context, diversity, ownership and originality" (Pennycook 2007: 588). The unsettling of these assumptions is crucial in developing critical students and citizens in contexts of change and diversity.

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The Teacher Scenario Competences Situational Model

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This short paper presents *The Teacher Scenario Competences Situational Model* as an analytical tool to identify and characterize complexity as experienced by teachers in project-oriented teaching. The research goal is to understand this to render possible a future focus on teacher training and teacher professional development.

Keywords: teacher scenario competences, professional development, education

CONTEXTUALIZATION AND RESEARCH QUESTION

The Teacher Scenario Competences Situational Model was developed during my PhD dissertation (Fougt, 2015) as an analytical tool to identify and characterize the complexity experienced by teachers in project-oriented, *scenario-based teaching* (SBT) with 17 lower-secondary L1-teachers participating. A tool was needed to cope with the 'messiness of the real world' that several Design-Based Researchers address (Brown, 1992; Barab & Squire, 2004; Collins et al., 2004). The model is my answer and thus aimed at Designs for *Teacher* Learning.

Commonly accepted theory on teaching and learning stresses that the best way to learn is to address a meaningful problem and apply relevant subject matter in a social and project-oriented situation aimed at a product (Bundsgaard et al., 2011, 2012; Shaffer, 2006). SBT is one version hereof, and key concepts are simulation or enactment of a meaningful practice and meaningful application of subject matter in social situations – e.g. through simulating *journalism* or *engineering* in a complexity-reduced version aimed at teaching (cf. Bundsgaard, 2008; Bundsgaard et al., 2011; Hanghøj et al., forthcoming; Shaffer, 2006).

The main challenge for project-oriented teaching is the lack of actual subject learning involved (Barron et al., 1998; Bundsgaard, 2008; Dillenbourg, 2013). Barron and her colleagues have shown that students do not learn what makes a rocket good or bad (1998, p. 273), and in his

analysis of vocational students' ability to run a digital storage facility, Dillenbourg (2013) shows how students engage in trial and error instead of reflection. This challenge is richly addressed with a focus on *students* (cf. Hanghøj et al., forthcoming).

There seems to be less of a focus on teachers although Bundsgaard has described the challenge for teachers as their lacking ability to introduce specific subject matter exactly when the student needs it (Bundsgaard, 2008, p. 2). With the model presented here, I argue that it is far more complicated. Thus, the aim of this paper is to cope with and create a theoretical understanding of the complexity for teachers in planning, executing and evaluating SBT, leading to the following research question:

How can teacher scenario competences be identified in SBT?

Definition

I define the concept of *teacher scenario competences* as follows:

> *Teacher scenario competence is the teacher's competence to imagine a scenario with attention to the relevant actors and their interrelations; allowing him/her to imagining a situation with attention to the relevant actors and their interrelations; in turn leading to action in relation to a concrete situation with attention to the relevant actors and their interrelations; leading to the analysis of the imagined scenario, relating it to the actual situation with attention to the relevant actors and their interrelations, and a consequent revision of the entire scenario; and finally posing reflective, systematic questions on the process with attention to the relevant actors and their interrelations with the aim of systematic understandings for future actions* (Fougt, 2015, p. 75).

Methods and empirical data

Inspired by pedagogical relational models, theory, empirical data and analysis, I establish the *Teacher Scenario Competences Situation Model* as an analytical model in my dissertation. The main inspiration for the model comes from the American sociologist and former Anselm Strauss-student, Adele E. Clarke and her *Situational Analyses* (SA). Clarke worked with Grounded Theory

(GT) for 20 years, but later she criticized GT for its lack of consideration of complexity, which to her is a characteristic of the 'postmodern turn' (2003, p. 556) – and from here she developed SA.

SA is a map-based analytical approach aiming at a situated understanding of social phenomena through qualitative analyses of the various actors and their relations (ibid. p. 557). With SA, Clarke develops GT in six areas which she stresses: First the situation: "The key point is that in SA*, the situation itself becomes the fundamental unit of analysis*" (Clarke, 2009, s. 210, her emphasis). Second, discourse: "Arenas are … sites of action **and** discourse … " (ibid. p. 201, her emphasis). Third, the non-human actors: "Humans are not enough. Fresh methodological attention needs to be paid to *nonhuman objects* in situations" (ibid., her emphasis). Fourth, the implicit actors – actors present but silenced, and actors not-present but with a voice (ibid., p. 204). Fifth, relations among actors as key (2003, p. 569), and sixth, the presence of the researcher and its impact on the studied situation (Clarke & Charmaz, 2014, s. 21).

Due to my research interest in SBT, I am also inspired by SBT theory (Bundsgaard et al., 2011, 2012; Hanghøj et al., forthcoming) and pedagogical relational models (Bundsgaard, 2005; Hiim & Hippe, 1997; Schnack, 2000). By combining an empirical, data-driven approach with a theoretical and model-based approach, I am deliberately opposing the grounded approach that Clarke otherwise firmly stresses (2009, p. 212), and hereby I criticize GT and SA for not being aware of what they don't see.

Above I presented the lack of subject learning as the main challenge in project-oriented teaching (cf. Bundsgaard, 2008). Therefore, *subject learning* is an actor. Theoretically, Bundsgaard and I have operationalized *subject learning* in a holistic definition as consisting of five *dimensions* (Bundsgaard & Fougt, forthcoming):

1. Knowledge, concepts, procedures, and artifacts
2. Systematic approaches: Methods
3. A social constellation: Role, position, forms of communication, and storylines
4. An interest: values, interests, and motives
5. A perspective: Ontology and epistemology.

The key point of addressing them as dimensions is that they are dependent: A doctor or a teacher who only knows his concepts and methods but has no understanding of e.g. the social constellation or the interest or perspective associated with his/her practice is a bad doctor or teacher! Thus subject learning needs to be an actor. In my PhD project, the lack of subject learning was met through a structured planning guide for the teaching (Bundsgaard & Fougt, 2012). Consequently, teacher plans are also an actor.

Furthermore, SBT is characterized by a doubling of levels and actors as SBT is carried out at the teaching level aimed at learning as well as at the scenario level aimed at production (Fougt, 2015). Journalists use knowledge and systematic approaches, they work in a social constellation with photographers, editors etc., they have certain interests and values (Shaffer, 2006), and thereby a certain perspective on the world. This professional scenario has to be complexity-reduced to teaching and subject-specific learning. Thus, the doubling at the two levels is an actor, and theoretically, the following actors emerge:

- The situation
- Human and non-human actors
- Implicit actors
- Discourse
- Relations
- Subject knowledge dimensions 1-5
- Teaching level and scenario level
- The teacher's plan

I am also inspired by three pedagogical relational models: *The Pedagogical Triangle* (e.g. Schnack, 2000), Hiim´s and Hippe's *Pedagogical Relational Model* (1997) and Bundgaard's *Model of teaching as a Communication Situation* (2005).

The "pedagogical triangle" points out student, teacher and content. Based on a critique hereof, Hetmar points out context as a needed actor just as she stresses the actual place or space for the teaching (1996). Bundsgaard stresses that in an ordinary teaching situation, there are usually several students, not just one, and he points out the difference between approach and content:

Content is the focus or perspective of the course, e.g. gender perspective, communication criticism, advertising, literary period.
approach is the tasks and texts that are processed or taught, i.e. the way in which the given content is addressed (Bundsgaard, 2005, p. 89).

Thus, based on the three models, the following actors are emerge:

- Teacher
- Different students
- Context
- Approach
- Content
- Place and space

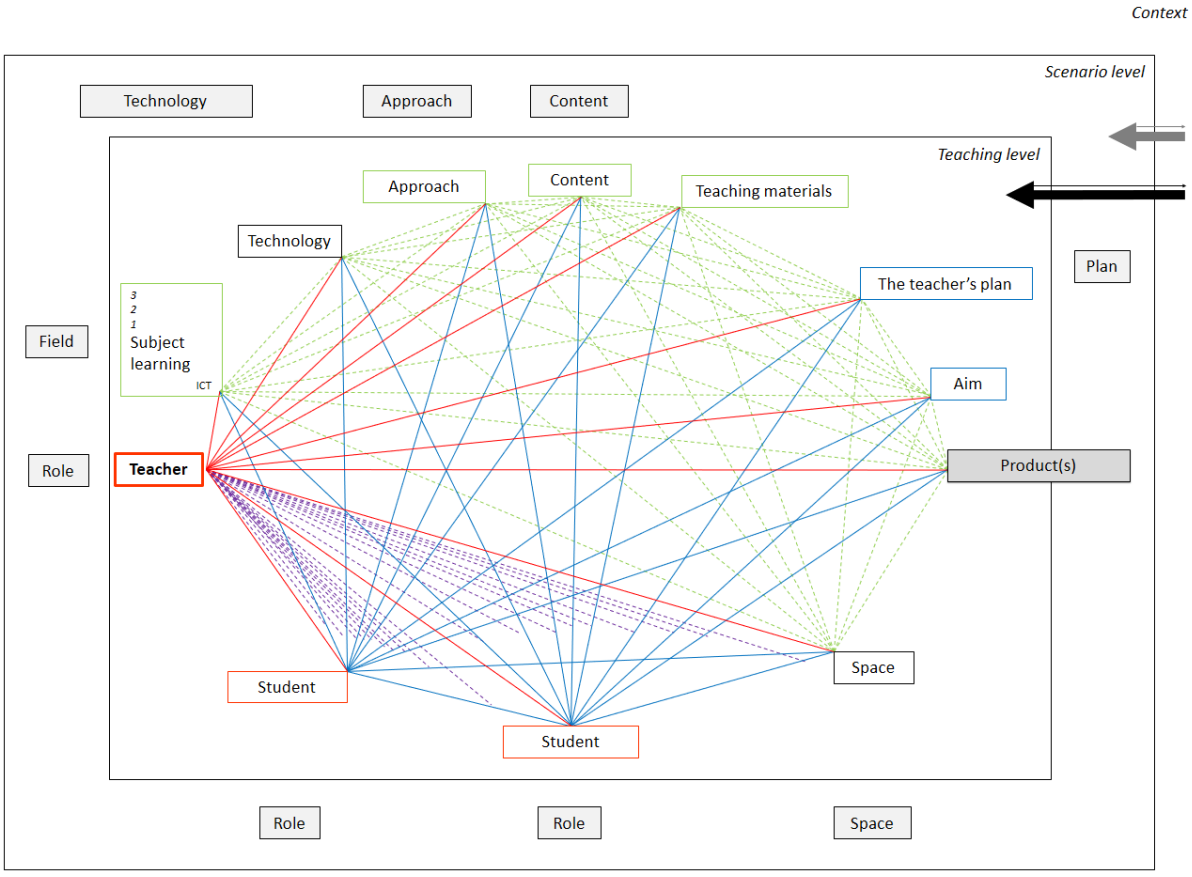
The project is focused on SBT with ICT. Empirically, several teachers spoke of ICT as something outside their subjects, cf. Clarke's stressing the discourse. Therefore, I distinguish analytically between ICT as the subject-specific use of ICT, and technology as the term outside the subject (Fougt, 2015). Furthermore, through the joint planning with teachers, teaching materials appeared as an actor. Thus, empirically, the following actors emerge:

- ICT
- Technology
- Teaching materials

The empirical data consists of 17 cases of individual teachers with an initial teacher interview, observations before (21 lessons) and during the project (63 lessons), joint planning meetings (16) and emails with teachers (527), teachers' plans for the course, student products, and final knowledge sharing in teams, individually described in Fougt (2015).

Results

I use the actors derived from theory, models and empirical data to create The Teacher Scenario Competences Situational Model, where the above-mentioned dimensions 3-5 of subject learning are merged into *3*:



Model 1: The Teacher Scenario Competences Situational Model (Fougt, 2015, p. 124)

In the data analyses, the model visualizes the teachers' scenario competences through the highlighting and downtoning of the teacher's relations and relational relations (relations to relations,

e.g. a teacher's relation to the students' relation to ICT) (Fougt, 2015). In SBT in particular, and in teaching in general, teachers have to monitor e.g. the relation to the content and approach, as well as the relational relations between e.g. pupil, content, approach and room. Maybe the classroom could be arranged differently in order to better match the scenario? The point is that the teacher must be able to monitor all relations and relational relations in order to plan, teach, and evaluate SBT – and that is, quite simply, tremendously complex.

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Assessing Digital Student Productions, a Design-Based Research Study on the Development of a Criteria-Based Assessment Tool for Students' Digital Multimodal Productions

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Digital multimodal production is becoming increasingly important as a 21st century skill and as a learning condition in school (K-12). Moreover, there is a growing attention to the significance of criteria-based assessment for learning. Nevertheless, assessment of students' digital multimodal productions is often vague or lacking. Therefore, the research project aims at developing a tool to support assessment of student's digital multimodal productions through a design-based research method. This paper presents a proposal for issues to be considered through a prototyping phase, based on interviews with six experienced teachers, analysis of educational materials, analysis of the national curriculum, as well as diverse theoretical perspectives covering text theory, assessment theory, and multimodal theory.

Keywords: Assessment, student production, multimodal production, assessment criteria, feedback

This paper provides a proposal for issues to be taken into consideration when formulating assessment criteria for students' digital multimodal productions. The proposal is the outcome of a preliminary research stage and forms a basis to be developed in a forthcoming prototyping phase in a design-based research setup. The aim is to provide a better understanding of the function and characteristics of appropriate assessment criteria and thus to *improve evaluation practices of digital multimodal productions* in school. In this paper, we present our initial assumptions to be tested and developed through a series of interventions. The project, called "Assessing Student's Multimodal Productions", is carried out at Metropolitan University College, Copenhagen.

Background

Students' digital productions are important for several reasons. First of all, in a digitalized society we need competent citizens who can act and communicate creatively and critically with digital and multimodal texts ("Assessment & Teaching of 21st Century Skills," 2016). Therefore it is essential to support and qualify not only students' reception, but also students' production of digital multimodal texts in school (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). Secondly, as pointed out by Gunther Kress and Staffan Selander (2012), production of multimodal texts is at the core of the learning process, understood as a meaning-making process where modes like image, sound, video, and words are at the disposal to represent different aspects of the student's knowledge and understanding of a given subject. Nevertheless, The International Computer and Information Literacy Study shows that students' productive skills, at least in Denmark, are far from being advanced (Bundsgaard, Pettersson, & Puck, 2014), even though schools have invested massively in computer technology, and it is common to use computers for information search and collaborative writing processes.

Moreover, research has pointed to the fact that learning is optimised if it is based on evaluation practices with explicit objectives and criteria connected to the learning processes (Black & Wiliam, 1998; Hattie, 2008, 2013). Furthermore, *feedback* about tasks has proved to be an effective learning contributor – *if* based on explicit criteria and used for formative rather than summative assessment (Hattie & Timperley, 2007; Wølner, 2015). Unfortunately, studies show that feedback in general in Danish schools is often *informal* (Danmarks Evalueringsinstitut, 2013) and *not* based on clear criteria. This is supported by an analysis in our pre-study of learning materials on multimodal production and interviews with teachers confirming that evaluation practices connected to student productions are by and large vague or non-existing in Danish classrooms (Jensen & Sandfeld, 2015). Furthermore, the studies showed that teachers confuse assessment of the production, of the achieved learning objectives, and of the learning process. In particular, they seem to be reluctant or unsure to *assess the product itself*.

How to Support Formulating Assessment Criteria

To sum up, *student production* of multimodal texts is essential for representing and expressing knowledge and understanding, and is best supported by *feedback* based on explicit criteria. The question now facing the teacher is: Which criteria to employ when assessing the product during the

production process? And this leads us to the following question: How can we support the formulation of assessment criteria regarding student's digital multimodal productions?

Answers to this question will be of great importance to the main question of our research project, which seek to find out how a criteria based assessment tool should be designed to best support students' digital production competencies.

The method we employ is *design-based* (Kennedy-Clark, 2015). We want *both* to understand and conceptualize assessment of students' productions, *and* to design a tool to improve assessment practises. The study is conducted in three phases: 1) A preliminary research phase, now completed, to be followed by 2) an upcoming prototyping phase, and finally 3) an assessment phase. An important result of the first phase is a rough outline of an assessment tool and a theoretical understanding of the problem. We have conducted a series of studies before entering phase two: Interviews with six experienced teachers, analysis of educational materials, analysis of the national curriculum, and a short review including theory concerning assessment theory, digital competences, genre, text actions and more. As a result, a number of issues to be taken into consideration when formulating assessment criteria have become apparent.

Form and Content

A recurring issue in our interviews has been the relationship between *form and content*, though often expressed in different words. For instance, one teacher said: "You can talk about what is form, or at least the *aesthetics*. I don't think that it comes across as the most important at all. I definitely think one should focus on what regards *content*." Another teacher remarked that the students have become aware of differences "in relationship to both the *narrative* and the *technical means*". In these examples, one meets similar oppositions, although in different words and with different focus. Some of the terms related to *form* used by the teachers include "effects", "means", "aesthetics", "visuals", and as one teacher put it in relation to film the "purely cinematic". Terms related to *content* include "message", "story", "narrative", "storyboard", "dramaturgy", and not least the "subject". Regardless of the specific terms, the notion of an opposition between form and content seemed to be a common one for all the teachers we interviewed. However, the opposition was approached very differently: Some teachers stressed that the content, the story or the subject conveyed, was key, and that aspects related to form were merely to be seen as means to

communicate the content. Others stressed the accomplishment of skills related to form – for instance how to record and edit a video. Finally, some teachers viewed the opposition as something of a dilemma. No matter the approach, the opposition between form and content seems to be ubiquitous and constitute an important question for teachers when assessing students' productions.

Typology

Another issue to be tested and refined is the question of *typology*. From the beginning of our project, we had the intention to make a tool that could be used *across* different multimodal genres, in order to make the tool useful in many different production situations and in different learning contexts. Theoretically, it is possible to make assessment criterias exclusively on the basis of e.g. *modes* like image and audio and the organization of or cohesion between modes (Hung, Chiu, & Yeh, 2013 and Ostenson, 2012 are good examples). But such criteria seem to be too general to be useful with specific products, such as websites, films and photo stories, where a mode like eg. image would appear with significantly different functions. Moreover, our interviews with teachers and analysis of learning materials point to the fact that multimodal products are categorized as specific text types with special features and functions, types that an assessment tool would have to address.

Text types have been taught from the perspective of *genre* ever since Aristotle. This perspective has been renewed by the genre pedagogy and its focus on the empowerment of students through an understanding of the social functions of language (Martins, 2004; Mulvad, 2013). Nevertheless, linguistically based conceptions of genres seem to be insufficient in dealing with genres of new media, where specific affordances of different semiotic modes play a major role. With new technologies new formats arises, to be exploited by different rhetoric purposes (Ledin, 2013). Therefore, assessment criteria that pay attention to the interplay between format and purpose might be of special interest.

Tool

Taking all these issues into consideration, when and how might a "tool" be beneficial, and what should be the key characteristics of the tool? First of all, the tool must support students being active in discussing and formulating criteria (Wølner, 2015; Wille, 2013). Secondly, the assessment criteria depend on the learning objectives. For instance, making a book trailer to show one's understanding of the book, and making a book trailer to learn an application like iMovie, calls for different assessment criteria. Thus, the tool should not lay down criteria independently of the learning setting in which the criteria are to be employed. Instead, we want to support the teacher's process of formulating criteria, preferably in collaboration with the students. On the other hand, the best way to actually support and facilitate the work of the teacher formulating assessment criteria might very well be to suggest concrete criteria to be utilised and rephrased by the teacher, not least in the light of ever decreasing teacher preparation time. Thus, our proposal for a tool to be tested in phase two is a combination of 1) general guidelines for product assessment and 2) suggestions for concrete assessment criteria, both assisting the teacher drawing up appropriate and effective assessment criteria.

Conclusion

As we begin the prototyping phase, we have outlined a proposal for issues to be taken into consideration when formulating assessment criteria for digital multimodal student productions (including issues of form and content, and of typology) as well as a model of an assessment tool. During the iterations of the next phase, beginning in February 2016, the aim is to test and develop this proposal, thus gaining a better understanding of assessment of students' productions.

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Is the adaptive researcher the road to success in design-based research?

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In this paper, we explore the researcher role in design-based research. Inspired by frame analyses we draw upon two research positions. These are the action-taker position and when being mobilized. We provide with two examples that influence the researcher adaptiveness. The first concerns meetings with different agendas and tasks, and the second explore how the practitioners are affected by an adaptive researcher role. These examples uncovered two sub-positions related to the action-taker position. Shifting between research positions seems to maintain collaboration as authority is aligned and prevent long-term alliances.

Keywords: researcher role, design-based research, frame analyses, research practice.

INTRODUCTION

In this paper, we argue that a researcher applying an adaptive approach can contribute to a more successful collaboration in design-based research (DBR). From here, the first author is referred as the researcher.

DBR is a practice-oriented methodology, mainly where an artefact is developed and tested in collaboration with practitioners (Barab & Squire, 2004; Wang & Hannafin, 2005). It is common that the researcher drives the research (Edelson, 2006). Thus, DBR provides the researcher with opportunities to lead and administrate the direction of the research. Moreover, DBR allows the researcher to act as designer not just of the research project, but of pedagogy (Christensen, Gynther, & Petersen, 2012). At the same time, the researcher must maintain productive collaboration. There appears to be the need to address researcher practice in collaboration with the practice field in DBR methodology (Reimann, 2011).

The following research questions were set to guide the research: How do different meetings, with varied agendas and tasks, influence possibilities of an adaptive research role and how are practitioners affected by an adaptive researcher role?

We see the researcher role as an umbrella term that plays host to several underlying positions. Frame analyses have provided us with two leading research positions: the action-taker and when being mobilized. Framing can be understood as how a problem is defined and refers to two related key processes, frame alignment and resonance (Coburn, 2006; Coburn, Bea, & Turner, 2008; Penuel, Coburn, & Gallagher, 2013). Coburn (2006) explicates frame alignment as 'the action taken by those who produce and invoke frames in an attempt to connect these frames with the interest, values, and beliefs of those they seek to mobilize' (p. 347). Frame alignment is a necessary condition for movement in the practitioner's participation in the research project (Snow, Burke Rochford, Worden et al., 1986). Resonance revolves around the frames' potential to create a connection with the practitioners and motivate them to action (Penuel et al., 2013).

In DBR, an actual implementation of an artefact through iterations is one of the core elements of successful research. Success is linked to frame alignment and its dependency on how the participants respond to the frame (Penuel et al., 2013). One measure of success is the degree to which others in a group took up and argued for a given position as their own (a key indicator of resonance).

METHODS AND MATERIALS

The background of the PhD-project arises from a need for improved outdoor science education. An artefact to help teachers in their planning and conduction have been tested with two high-school science teachers, Arya and Gustav (pseudonyms). The research design is based on Reeves' model (2006) with its four main phases (Figure 1), with one iteration consisting of 1) a workshop 2) conduction and 3) reflection.

The main data derives from an introductory meeting and two workshops from the first and third iteration, respectively. The introductory meeting was a semi-structured interview. It was also the researcher's first encounter with the two science teachers. All data items were audio files and were transcribed by the researcher (Table 1).

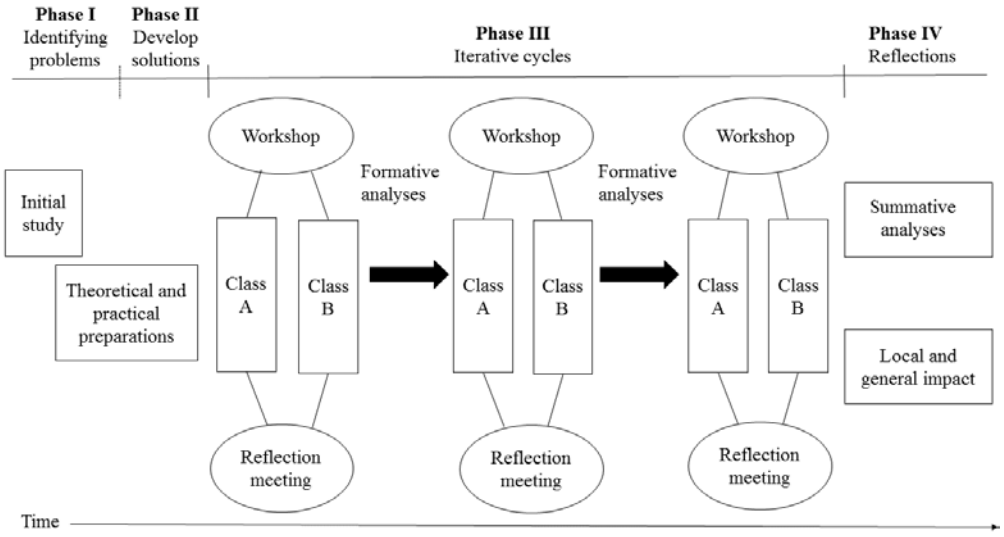

Figure 1: A schematic research design.

Table 1: An overview on the empirical data. WS= Workshop.

	Introductory meeting	**First iteration**	**Third iteration**
From		WS	WS
File	Audio	Audio	Audio
	Own reflections	Field notes	Field notes
Time		WS: 2 h 20 min	WS: 1 h 6 min
When	21 August 2014	WS: 27 October 2014	28 May 2015

To look for patterns in the transcribed material, a system of concepts was used. Inspired by frame analyses the main concepts were: *framing*, *frame alignment* and *resonance, negotiation and arguing* and the two positions *action-taker* and *being mobilized*. We are not attempting to provide an exhaustive analysis of the researcher's collaboration with the practitioners. Rather, we want to provide two examples of her shifting positions during the collaboration. More examples and more in-depth discussion of the results are available and will be provided at the presentation. The two examples that display the researchers' shifting positions are different meetings with varied agendas and tasks, and the actors in play (referring to Ervin Goffman's (1958) dramaturgical model).

RESULTS

Different meetings with varied agendas and tasks

In the introductory meeting, the researcher attempts to frame the project for the teachers with the intention of motivating them to action (resonance). Additionally, the researcher aimed to connect the project with the interests, values and beliefs of the teachers (frame alignment). At the introductory meeting, Arya expresses several concerns about outdoor education and she asks questions about the research: '*I am unsure of what you are going to explore... Are we the ones planning the outdoor education and you register what you see?*' She is prepared to act (resonance), but requests an understanding of how this is going to be conducted.

We (the authors) designed a conceptual tool derived from the artefact being tested. The tool was used in the workshops and aimed specifically to help the group (Arya, Gustav and the researcher) plan outdoor education. The conceptual tool became an action-taker as it mobilized both practitioners as well as the researcher to act. The researcher refers to the practice field, telling narratives and suggesting changes.

In the following excerpt, the group agrees to use a nature trail as student activity. The researcher argues for open-ended questions, both when being mobilized and as an action-taker. An action-taker position becomes especially clear when the researcher refers to specific research literature.

> **Researcher:** They [the students] can get questions they can't google!
> **Arya:** Can't google?
> **Researcher:** Questions where there are no definite answer. Like to see ecological relations, maybe exploratory questions.
> **Arya:** I believe it would be hard to find those questions.
> **Researcher:** Okay, for instance, in geology the students need to answer what kind of rock material the opera house [in Oslo] could be built with. There is no definite answer to that.
> **Arya:** Yeah, or what kind of succession phase we see right now!

Actors in play

Disagreements, negotiations and argumentations were frequent in the collaboration. In these situations, alliances arose that were almost exclusively based on topic. Arya and the researcher

formed alliances when discussing the use of technology in outdoor education. On the topic outdoor education, Gustav and the researcher formed an alliance and talked about positive outcomes and relation with nature.

In cases where Gustav and the researcher formed an alliance, Arya responded by asking critical questions 'But I think it's difficult. You go outside, and there are no textbooks there. Still they need to learn a great deal and how do you do that?' Arya's comments often provided the group with new ideas and contributed to progress in the research.

Contrary to Arya, Gustav became quiet and resigned when Arya and the researcher formed an alliance. The researcher included Gustav in the conversation by asking him specific questions about practical issues concerning outdoor education such as: 'how far is it to the bonfire?' In those cases, the researcher inhabited the mobilized position in order to include Gustav in the conversation. The researcher's intent was as a process leader, a characteristic of an action-taker position. From this result derives a new sub-position, the action-taker as a process leader and the action-taker as a traditional position, as in the introductory meeting.

DISCUSSION

A successful collaboration

At the introductory meeting, the researcher inhabited the action-taker position, in particular the traditional sub-position. Smith (1998) points to this interview form as having a clear separation of power between the participants and the researcher. Moreover, Coburn (2006; et al., 2008) found that differences in authority can affect the dynamics of the collaboration and therefore the research itself. The researcher may also take too much control over the design in DBR (Barab & Squire, 2004). Hence, the researcher being mobilized by the conceptual tool in the workshops aligned authority and the practitioners were involved with its design. When participants had authority, they could influence the direction of collaborative work (Penuel et al., 2013). Forming alliances made a change in authority. Alliances caused Arya to ask critical questions and Gustav to withdraw. However, long-term alliances can be risky. The researcher responded by shifting positions and the two sub-positions emerged. This influenced the success of the collaboration.

Attached qualities to the positions

Some of the position's qualities are predetermined by frame analyses while others have been detected or clarified during this research. When in an action-taker position, the researcher thinks beyond the practical issues. She is an active user of research literature, especially for argumentation. Frame analyses contributed to uncover that the action-taker position is embedded with related sub-positions. The action-taker as a process leader and the traditional action-taker. The latter sub-position provides the researcher with authority through for instance leading an interview. The process-leader sub-position also leads, but appears as being mobilized. The ones being mobilized are mainly the practitioners. However, when the researcher is being mobilized, argumentation comes from a practical view. The mobilized researcher acts according to their own experiences of being in the practice field, usually through the use of personal narratives.

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Students as Math Level Designers: How students position themselves through design of a math learning game

By ERIK OTTAR JENSEN, THORKILD HANGHØJ, LARS RENG and HENRIK SCHOENAU-FOG, Aalborg University, Copenhagen

This short paper presents findings from a design-based study on how students positioned themselves as game designers and as math learners. The design intervention was carried out in a Danish public school with two classes of 5th graders. Over the course of two weeks, the students worked with a design template for a runner game in the Unity 3D game design engine and were asked to design math questions and modify the game design for a math game. The main findings point to the importance of allowing students more autonomy in terms of designing both the subject-related content and specific game mechanics, which needs to be more meaningful and have clear consequences. Moreover, the study also point to the importance of designing and communicating clear relationships between design activities and mathematical goals.

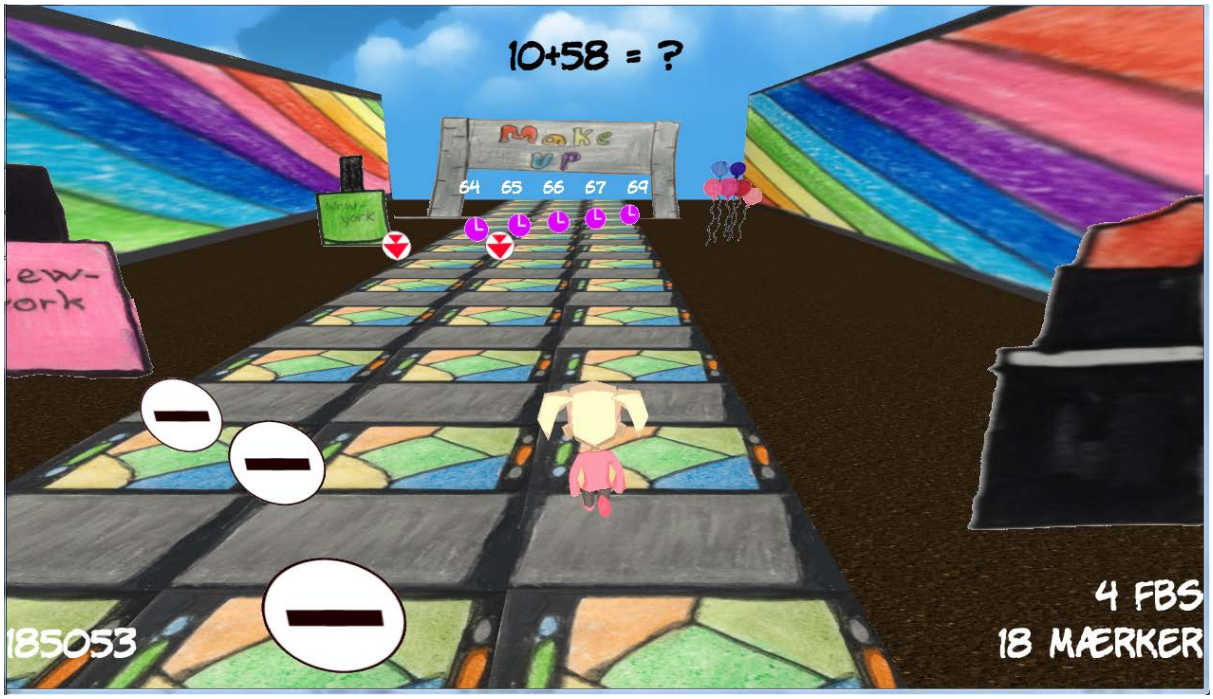
Keywords: design-based research, game design, math education

IINTRODUCTION

There exists a huge global market for edutainment games, which have often been criticised for providing shallow learning experiences (Egenfeldt-Nielsen, 2005). At the same time, there is a growing interest among educators in letting students design their own games through tools such as Scratch or Game Salad. Based on two of the authors' previous experience with teaching the professional 3D game design platform Unity to students at Aalborg University (Reng & Kofoed, 2015; Schoenau-Fog et al., 2015), this study aim to explore how the same platform might be used to teach middle school students math being math level game designers. This leads to the following research question: How do the middle students position themselves as designers of a math game, and how do they perceive this as a mathematical learning activity?

CASE

The study was conducted with 40 students aged between 11 and 12, in a public school in Copenhagen. The students produced math questions and visual theme for a Unity game template, producing a game with the students' own math questions representing the difficulty of the game. The template was a runner game in which the avatar runs through a level containing a math question. The level ends with a number line containing a range of numbers. The objective of the game is to steer the avatar as close as possible to the correct number on the number line. The students were introduced to level difficulty in computer games and, working in pairs, designed math questions in varying levels of difficulty and arranged the questions from easy to difficult. The course was concluded with a presentation of the games to two 4th grade classes.



Picture 1: This shows a level from the game where a student have designed a makeup theme, math question and numberline.

THEORY

Our theoretical approach is based on recent work on scenario-based education, which assumes that the educational use of game scenarios can be understood as an interplay of four different domains, which each refer to different types of knowledge practices (Hanghøj, 2011). The four different domains are: the *disciplinary domain*, which in this case refers to mathematical practices within math as a school subject; the *pedagogical domain*, which refers to specific learning practices such as students doing group work or collaborative game design; the *scenario domain*, which in this case refers to math game design practices within the Unity framework; and, finally, the *everyday domain*, which here refers to students' everyday experiences with gaming and game design. Drawing on this framework, it becomes possible to map and understand some of the tensions and translations, which emerge across the different domains.

The second theoretical perspective draws on the work of Dialogical Self Theory (Hermanns, 2001; Ligorio, 2010), which argues that human beings continually take up different *I-positions* as they communicate and interact with others. To give an example: Designing a digital game at home (everyday domain) offers a different range of I-positions than designing a math game at school (scenario domain), which requires translation in order to meet the validity criteria of the subject (disciplinary domain) as well as the needs and demands of specific learning activities (pedagogical domain). In this way, game design activities in school may offer students the opportunity to enlarge and reorganise their repertoire of I-positions. However, the same game design activities may also lead students to enact I-positions, which clash with their everyday identities as game players, as game designers or as learners in the classroom. In order to describe how such tensions emerge in relation to math as a subject, we will use Yackel and Cobb's (1996) notion of *sociomathematical norms*, which refers to normative understandings of what counts as mathematically acceptable explanations or justifications in a classroom.

METHOD

The pilot study is informed by Design-Based Research (Barab & Squire, 2004) and aims to explore theoretical assumptions on games and learning by intervening with a specific design template in a local educational context. Data collection included observations and student interviews. Moreover, we conducted pre- and post-test on math abilities and motivation through the theoretical framework

of player engagement (Schoenau-Fog, 2011) understood as the desire to continue an activity. The focus of this paper is the interplay of different domains and student positioning within a game-oriented learning setting (Hanghøj, 2011) in order to explore how the students perceived the relationship between game design, math as a subject, the learning activities, as well as their everyday experience with games. This perspective is examined through four student interviews with two students in each conducted after the intervention. Thematic coding (Gibbs, 2007) using domain theory specific for understanding games in educational context were used to process the data from the interviews.

ANALYSIS

The analysis of the pre-, during and post tests on students' level of their desire to continue the design activity indicated that they had high expectations toward designing and playing games, which were only partially met. The findings indicated that students lost their motivation due to challenges with the learning design, and the levels of their desire to continue designing their own math game fell during the intervention (from 4.9 (before) over 4.2 (during) to 3.6 (after) on a scale from 1 to 5). However, their determination to design a completely new math game was still relatively high at the end of the project (scoring 4.3 out of 5), indicating that the intervention did not demotivate students to develop math games and that they were more likely frustrated with their experience with designing the specific game in the intervention.

Based on the thematic coding of the interviews, two analytical themes emerged.

Theme 1: Being a math game designer

Generally, all the students were positive about being positioned as game designers. They described the activity as a welcome relief from working with textbooks and handouts in math classes. The students particularly enjoyed being able to make drawings for their games and present their games to students in other classes. This indicate how the students were interested in adopting new I-positions such as I-as-presenter or I-as-game-designer. The students also liked the fact that Unity was a professional platform and that it could be used to design things in 3D. At the

same time, several of the students were critical of the Unity template. One student mentioned how he would have preferred to work in the programming tool Scratch instead as this would have allowed to *"make more [things] of my own".* Several other students mentioned that they felt somewhat restrained by the Unity template, which did not allow them to change the narrative or the key game dynamics. In this way, several of the students were critical that they were unable to *"really make the game"* and only allowed to change a few features within the game such as the graphics and the math questions. Two of the students explicitly mentioned that they did not like the runner game, which indicates the importance of game preferences when designing a game. These findings show that the students did not experience sufficient autonomy in their design process as they were only offered had a quite limited repertoire of possible I-positions.

Theme 2: Learning math through level design

The second theme explores the variation in the students' experience of math learning in relation to the game design process and the game design. Findings suggest that the students' existing sociomathematical norms shaped their expectations towards the course, which made it difficult for some of the students to perceive the activities in the course as valid mathematical activities in the form of activities normally carried out in math class. One student explains the experience of math learning: "*Well, I didn't notice anything, but I probably learned something."* The student believed that she learned some form of math but it was not obvious to her what she learned. Another student stated that: "*The more you write math questions the better you become at it, right? So of course we might have learned something about math questions. But I don't know if we have learned like a lot.*" In this way, the potential for math learning was perceived as being centered around the production of math questions based on the assumption that when you write math questions you learn about math questions. Even though the students perceived the math as being related to the production of math questions, most did not find valid mathematical meaning in creating the math questions. They experienced that they were doing training exercises, making a lot of questions, instead of innovative math design. The findings suggest that students were not aware of how game design activities were connected to mathematical learning, and that it differed from existing sociomathematical norms in the classroom.

DISCUSSION

The design intervention was hindered by several practical challenges, which mainly concerned the teachers' lack of preparation time and technical obstacles - e.g. the students had to share their Unity files on USB sticks as they could not use the school network. These challenges clearly had negative influence on the students' overall perception of the design interventions. Several of these challenges could have been avoided if there had been more clear adjustment of the expectations and closer collaboration among the participating teachers and designer-researchers.

CONCLUSION

The study shows how students' educational game design activities both involve possibilities and challenges for creating meaningful math learning environments. The main findings point to the importance of allowing students more autonomy in terms of designing both the subject-related content and specific game mechanics, which both needs to be more meaningful and have clear consequences. Moreover, the study also point to the importance of designing and communicating clear relationship between design activities and mathematical goals in order to produce "valid" mathematical knowledge.

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Collaborative Pattern Language Representation of Designs for Learning

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Abstract

In the article we present how teachers by use of design patterns in a participatory design process have captured their experiences of using information technology in teaching. Focus in the design patterns shifted over time from focusing difficulties with technology and proposed solutions to these to didactic and pedagogical aspects of technology use in teaching and learning. A thematic analysis of the teachers' patterns and pattern languages building on the themes "context of the teacher", "context of the pupils" and "technology", is presented. Writing of design patterns helped teachers see relations and dependencies between problems and solutions that would otherwise be difficult to see while the writing of the design patterns simultaneously counted as doing designs for learning.

Keywords: designs for learning, design pattern, pattern language, participatory design

INTRODUCTION

Teachers are in their practice engaged in designs for learning making choices grounded in their teaching experience. These designs could be labelled well argued for and 'good' design solutions counting as examples of designs for learning (Selander 2008; Kress & Selander 2012). A design solution here means a solution to a 'problem' that a teacher has that includes making choices regarding didactics and the use of artefacts for solving the problem. Teachers strive towards overcoming difficulties and solving problems related to their teaching and it could be claimed that many problems already have a good design solution. However, an identified problem concerns the representation of these design solutions (Laurillard, 2008). Design solutions run the risk of becoming inaccessible to colleagues and the teaching community and thus taps into questions of sustainability of working design solutions. The broader question we approach in this paper is how

the use of design patterns and pattern languages can support teachers´ capturing, organization, and communication of designs for learning? A more specific question concerns what designs for learning are expressed in the teachers´ patterns and pattern languages?

Representing designs for learning

In the Scandinavian participatory design tradition the concept of change not only denotes new designs and technology, but also change and development of human's' thinking, organisations and communities ways to work and deal with problems (Gregory, 2003). Work and research within participatory design use a range of techniques, methods and practices including different types of workshops, design games, multimodal narratives, and constructions. By interacting and learning in each other's contexts a mutual understanding between designers and participants is developed (Muller, 2003). Involving people in design of processes and artefacts that concern them and their future use of these is central to participatory design (Muller, 2003).

Metaphors have in participatory design been used to establish a 'third space' between designers and users (Kensing and Halskov Madsen 1991; Muller, 2003). In interaction design there are different language oriented descriptions of interactive systems, for instance design patterns and pattern languages (Alexander, Ishikawa & Silverstein, 1977; Dearden & Finlay, 2006). Design patterns and pattern languages could form this third space between designers and users (cf. Muller, 2003). Different approaches to the use of design patterns and pattern languages for learning and how these can support the use of technology in schools is reported in the literature (Goodyear & Retalis, 2010; Mor & Winters, 2008). Much effort is invested in creating theoretically sound and pedagogically anchored design patterns and languages. However, the impact of these on everyday teaching practice has been questioned due to the level of abstraction expressed in such patterns and pattern languages (ibid.). The abstracted description needs to be translated into a concrete practice which poses a problem to the teacher. In approaching this problem, we choose to stay on the level of contextual descriptions as formulated by the teachers. Capturing teachers' design solutions in design pattern collections is not enough to capture and communicate their design knowledge. These need to be incorporated into a language increasing the communicative

power. There is a need for a lingua franca for design – and we and many others claim pattern languages can provide just that (Erickson, 2000).

THE KISTA PATTERN LANGUAGE

The Kista pattern language developed over a period of 2 years where eight teachers participated in a participatory design workshop series. The teachers work at a primary school in the multicultural suburbs of northern Stockholm. Our design work started with a future workshop (Cerratto-Pargman et al, 2014; Knutsson & Ramberg, 2015), followed by six workshops focusing on design patterns and pattern language development to capture teachers' designs for learning. The design patterns were formulated by the teachers and our contribution was primarily presenting them with the concept of design patterns and pattern languages, facilitating the workshops and answering to questions as these occurred.

The design patterns and the recurring themes that were experienced to be central to their practice is presented below. The themes provide additional structure and communicative value to that of individual design patterns and were formulated as "context of the teacher", "context of the pupils" and "technology", with connections between these often facilitated by the use of technology (see figure 1).

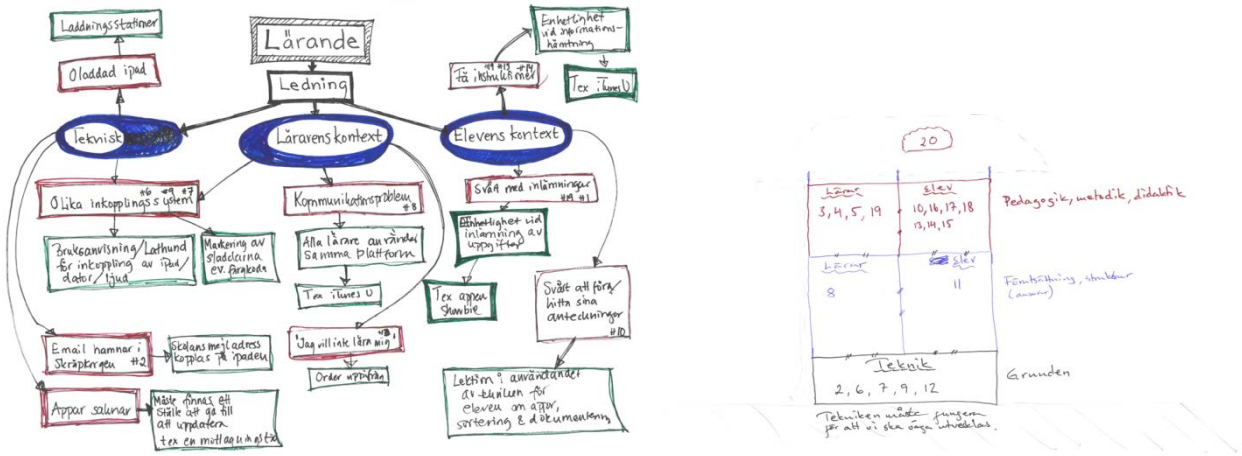

Figure 1: The teachers' pattern languages with the themes "context of the teachers", "context of the pupils" and "technology", in Swedish.

The vocabulary of the pattern language contains the individual design patterns; these could thus be seen as similar to the words of a natural language. The syntax of the pattern language builds on each design pattern being connected to at least one other pattern, but many being connected to one more abstract and one more detailed. The language has a hierarchal structure where patterns are connected in the form of a network.

In the following, we introduce the individual patterns through a thematic analysis building on Pattern Types (PT:s) as a way to navigate in the language as a network. A PT is defined as an abstract category showing the choices a user of the language has when choosing among the 28 individual patterns. The PT:s are described focusing the design solutions as formulated by the teachers.

PT1: DIGITALIZATION OF TEACHING MATERIAL - for documentation and re-use, including video recording of lectures.

- pattern#10: Increase the value of lessons by note taking
- pattern#12: Increase lecture sustainability by video recordings

PT2: DIGITAL LEARNING ENVIRONMENT – (VLE) to be used by all teachers. The main purpose is to push material and instructions to the pupils, and to collect the pupils' assignments in one place.

- pattern#1: Easy submission of students' works.
- pattern#2: One single e-mail address to be used
- pattern#8: Use the same general digital environment (VLE)
- pattern#16: Teach pupils how to use the digital environment
- pattern#21: Full use of the chosen general VLE
- pattern#27: Automatic app download, tablets should be the same for all
- pattern#28: Limit the number of channels for communication

PT3: OPEN CLASSROOM - communicative applications to open up the classroom physically and socially.

- pattern#17: Display of pupil's work in the classroom
- pattern#18: Make invisible pupils visible by communicative apps

- pattern#19: Share ideas and thoughts using virtual whiteboards
- pattern#20: Allow pupils to work outside the classroom using communicative apps

PT4: ROBUST CLASSROOM TECHNOLOGY - solutions for the physical classroom.

- pattern#6: Design and equip classrooms the same way
- pattern#7: One display solution in all classrooms
- pattern#9: Wireless connection of tablets for display
- pattern#11: Charging stations for the tablets
- pattern#22: Classroom manuals for the tablets
- pattern#23: Lending services for the pupils
- pattern#25: Lending of tablets

PT5: INSTRUCTION AND DOCUMENTATION TECHNOLOGY - teacher guided presentation, instruction and documentation of students' science labs.

- pattern#13: Use the projector and apps for instruction and documentation
- pattern#14: Use templates when documenting science labs
- pattern#15: Use push messages to improve instructions
- pattern#24: Develop genre specific texts

PT6: STUDENTS' DIGITAL ARENAS - learning and teaching in students' digital arenas.

- pattern#3: Share good examples to other teachers
- pattern#4: Place pebbles for learning on the pupils' paths
- pattern#5: Games as teaching tools
- pattern#26: Communicate with pupils through social media

By thematically structuring and connecting individual design patterns, interrelations between problems and solutions become visible and can therefore aid the teacher in doing and communicating designs for learning.

DISCUSSION AND CONCLUDING REMARKS

A language is used for describing things and events, for communication and exchange of ideas, artefacts, and etc. A 'natural' language grows when humans need to use the language to communicate and the same claim could be made about a pattern language – a pattern language

must become ‘alive’ as Alexander puts it. If the goal is a hierarchal pattern language with a hierarchal structure, abstract patterns (categories) can be combined with concrete solutions. The language traverses from larger patterns describing e.g. a school, its environment and an assumed general pedagogy, to more concrete descriptions with detailed solutions to recurring problems. In ‘natural’ languages, words and phrases cannot be combined in any order, they need structure and sequence and the same line of reasoning applies to design patterns. The design patterns need to be organised as a language with a hierarchical structure and means for communication using different levels of abstraction.

Construction of design patterns could be seen as an activity striving to avoid re-inventing the wheel. In working with the design patterns and pattern languages the teachers reported seeing relations and dependencies between problems and solutions that would otherwise be difficult to see. Other benefits observed were enabling keeping track of when and how a problem was solved and what new problems and possibilities this in turn gave rise to. The design patterns represent the teachers’ design knowledge while these representations also count as resources for future design processes. This two-folded aspect of design patterns was pointed out by the concept’s originators: Christopher Alexander and his colleagues (Alexander et al., 1977; Dearden et al, 2002), the pattern language works as a tool for design.

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Connecting physical and virtual spaces in a HyFlex pedagogic model with focus on interaction.

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This paper highlights interaction in physical and virtual spaces in a higher education HyFlex learning environment. The result implies that a HyFlex model requires an increased didactic awareness in designing for learning and in the paper we discuss the need for team teaching and co-design.

Keywords: HyFlex, virtual, physical space, higher education, designs for learning, co-design

Introduction

This paper highlights interaction in a HyFlex higher education learning environment. HyFlex (hybrid and flexible) course design combines physical and virtual spaces and face-to-face with online learning. In this case study the lectures/seminars are streamed live, with one lecturer and another teacher in the room as a facilitator of the streaming. The aim with the paper is to investigate the interplay between space and interaction in a higher education HyFlex learning environment. What kinds of different spaces are connected in a HyFlex model? How do the participants, with special focus on the lecturing teachers, design their interaction in the different spaces?

In this paper we focus on a HyFlex design that combines physical and virtual spaces and face-to-face with online learning and live streaming. This area, especially with focus on higher education and teacher interaction, is somewhat under researched. However, in a fairly similar setting (video conferencing in a campus space) McNaughton et al (2014) found that it affected the teacher practice as the teachers identified a conflict between their pedagogical design and the material environment. When the teacher moved around in the space only one third of the room was used in a repetitive way. Furthermore, the teacher felt disconnected from the remote students. That is, the design of the space and the framing of a video conference affected the interaction both in the

campus space and online. This connects to the aim with our study to investigate the interplay between space and interaction in a higher education HyFlex learning environment.

Theoretical frame

The case study is theoretical framed by the perspective Designs for learning (Selander & Kress, 2010). In a HyFlex learning environment, designs for learning helps us to understand how different physical and virtual spaces, constitutes essential elements in communication and interaction. With designs in learning we could deepen our understanding of how different spaces becomes resources in a meaning-making process, here with special focus on teacher interaction with students (see also Leijon, 2016).

Design

The case study combines video observation, streamed material from lectures, with interviews with three teachers in a higher education setting. During the interviews, excerpts from the streamed lectures were watched and discussed, focusing on the teacher interaction in the rooms. The material is analysed from a multimodal perspective (Kress & van Leeuwen, 2001) focusing on both visual and auditory information as well as the participant use of both physical and virtual space as a resource in their communication. Both authors of the paper have their own experience from working in this HyFlex environment as teachers and one as facilitator as well. In this study one of the authors participated as facilitator, and thereby had a dual role as a participant and a researcher.

Results

In a HyFlex learning environment with live streamed lectures and seminars several different spaces are shaped. First, we have the physical setting at campus, that could be a seminar room or a lecture hall. The campus students enter a room designed to be functional for the live streaming session. Both students and teacher have to consider how their interaction in the learning sequence in the physical room is affected by the technical resources for the streaming, that is camera and microphone. They also have to reflect upon that all their interaction is being recorded and live

streamed. Maybe the design *for* learning somewhat constrains their possibilities to interact and designing their way *in* learning? Do increased flexibility online means decreased flexibility in the campus space? Our observations highlight a transformation of the campus space to a lecture space, with a limited stage for the teacher and the students.

Second, designs *for* learning also concerns the space the facilitator designs for the live streaming. Choosing camera angels, clips and so on, the facilitator designs the representation of the interaction in the physical space for the remote students. From a lecture perspective, this space is out of reach as it is designed by the facilitator. The performing teacher (and the students) have no access to how they are represented online. Unless they follow the streaming in real time, using their laptops or mobile phones, while attending the campus space. How does this affect their design *in* learning?

Third, a HyFlex setting connects several different space outside campus. The remote students can attend at a café or at home in their kitchen. How does this blend of spaces affect the interaction?

Fourth, the online students have agency to design a parallel synchronous chat space. We have observed a student discussion that moves back and forth between technical questions, comments on the lecture and elaborations on the presented topic. The lecturing teacher have no direct access to this chat.

So, how do the participants, with special focus on the lecturing teachers, design their interaction in these different spaces? The results show how three teachers use different strategies to design their interaction in a HyFlex model. The first strategy we call “online and room oriented,” the second “room-oriented” and the third “room-oriented and online on demand”. In the following section we will elaborate on the different strategies.

The first teacher (online and room oriented) has a well developed strategy on how to interact with students in the room and students in the online space. He introduces the session by looking straight in to the camera and talks directly to the online students, then he alternates the focus

towards the physical room. This interplay continues throughout the lecture, when he asks questions to the students in the room he also poses questions to online. When the facilitator raises questions from the chat, the teacher listens and then look in to the camera while answering, and when the teacher sums up and closes the session, the alternating rhythm is repeated and both audiences are invited to participate by the lecturer. However, the teacher movement in the physical room is constrained to the area in the front as the teacher has to cope to use the computer, the whiteboard as well as interact with the camera that caters for the live stream, and that is placed in the middle of the room.

In the interview the teacher states that he makes no special preparation for the live stream session, the interaction and the alternation comes automatically, he says.

T1: I am somewhat afraid of that, when I look into the camera, that I will leave the group in the room /…/ I kind of start to discuss with someone not being present, and the students in the room are supposed to be passive — they are listening, of course, but I still find this a bit problematic. You feel it as a teacher.

The teacher mentions the feeling of being hindered to move around in the room as he wants. He also raises issues about the fear of loosing contact with the students in the room while paying attention to the online students.

The second teacher (room oriented) starts in the same way, directing herself towards both online and the physical room. Then her attention lies towards the physical room only. This means that she also moves around a lot in the room, walking towards the students and initiates group discussions without involving the online group. She uses the physical room to design the interaction with the participating students. This focus on the physical attendees means that there is no interaction in the online chat space, hence she does not have to interact verbally with the facilitator.

T2: [When asking questions] *I didn´t think so much about those on-line, even if I knew they* [the questions] *reached them too, and they had the possibility to write in the chat* […], *I think, I didn´t*

expect them to answer. I could have done that, but I suppose it´s because you don´t have the direct response from them.

The teacher expresses an awareness of the on-line students, but she doesn´t integrate them in her design of the interaction during the lecture.

The third teacher (room-oriented and online on demand) is a mix of the first two. She starts the lecture in the same way as the others, by turning to both audiences, but then she somewhat looses the online, only to connect again when the facilitator poses questions from the chat flow. The teacher listens to the question facing the facilitator and answers by talking direct to the facilitator. The students online are mentioned indirectly, in third person. She says the following about her movement in the room:

T3: I was thinking about how to move in the room. I even asked you (the facilitator) about that /…/ Where can I stand, how shall I, how can I move. How big is my space so to say?

Her movement in the physical becomes a mix of standing in the front and moving a step closer to the students in the room. However, she never completely leaves the front, as she is aware of the camera and the risk of getting out of the picture.

Discussion

To sum up — three different teachers, three different strategies for designing their lectures in a HyFlex environment. The result highlights questions about who is the designer in a HyFlex environment. It is the teacher that frames the learning sequence with a didactic design, but does he or she have agency and ownership of the design of the space? A HyFlex model connects different spaces, and in this paper we have mentioned some. The seminar room connects to student physical environment at home. There is also a disconnection between the campus space and the spaces that are created online, for example in the chat forum. It is a complex learning environment a teacher has to reflect and react upon. With our paper we have shown how the complexity in a HyFlex model affects the teachers didactic design — their designs in learning. The

result also implies that a HyFlex model requires an increased didactic awareness in designing for learning. The teachers in our study are, fair to say, all three quite new to this pedagogical model. In an educational developmental process it is important to understand how the complexity affects interaction and what choices the teacher makes. The result also pinpoints the fact that designing for online, the setting might constrain the movement and the physical interaction in the campus room. This is also worth to reflect upon for at teacher in a HyFlex learning environment. Furthermore, the result raises questions about team teaching. The facilitator has an important role as a link between the interaction in the campus space and the interaction online. Camera position, angels, frames, clips and so on is the work of the facilitator. Is this a co-designing process or is the teacher in the hand of the facilitator when it comes to representing the communication in their designs in learning? Activities in a HyFlex learning environment could preferably be co-designed by the lecturer and facilitator including the physical space and the on-line space.

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Actors and Power in Design-Based Research Methodology

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Category: PhD project

Short paper (2000 word): 1998

Abstract

In recent years, the methodology Design-Based Research has gained ground in research in teacher training education in Denmark along with Action Research (AR). In both methodologies the teacher's knowledge and experience are crucial to the research. However in DBR interventions is often designed and carried out by the researcher alone. Therefore the actors in DBR and AR have slightly different roles as co-researchers. This raises the question: To what extent does DBR methodology involve the teacher in the design process? This has led to a critical discourse analysis of key methodology articles on DBR. The analysis identifies the researcher as the primary acting subject and thus confirms my empirical observations. The result gives rise to ethical considerations of the role of hegemonies in the DBR methodology in a school context.

Keywords: Design-Based Research methodology, role of the teacher, hegemonies, research ethics

Contextualization and research question

In recent years, the research methodology Design-Based Research (DBR) (Barab & Squire, 2004) has gained ground in research in teacher training education in Denmark (Fougt, 2013; Gynther, Christensen, & Petersen, 2012; Hanghøj, 2009; Lorentzen & Georgsen, 2014; Majgaard, Misfeldt, & Nielsen, 2011). Design-Based Research hereby supplements Action Research (AR) and similar interventional research methodologies. In this context both DBR and AR are used in order to develop new didactical designs and teacher competencies. In both DBR and AR the teacher's knowledge and experience are crucial to the research (Greenwood, 2007). However in DBR interventions is often designed by the researcher alone and carried out by implementing a design

in an iterative process to develop theoretical principles (Anderson & Scattuck, 2012). Therefore the actors in DBR and AR have slightly different roles as researchers.

DBR was originally developed by Ann Brown as an alternative to positivistic research in laboratory environments (Brown, 1992). The goal was to examine learning in a naturalistic environment e. g. the 'messy reality' of teachers and pupils in classrooms and it therefore incorporates many actors. Still, DBR is led and controlled by a researcher (Barab & Squire, 2004; Elf, 2008: 26).

In addition to this, studies of classroom observations in my PhD project have indicated that in DBR the teacher is positioned as a more or less passive actor (Lorentzen forthcoming), and is thus not always taken seriously by the researcher, who is in charge. These considerations led to the question: *To what extent does DBR methodology involve the teacher in the design process?* This overall research question can be broken down to the following more specific questions:

- How and to what extent does the researcher incorporate the teacher as a fellow researcher in the classroom?
- How are pupils/students in the classroom considered in DBR research?
-

Method: the critical discourse analysis

- My method to answer these questions is to find out how the above actors are mentioned in papers on DBR methodologies. Therefore I have conducted a critical discourse analysis (Fairclough, 1992, 2003) of a number of key methodology articles on DBR (Barab & Squire, 2004; Brown, 1992; Collective, 2003; Collins, Joseph, & Bielaczyc, 2004; Majgaard et al., 2011; Reiman, 2011). These articles were selected on the grounds of the following criteria: 1) the articles are written by influential researches in the field, and 2) the articles are often cited and used in Danish research literature.

The discourse analysis is based on Fairclough's critical approach, where sentences are analyzed on a linguistic micro level with the purpose of identifying hidden text hegemonies. A central element in the discourse analysis is to view the connection between discourse and social praxis as dialectic. This means that discourses found in texts represent social structures that are present in society – for instance it might be a hierarchy of power that is expressed in law texts or the way certain social classes are viewed as 'normal' in news broadcasting. At the same time these very

discourses contribute to create and maintain such social structures in society by expressing them in language. Fairclough argues that this dialectical interaction is difficult to identify, and that we are not conscious about these mattes in our common actions with language (Fairclough, 1992, s. 72). By conducting a critical discourse analysis of texts it is possible to identify such hegemonies.

Excerpts from the analysis

Due to space restrictions I can only bring a few excerpts from my analysis in the following. These examples illustrate how I analyze the discourse and are indicative of the role of the teacher in DBR from 1992 until today.

The original impulse

In the original impulse to DBR (Brown, 1992) Ann Brown clearly calls for more knowledge about the teacher's role in design experiments:

> I need to know a great deal more about school restructuring, teacher training and support, and *teachers as researchers* (Brown, 1992, s. 173) (my Italics).

A closer examination of the text reveals it is the researcher who holds the initiative and is positioned as the acting part. Although the teacher is considered a co-researcher from the birth of the methodology he/she is only described very vaguely.

A meaningful change

A decade later, DBR is a fully formed research methodology. Yet The Design-Based Research Collective, which consists of 10 international researchers, only mentions the collaboration between teacher and researcher very broadly:

> Finally, in design-based research, *practitioners* and *researchers* work together to produce meaningful change in contexts of practice (…). Such collaboration means that goals and design

> constraints are drawn from the local context as well as *the researcher's agenda*, addressing one concern of many reform efforts (Design-Based Research Collective, 2003, s. 6).

In addition to this the word phrase 'meaningful change' is worth a more in-depth exploration. 'Meaningful change' is loaded with positive value, and 'change' indicates a change for something better. The problem is that we as readers do not know *what* kind of change and *who* this change is meaningful for? Although this is not explicated by the text (or any of the others) there a several actors involved in classroom/school research hence it makes quite a difference whether a given 'change' is 'meaningful' to the pupils, their parents, the teacher, the headmaster, the school's board, politicians or the researchers of a given design experiment. The point is to show that the role of the teacher in a DBR experiment can be affected by different stakeholders.

The researcher is the primary actor

Barab and Squire are faithful towards Brown's concept: the researcher is the designer and the primary actor in an intervention. The attention is solely on the researcher:

> […] *learning scientists* bring agendas to work, seeking to produce specific results such as engaging students in the making of science, creating online communities for professional development, or creating history classrooms […]. (Barab & Squire, 2004, s. 2) (my Italics)

What is noteworthy is that the authors talk about a movement from the researchers that leads to changes in the learning environment and the pupils' learning *without* the teacher as an intermediary.

The vision of the researcher

In the article *How design-based research and action research contribute to the development of a new design for learning* (Majgaard et al., 2011) DBR and AR are combined and discussed. Here the researchers have chosen to combine DBR and AR because the learning object, which is being tested in a 1st grade math class, is not fully developed. Therefore both the teacher and the children

are included as designers, which is inspired by the concept of participation in AR (Majgaard et al., 2011, s. 14 & 20). At the same time, the researchers wanted to secure a strong theoretical frame and research question, which means that DBR was also used as a methodology.

The described research design reflects that the researchers are the designers and leaders of the intervention. The text says: 'Our hope was' and 'we envisioned this problem' (ibid s. 18 & 7). In both cases the personal pronouns refer to the group of researchers. In this way a fundamental difference between AR and DBR is made clear: the question is whom the research actually addresses? In this case, the objective of the researchers is to use a new technology that enhances the reflection and better learning for the pupils. This objective differs from the typical objective in AR because it is not aimed at the development of the participant's empowerment and social emancipation which is the prime ambition of AR (Greenwood & Levin, 1998). Furthermore the objective is not formulated by the teacher and the pupils, but the researchers. So, the project may share an interest in the participants as gatekeepers but not the core aim and ambition of AR. Ultimately, the research process is envisioned and controlled by the researchers, and therefore the teacher and the pupils must be considered objects of the researchers.

Summary

On the basis of the discourse analysis I can conclude that DBR first and foremost is an design approach, 'an engineering model of research' as Thorkild Hanghøj puts it (Hanghøj, 2009), and in this approach the researcher holds the power. The close readings of the texts show a uniform picture of this. There are remarkably few considerations on the teacher as a co-designer/researcher. Such considerations do exits though, but primarily as a potential that must be further developed (Brown, 1992; Reiman, 2011). In overall the discourse analysis clearly indicates that the researcher holds the power, and that the teacher is viewed as a passive object. The pupils in the classrooms are not mentioned at all.

So what? Conclusion and some ethical considerations

The result gives rise to some ethical considerations of the role of hegemonies in the DBR methodology in a school context: The question about the researcher's objective and which interests the research actually serves. DBR inscribes the researcher as the controlling subject in a non-democratic structure which performs a hidden hegemony. In contrast to this is AR's program about democratic equality and the emancipation among actors in the school life. Thus the dilemma of DBR, when applied to the school's learning environments, is that it seeks to create innovative teaching and learning, but in doing so it supports the researcher's (and maybe other actors') ideals.

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Approaching Participatory Design in “Citizen Science”

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This paper explores the use of participatory design methods in engaging older people in Citizen Science. Based on a pilot in a small Scottish town it looks at the application of designerly practices to bringing lay knowledge into professional practices around biological recording. Charting our journey, our initial focus on enabling people to collect biological data, with a focus on participatory methods and design thinking, and its evolution into work about what collecting biological participants enabled for participants. It captures reflections on well-being, mobility, changing environments and communities, and a growing confidence in themselves as experts in their own lives. The paper closes with some personal reflections on what we learnt as facilitators about the use of participatory methods. In particular the role of our own (and participants) tacit assumptions in framing approaches, and the need to open and flexible, to frame and reframe as process and outcomes shift.

(149words)

Keywords: Participatory Design, Citizen Science, Openness

INTRODUCTION

This short paper concerns a joint project between the OU in Scotland (OUiS) and the Trust for Conservation Volunteers Scotland (TCVS, a conservation charity). It looks at the use participatory design in a citizen science pilot with older residents of a semi-rural small town in central Scotland. It explores the evolution of the pilot from a study on methods to engage older people as an untapped set of data gatherers within the biological sciences to a broader focus on the outcomes for older people using these methods and a broader exploration of their lived experiences.

BACKGROUND AND CONTEXT

Our interest in participatory approaches had developed through our engagement with partners in the third sector, and we found participatory methods (Sanders and Stapper 2008; 2014) structured within a design framework an effective way to empower communities and individuals to bring new voices into academia (Macintyre 2014a). A critical component of this is the idea of learning for and through doing (Kemmis 2010). Learning through a series of structured inquiries is now part of the education landscape, underpinning “Citizen Science” (Scanlon 2012), where engaging people to collect data, creates benefits for those collecting the data as well as those in need of data. Indeed, one might argue the benefits for those collecting data while less concrete and falling under the banner of “Well Being” may be more important, as Citizen Science data is often ignored by professional bodies. It was these ambiguities that brought TCVS and OUiS together.

AIMS & Objectives

Older people have been neglected within discourses around Citizen Science. We wanted to explore how participatory design methods might be employed to develop ways of working suited to older people. While the initial conversations between partners was about exploring how we might realise the benefits data collection from this time rich group, it became clear these methods might tease out how to realise the benefits of these activities for the participants themselves. The objectives were as much about the process of engaging people in conversations about Citizen Science as any tangible methods for collecting data.

METHODS & APPROACH

Through TCVS network we developed a relationship with a day centre for older people located in a semi-rural small town with reasonable access to green areas. We started with a "town hall" style (40 participants) meeting where we introduced ourselves, the idea of collecting data and its benefits and our approach. Our approach to the community group leaned heavily on ideas around design thinking (Brown and Martin 2015) and participatory methods (Gregory 2003; Bjongvinsson *et.al* 2012). We emphasised that the role of the OUiS and TCVS was to enable and support volunteers to design and test solutions to Citizen Science that worked for them. In a sense we wanted to draw on and build their social capital (Bourdieu 1986; 2005) by placing lay voices within professional discourses (Fenge *et.al* 2011). We started working with a core group of 6 participants, though group size varied between 6 and 8 with floating members attending regularly. Each visit lasted about 2 hours. We met 12 times over a year.

WHAT WE FOUND

In this section we try to be open and honest about the process, surfacing our learning journey as well as being clear about what worked and what did not.

Small Steps

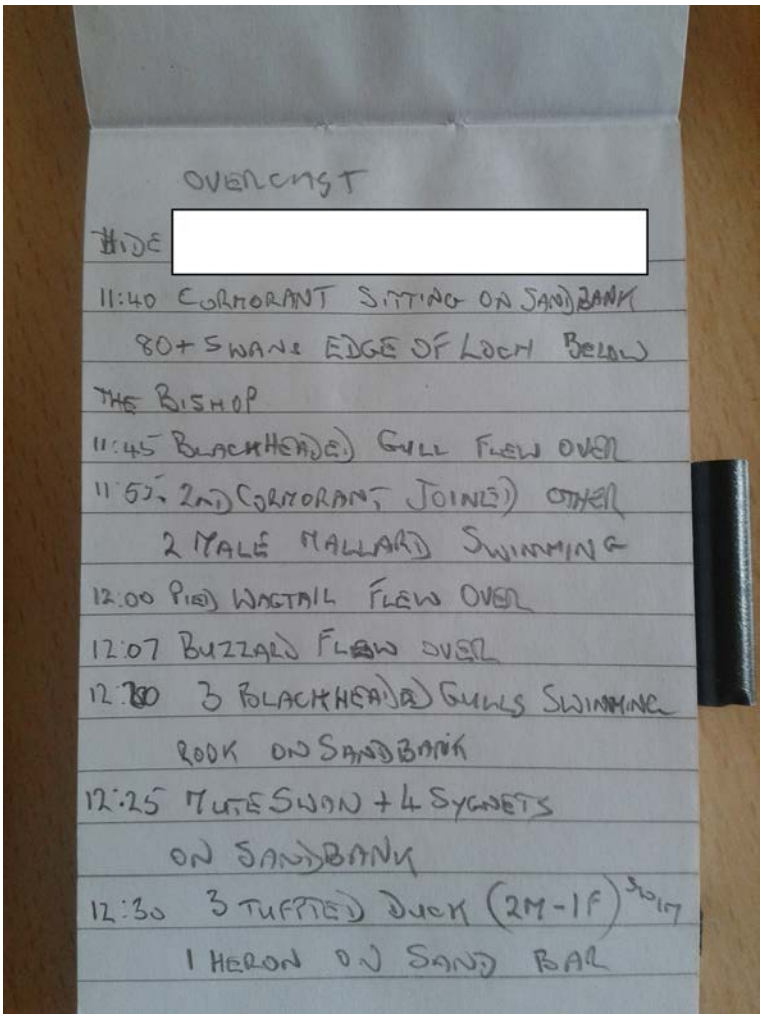
The idea of a design led approach was not familiar to participants, the language of "users", "prototypes" was too formal and technical, with too much focus on "designerly ways of knowing" (Dorst 2011). As our relationship with participants developed, talk about design became hidden, embedded in the process. We became confident and comfortable enough to stop talking and let things unfold. Later, reflecting on those early stages, participants acknowledged the language was only part of the problem. They were also unfamiliar with the form of engagement, they were more familiar with adapting to what was being offered, sometimes consulted, not designing. Our previous work had been with younger people who seemed to accept the role of designer readily (Macintyre 2014b). We are not trying to make a broad inter-generational point here about differences in capital (Bourdieu 1986), these participants lacked a sense of themselves as designers.

Mapping & Context

At the second meeting we asked people to draw a map of their world, the places they went, and try to think about the wildlife they had or might encounter. One of our assumptions was that people might not recognise that they encountered wildlife on a daily basis. Some were interested in wildlife already, this ranged from photography, to bird watching, and for one participant with visual impairments listening to bird calls. Their maps were the most extensive, as they also included they places they went to engage in those activities. Other peoples maps were restricted, and people began to reflect on mobility concerns, in particular being too far from home.

Many had been interested in wildlife when younger but became disengaged, either when they "moved away" from the countryside, but more often through "getting older". Mobility was a concern, so we asked people to "tell us what you see" in your everyday life, to draw these over their personal maps recording the locations and the species they encounter. The day centre co-ordinator was keen to organise special trips. However, mindful of sustainability, and mobility concerns we framed the possible solutions in relation to everyday practices. For the more mobile the network of paths within town and a local loch were everyday, for others it was their back garden. However, over the course of the pilot most did make "special trips" and got more confident about ranging further from familiar routes.

Figure 1: A Trip to a Local Wildlife Hide



Building Prototypes

When we started to explore how data might be collected participants wanted to record data immediately, many expressed concern about their failing memory and an inability to recall important details if they had to wait till they got home. Standard biological recording sheets were not seen as solution, as a series of A4 sheets lacked structural integrity, would likely be left at home. Our frame became, was it mobile, compact enough to be carried. We brought in some tablets and mobile phones, demonstrating approaches that might be useful. Participants felt, while they might cope, as they were a prototyping for “people like them” digital tools might exclude older

people without the access, opportunity or knowledge required to utilise them. Participants chose a notebook and pencil (see Figure 2).

Figure 2: A “Police” Notebook

Having decided on a form factor we then looked at function, participants were keen to collect useful data, and felt a standardised format was useful. Using the standard biological recording sheets as a template they developed a simplified proforma inserted in the cover page of each notebook. While the usefulness of the data was not the principal focus participants also talked through how if scaled up. They began to set out a telephone system where people were able to leave messages about their data. Interesting despite the initial rejection of technical solutions they soon became part of people’s own solutions, a keen photographer began to insert digital prints into

his notebook. In later visits along with the police notebooks people started to bring along recently purchased tablets with the OU Citizen Science app iSpot (http://www.ispotnature.org/communities/uk-and-ireland).

Figure 3: A Garden Visitor: Images Start to Appear

Beyond Prototypes

The prototype arrived quite quickly. However, we maintained our engagement with the group and our focus shifted from the design, to what it enabled. These discussions touched on a diverse areas. Often about what it means to get older, to become less mobile, the frustration that many of

the places they wanted to get to collect data meant reliance on infrequent public transport, uneven paths and worries about getting cold or wet. They were pushing themselves to do new things, go new places to collect new records, the notebook was changing their behaviour, encouraging them to go outdoors more often. Participants noted an increase in confidence to explore and health benefits in particular weight loss, which they attributed to being more mobile.

For some it seemed to rekindle dormant interests, those that had grown up in the country started to talk about their memories of nature, and this led to reflections on the changing role of nature in society, people being less connected, and also reflections on changes in the natural world; changes in farming practice over their lives, uncertainties about climate and what appeared to be more frequent dramatic weather events, earlier seasonal events, and the blurring of the seasons. They also spoke about developing new interests, most of the group had an interest in birds, but some developed an interest in plants and others insects, purchasing guides that allowed them to identify them and build their knowledge. This interest in plants and insects was often strongly linked to changing seasonal patterns and more general environmental observations.

One of the things we asked participants to do was test their prototypes with friends and try to grow their group through handing out prototypes. There was some success, but nothing significant, the group of 8 semi-regular attendees remained. Members began to reflect on community participation, citing examples of local clubs which had closed, the inability to develop or maintain an interests. They compared this to neighbouring towns of similar size, and noted they now travelled to these towns to attend clubs and events that used to take place locally. Participants returned to these questions again and again, and while numerous causes were cited, less settled population, too settled, too close to other towns, too many older residents, not enough older people with similar interests, it seemed odd that what appears a solitary and largely self directed activity like counting wildlife numbers led to reflections on the nature of community and their place within it.

DISCUSSION & CONCLUSIONS

The focus on everyday places, on what might appear banal locations and species provides a useful starting point, building confidence and as they so start to look beyond the everyday.

Prototypes, and “testing” of their affordances became less important, what became vital was the way the notebooks encouraged – engagement with the outdoors. The design process and the focus on using participatory methods to solve problems provides a structure to what might otherwise have been a meandering process. Not just for us as facilitators but crucially for the participants for which the design process provided structure, a set of tools, a topic and reason to make changes in their lives. In making those changes they confronted issues, from questions about mobility, to health, and even reflections on community.

If the intention had been to draw on peoples social capital to design inclusive approaches (Gedajilovic *et.al* 2013) the outcome was different. The focus of our relationship shifted from the design element to the participatory component. Our work shifted to listening to participants tells us about how they used these notebooks, to what they enabled. Data collection, and thoughts of capturing the knowledge faded and the focus became the practice of going out and collecting data. We certainly make no grand claims for the work we have done, what started on the fashionable end of learning and the use of design thinking seemed to have ended up as “old fashioned” community learning.

We started of with a set of tacit assumptions about older peoples lives and outcomes, assumptions that were challenged. Own own journey seems to illustrates the role of our social capital and tacit understanding in framing solutions within the design process (Corbett 2005). These frames are a key designerly tools. However, as much as they condition the exploration of problems and the ability to exploit solutions (Holcomb et.al 2009) in successful designs, they can also lead to things not working (Kahneman 2011). Participatory approaches allow us to make them visible, to explore the way we frame and reframe our approach (Dorst and Cross 2001) within our learning journey. What we have learnt is not to ignore assumptions, or try and erase them, but to be open about them and their role in shaping process and outcomes.

Word Count: 1983

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Postmodern picture books as hypertexts?

Postmodern picture book design as resource for cognitive learning.

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This paper is part of my postdoctoral research project called "Play, parody, intertextuality and interaction: postmodern Flemish picture books as semiotic playgrounds". The paper deals with the influence of new media on the design of 'older media', more specific contemporary picture books for children. It unites insights from postmodern picture book research with studies on hypertexts and new media. The so called 'loop books' by Flemish picture book maker Tom Schamp are used as a case study to look at how postmodern picture book design can be used as a resource for cognitive and interactive learning. Also a comparison is made between the use of spatial and temporal reading paths in the loop books and in hypertexts and new media.

Keywords: Picture books, new media, hypertexts, cognitive learning, postmodernism, visual literacy

INTRODUCTION

Against the background of our ever growing digital society, recent research has come to devote an increasing amount of attention to the role played by 'new media' and 'new literacy' in connection to children and learning (see e.g. Unsworth 2006, Cole & Pullen eds. 2010, Davidsen & Christiansen 2014). While many interesting studies are made about new media, it is at the same time interesting to ask ourselves how new media influence what we, in reverse, could describe as 'old' or 'conventional media'. One of the main questions in this paper will be if and how contemporary picture book design, within picture book research often referred to as 'postmodern' picture book design (Sipe & Pantaleo 2008), shows resemblance to the design of new media. In connection to this I will also discuss how postmodern picture books can be seen as multimodal artefacts designed for interactive learning.

As a case study I will be looking at fragments from a contemporary picture book, *Otto in de stad* (2008, 'Otto in the city'). The book is part of a series of four books by the (inter)nationally renowned Flemish picture book artist Tom Schamp about the cat protagonist Otto. In each of the books the reader gets to follow Otto on a journey throughout a landscape filled by (visual) intertextual references and visual and/or verbal puns expressed through the many characters and objects depicted in the detailed sceneries. In *Otto in de stad* the entire scenery consists of humorous intertextual references to the city of Brussels. Through verbal and visual puns existing shops, museums, buildings and places are referred to in an almost parody-like way.

Because of their specific visual and circular structure – the books can be read from cover to cover and can then be turned around and be 're-read' in the other direction as well – the books are promoted as 'loop books' by the publisher (in Dutch called 'lusboeken'). The loop books about Otto provide an interesting case study because they illustrate many of the typical features connected to cognitive learning in contemporary (postmodern) picture book research. Furthermore their design displays an interesting combination of traditional linear and sequential reading paths with 'newer' spatially organized reading paths comparable to those in digital texts or so called 'hypertexts' (cf. Bolter 2001).

INTERACTIVE LEARNING THROUGH POSTMODERN PICTURE BOOK DESIGN

During the last decades picture book research has come to devote a growing attention to the so called 'postmodern picture book' (cf. Lewis 2001, Anstey & Bull 2004, Allan 2012). Typical characteristics ascribed to postmodern picture books are the creative use of (visual) intertextuality, multi-layered play, the mixing of genres, media, (literary) conventions, 'high' and 'low' culture, and the explicit use of play and parody. All of these features are extensively present in the loop books by Schamp where they are used as metafictional tools to activate the reader and make him/her into an interactive meaning maker.

Just like so called 'wimmelbooks' (cf. Rémi 2012) the loop books can be described as (almost) wordless picture books that display large sceneries with numerous small details presenting several storylines or visual captions simultaneously. This wimmel-structure (the German verb 'wimmeln' means 'to swarm' or 'to be extensively present') makes the books highly 're-readable' as the reader can choose alternative reading paths and he/she can discover new details in each reading.

This feature of cognitive learning, but also the training of visual and verbal literacy, is typically connected to (almost) wordless picture books (cf. Arzipe 2014).

Although there is a verbal storyline present in the loop books, this is often restricted to single or short lines on each spread. These lines provide verbal comments and can play a more or less specific role in directing the reader's attention to the visual, establishing a relationship of referential interplay between words and images (cf. Van Meerbergen 2010). A distinction can be made between two types of verbal references in relation to the visual. Either the verbal line is giving a more general comment; in other cases it is directing the focus of the reader to a more specific (visual) aspect or scene.

An example of a more general verbal reference to the visual can be found on the first spread where the following statement is presented 'there is so much to see here [in the city]' (my translation), leaving the visual details to be explored freely by the reader.

Example 1. 'Otto wants an ice cream'

In Example 1 (see also Example 2) a more specific reference is made to a certain visual caption. The verbal line reads: 'Otto wants an ice cream' (my translation). This line implicitly activates the reader to look for more visual information about the topic in the accompanying visual scenery. When looking at the visual details Otto can be seen depicted in frontal inclusive perspective gazing at the reader and attracting his/her attention (cf. Kress & Van Leeuwen 2006).

Otto is holding up two ice creams while he is standing in between an ice cream stand and his father sitting in the car. A visual pun is created by the penguins and the ice bear inhabiting the ice cream stand. Furthermore the ice cream stand carries the inscription 'Ola Paola' in the depicted ice creams. Here a parody-like reference is made to the (Belgian) ice cream brand 'Ola' (in Sweden called 'GB Glace', in Denmark 'Frisko') and the former Belgian queen called Paola. This is then

combined with an intertextual play that is realised by the fact that Otto is standing in front of a park with royal lion statues by the fence (the lion's gaze also directed to the reader), creating a possible reference to the 'Warande Park' next to the royal castle in Brussels. On top of this a reference is made to a popular Flemish expression: "(h)ola Paola" (meaning 'take it easy, slow down').

This example illustrates the multi-layered verbal/visual and intertextual play that is typically to be found in Schamp's (loop) books, directed to readers of varying age and cognitive skills, but also readers with varying social and cultural backgrounds. In this respect the loop books can be described as typical 'crossover picture books', addressing readers of different ages and backgrounds (cf. Beckett 2006). By their use of metafictional features together with the multi-sequential ('wimmel') and multi-layered cognitive structure, these loop books put a high demand on the reader's involvement in the reading act. The reader is made into an interactive reader because (s)he has to connect (visual/verbal) information and actively construct meaning.

LOOP BOOKS AS HYPERTEXTS?

Because of their use of multi-sequential and multi-layered verbal/visual structure, the reading of the loop books can be compared to the reading of so-called 'hypertexts' or digital texts where readers can move around freely and click their way to new information (cf. Gunder 2001). In a similar way Hassett (2005:1) connects the use of metafictive devices such as "extensive cross referencing elements, evocative graphics, various pathways to follow, links to other meanings, and/or parallel displays of information" in postmodern picture books to the reading of hypertexts. Also Dresang (2008:42) describes the postmodern picture book as a "handheld hypertext" because of its use of e.g. nonlinear and multi-sequential structures.

In the loop books an interesting combination of both linear and multi-sequential reading structures can be found. The particular loop structure, connecting each page with the previous one in a visual way, provides the reader with a basic linear and sequential reading structure. This is enforced by the consequent use of (visual) pageturners, "encouraging the reader to turn the page and to find out what happens next" (Nikolajeva & Scott 2001:152). Pageturners typically create reader involvement and movement from one page to the next. While verbal pageturners often are realised through split sentences or words and split questions, visual pageturners can be realised through split depiction (of objects) and the expression of movement to the right (cf. Gressnich 2012).

In the loop books the pageturners often consist of a split depiction of roads and/or objects such as houses or different types of cars. This is shown in Example 2 where the Magritte Museum (and the inscription on the roof) is split in two from one page to the next. In addition the cars provide a clear movement from one page to the next.

Example 2. Split depiction and flow to the right

While the loop structure and the visual pageturners provide a linear reading path from cover to cover in both directions throughout the books, more or less multi-sequential reading paths are offered through the wimmel-structure on each spread. The loop books thus consist of an overall linear reading structure while at the same time combining spatial and temporal patterns on each spread, the latter described as a typical feature of new media by Martinec & van Leeuwen (2009:1). The reader is thus provided with a basic linear reading path while at the same time given the freedom to read and explore more freely on each page. This type of reading could be compared to the reading of digital texts where scrolling or sweeping is combined with clicking or touching upon specific information, choosing what information to access (Martinec & van Leeuwen 2009:9).

CONCLUSION

The loop books provide us with an interesting example of contemporary picture books where traditional reading structures, use of form, format and space are challenged in a playful way, showing many resemblances to what has earlier been described as postmodern picture book aesthetics. The many forms of intertextual and multi-layered visual/verbal play make these texts into multimodal semiotic playgrounds activating and stimulating the reader into (inter)active meaning making. The specific combination of temporal and spatial reading paths reminds us at the same time of the visual reading paths used in digital texts and new media. These findings might suggest that 'older media' are being influenced by and adapt to new ways of visual display and reading introduced through new media.

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Digital representations as an expression of learning and science culture

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ABSTRACT

This research project aims to develop designs for learning for science teaching. The objective of these designs is to make students aware of the affordances provided by representational modes and to qualify students' digital multimodal representations as part of scientific culture. As design-based research, this study uses a social-semiotic framework and builds on existing research. The project encompasses an identification phase and three iterative courses in which we develop and test the designs for learning jointly with practitioners.

Keywords: Science education, digital representations, multimodality, design-based research

INTRODUCTION

In Denmark, a great deal of attention is generally directed toward integrating digital technologies in primary schools. Nevertheless, digital technologies are only used to a limited extent in science teaching. This is because a gap exists between teachers' current understanding of how learning takes place in school subjects and the digital possibilities that are offered and expected to be used in primary schools (Søndergaard & Hasse, 2012).

The new technologies enable the creation of digital representations. Thus, digitisation allows teachers to orchestrate the presentation of material in new ways, and students can similarly produce new representations for academic concepts and contexts. According to an Australian study, however, science teachers tend to choose representational modalities with the aim of

accommodating their students' differing learning styles rather than as a way of conveying science content (Prain & Waldrip, 2006).

As a field of discourse, science mixes various multimodal forms of representation (Tytler et al., 2007). For example, scientific concepts are represented through verbal language, graphics, diagrams and other visual representations (Prain & Waldrip, 2006). One can thus argue that working with multimodal representations in science classes plays an essential role in involving students in scientific culture, which makes it an especially apt way of working with the subject itself (Murcia, 2010). According to Jens Dolin (2005), "*Mastering a subject area requires the ability to express it in all its representational forms and to switch freely between them – this is a great demand to put on students and something only learned if it is the explicit objective of the teaching.*"

The aim of this research project is to team up with professional practitioners to develop designs for learning that makes students aware of the various affordances provided by each representational mode and that supports the students in their work of producing digital representations of scientific content as an expression of learning.

There is a gap in existing research regarding the possibilities digital tools offer when it comes to representation in a classroom setting: "*... greater understanding of the impact of digital tools on learning and teaching is required as they have the potential to change the way knowledge is represented and re-represented*" (Murcia, 2010).

Research also offers a basis for considering this avenue to hold a learning potential for students: *"This exponential growth in personal digital technologies coincides with a growing body of research which suggests that getting students to create a multimodal representation of a science concept is a good way to enhance learning"* (Hoban & Nielsen, 2010).

This leads us to the following research question: How can designs for learning in science teaching be constructed with a view to qualifying students' awareness of the conceptual affordance provided by representational modes and their production of digital representations as an expression of learning?

THERORETICAL POSITIONS

The theoretical framework of this study is a social-semiotic view of representation and learning. In terms of learning theory, social semiotics sees learning as “a sign-generating activity” that takes place within the framework of a didactic design. In social-semiotic thinking, a representation of any form of meaning is *criteria-based* (Kress & Van Leeuwen 2006). Consequently, a number of “authorized” representations have been developed for communication (and thus learning) in the individual subjects. With regard to the work with representations in science, the study is also informed by Vaughan Prain’s and Bruce Waldrip’s comprehensive work in this field (Prain et al., 2012).

The designs for learning proposed for this study thus builds on existing research. Tytler et al. (2009) have formulated some key principles for effectively planning, implementing and evaluating courses in which students work with constructing their own representations of scientific concepts. The teachers’ selection of central academic concepts is crucial in the planning phase. Students’ learning is reinforced if they are introduced to and work with the different representational modes (Waldrip, 2012a). Thus, it is essential that students understand that a single representational form cannot meet all objectives or cover all the aspects of the content being taught.

In addition to the aforementioned initiatives, Hubber et al. (2010) emphasizes that representations must be introduced and used as thinking tools and not merely as a self-contained unit to be learned. The work with representations must be continually coupled with practical activities and objects, and sufficient class time must be allocated to exploring the explicit meaning of the various representations.

There is little research on digital representation in science teaching in primary school classrooms.

METHODS

The project takes a design-based research (DBR) approach. In phase one of the study, we identified problems posed by the existing research, as well as the gaps therein. We also identified some problems occurring in current practice, for example, that science teachers have low awareness about representational modes.

In phase two, we involved the participating teachers in validating the problems identified and

developing proposals for solutions. Against the background of the theoretical positions outlined above from the research literature, researchers and teachers joined forces to create a preliminary design for learning.

In phase three, the design was tested in practice with two teachers and 60 students. The researchers observed the teaching sessions, their aim being to determine whether the design was viable. The classes were videotaped, and individual students were audio-recorded as a basis for subsequent analysis. After each teaching session, the researchers talked with the teachers about the design's viability and legitimacy. Ultimately, the students' digital products will be analysed and evaluated with respect to the efficacy of the design. The project is currently in this phase.

The data analysis will focus on the correlation between contextual factors and the use of the concrete design. The goal is to explain what does or does not function, what can be improved and whether the design can be applied in other contexts. In the spring of 2016, two iterative courses will follow, in which teachers and researchers will jointly create and re-test the new design. The aim will thus be to establish empirically founded design principles and some theoretical statements that transcend the local context.

PRELIMINARY FINDINGS

In this paper we outline a few preliminary points related to the design for learning for a microbiology unit with an inquiry-based approach. The design can basically be divided into four stages. In the first stage the students are introduced to what a variety of representational modes can accomplish and how they complement each other. This knowledge forms the basis and the scaffold for students' progress in the subsequent three stages. In the final stage, students create a multimodal digital product.

In the first stage, the students work with protein synthesis as a transition from an earlier unit on genetics. Various representational forms about protein synthesis, including text, a visual representation and an animation, are distributed to the groups of students. Using the representational form assigned to their group, the students are tasked with finding out what protein synthesis is all about. They then meet with the other groups and attempt collectively to describe

what their own representational mode has contributed to their understanding of the biological process. Next, they attempt to piece together a common understanding of protein synthesis by combining all the representational modes into a coherent whole. At the conclusion of this activity, all participants in the session follow up with a plenary meta-discussion about the affordances inherent in the various representational modes, with the students' personal reflections and recognitions forming the basis for the talk.

To a high degree the exercise proved to heighten the students' awareness of the affordances provided by the individual representational modes. This activity will therefore definitely be incorporated into the next stage of design development. In the collective dialogue, the students commented on and compared, for example, the possibilities and limitations of the various representational modes as follows:

"The text can describe things specifically and give details, provide some academic concepts, describe precisely what happens."

However, a student also said:

"It was a little difficult to understand everything that was written, because sometimes it can be difficult to visualize … That's maybe the disadvantage of the text."

With regard to the illustrations, the students expressed the following sentiments, among others:

"Illustrations can do things with colours, sequences and what is highlighted and stuff like that."

"*The disadvantage is that if I hadn't known it was about protein synthesis, I wouldn't have known what it depicted other than something about DNA."*

As to the animations, the students noted:

"The animation is easy to understand; it showed exactly what was happening and when."

However, another student felt: *"The animation is good if you are very visual, that is, if you need to see the things visually … I think the animation really needed some text, because if it hadn't said that the 'Pac-Man' there was an enzyme, I certainly wouldn't have grasped that that was what was happening."*

In the subsequent plenary discussion, the students and teachers concluded that it was precisely the combination of the various representational modes and their respective affordances that generated a true understanding of the academic topic – protein synthesis – in the best possible way.

Building on this recognition, the students worked further on planning a microbiology unit. During the planning process, they were to reflect on and explain how they would conclude the unit by presenting their work process and findings in a multimodal digital production employing the various representational modes.

The results of these multimodal digital products, for which roughly half the students chose to make films and the other half chose posters, indicate that the students are able to combine their own text, images (photos), their own illustrations and audio-visual animation at an scientific meaningful level, as well as to explain their choices.

These findings are intended to contribute to determining the long-term viability of the design for learning and its potential to enhance understanding among students through their reflections and choice of representational forms, and potentially to help enable the continuing and meaningful integration of IT into school subjects.

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Augmented Reality as Wearable Technology in Visualizing Human Anatomy

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Keywords: augmented reality, theory-generating practice, wearable technology, visual anatomy learning, IBSE

INTRODUCTION

This paper presents an investigation that aims to enhance understanding of augmented reality (AR) as an interactive affordance in the meaning-making of the lungs and respiration system in anatomy and physiology in a nursing education setting through the application Anatomy Alive.

The technology and the visual image of the lungs in human anatomy gives the students access to wear 'real' pictures of lungs 'in situ'. The design focus of the visual image has the purpose of stimulating sight, and the development of the technology of the app is based on a principle of design related to photographic resemblance of the lungs so it can be used as wearable technology (Buhl & Rahn, 2015).

The aim of the investigation is to explore how AR as a wearable technology and as a connection between technology, body, and picture in a pedagogical setting, based on Inquiry- Based-Science-Education (IBSE) and a theory-generating practice, can facilitate learning about the complex anatomy and physiology of the human body.

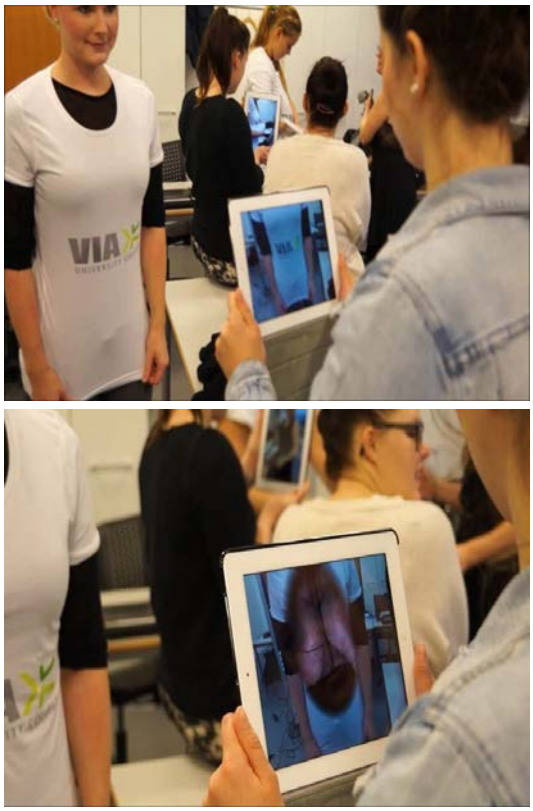

Figure 1: Students with the T-shirt logo and an iPad. Figure 2: AR-picture of the human lungs applied on student

The research question is how AR can be involved in nursing education as a pedagogical affordance to facilitate learning of human lung anatomy and respiration. The hypothesis is that the IBSE-approach together with AR-pictures projected directly on the body—as a wearable—can facilitate visual learning as a way to knowledge acquisition.

RESEARCH METHOD

The project was designed according to a design-based research (DBR) method (The Design-based Research Collective, 2003; Amiel & Reeves, 2008). DBR searches to design a change and at the same time test what happens in three different iterations when the change is being implemented for the purpose of generating new knowledge and an improved practice (Buhl & Rahn, 2015).

The hypothesis is that this approach, together with AR projected directly onto the body, can facilitate visual learning as a way to knowledge acquisition. Through

guided-inquiry, the lecturer submits a problem to be solved, and the students themselves control how the problem is to be solved and investigated (Frisdahl, 2014).

Methodologically, it is based on theory-generating practice, which is constructed on the idea that in the act of processing information knowledge is generated about a content, which through reflection is being externalized and conceptualized (Buhl, 2013b; Buhl & Ejsing-Duun, 2015).

Theory-generating practice describes using video as a mean to academic improvement. The theoretical framework is based on the idea that learning results from situations where practical experience is transformed into theoretical knowledge. These situations are called theory-generating practices, and they contain a methodology that connects bodily presence and analytic distance to empirical data (Buhl, 2013a).

Learning, teaching, and facilitating can be seen as social and perceptual practices, where all the participants—students, lecturer, and technology—in the given context are actors in a process in which there is generated knowledge.

In this study, theory-generating practice is used both to investigate students' use of AR and as an approach to investigate a lecturer's methodology used in the analysis of the practice where AR is used.

The bodily experience of being present in the learning situation is important; the students include their own bodies in the learning process by 'wearing' the lungs 'in situ'. The bodily experience and the inter-relational exchange in the learning situation affects the meaning-making of a situation.

The methodological approach of theory-generating practice that the lecturer uses, shows how it can be worked with video recordings of an instructor teaching a lesson and the investigator taking part in the lesson, and how both are using the video recordings as analytic material.

The goal is to generate data that can be used in the development of education and research. One gets a double role as lecturer and investigator, which means that one, as a lecturer, internalizes how the pedagogical IBSE approach to education takes place, and one internalizes as the investigator knowledge about it, when investigating with a video recorder and analysing of the recordings. It can be difficult to have an

analytical distance from my one's teaching, and the distance shall make one capable of adding a theory-based perspective on one's teaching profession and creates possibilities for improvement.

EMPIRICAL FRAMEWORK

The application Anatomy Alive was iterated three times in anatomy and physiology lessons (60 minutes) in three different classes. The lecturer is a facilitator through the lesson and the investigator of the empirical data (Buhl, 2013a). The data is empirically based on three iterations according to DBR, including 25, 30, and 25 nursing students in an anatomy and physiology lesson, where the class was divided into six groups and the students were given a problem to be solved together in the group (Buhl & Rahn, 2015).

The empirical data consists of video recordings of the lessons and the students' written assignments and their evaluations of the lessons. The analysis of data was done according to Bezemer's and Jewitt's multimodal approach (2010) for the purpose of identifying the relation between technology, body, and picture in the specific use of the app in a situation of learning.

The analysis of the data illustrates what students do in describing what they visualize from the application, how they interact in the room, and how they are in search of knowledge from the app.

RESULTS

The aim of this paper was to explore how AR as a wearable technology and as a connection between technology, body, and picture in a pedagogical setting based on IBSE and a theory-generating practice could facilitate learning about lung anatomy and respiration.

The results show that with the IBSE approach the students can take the time and the actions around the AR picture that are necessary to understand the lungs in the human body, as opposed to when the teacher is setting the pace for teaching the subject.

The students in the first and third iterations showed involvement and that they are explorative in the process and their observations. The students showed surprisingly elaborate responses in their written assignments. The video recordings show that in first and third iterations particularly actively groups of students in discussions, eager to share their observations with each other. The students showed openness about their knowledge and how their observations on the iPad are understood.

The progression of the process was stopped by the technology's lack of capacity; the capacity is to show the lungs from front and behind.

The results from the three iterations show how attempts at improvements of technical issues in the application leads to improved quality in the learning process. An improved illusion of the ability to see the lung was created, because in the first iteration the picture was shaking, and the students wondered about this.

Another technical change between the first and second iterations was on an institutional level about the app and increased focus on availability, spread, and making the app user-friendly (Kjærgaard, Kjeldsen, & Rahn, 2015). This resulted in fact that the image was been projected onto paper, which was applied to the use of the app in the second iteration. In contrast to the T-shirt, the paper evoked something else, and the interaction between technology, picture, and body was in many ways lost in the second iteration, and the students changed their behaviours. The students did not move around the body the same way they did in first and third iterations. Some groups took the image of the body and put it on the wall to better see the picture, as a picture in a textbook. The paper created a book-reference rather than a body-reference, and the students established the situation and communication with the cultural references—in this case a book—that they are used to using.

The fact that there was movement created when the picture was projected on a physical body seems to establish a linkage that creates special advantageous conditions to visual learning. What is unique is that the lungs are shown with the movement of a 'body in situ', and there is no need to transform knowledge from a 2D-model from the textbook to the physical body. It seems that the involvement of the physical body makes the cognitive translation easier between codes and meaning.

The analysis of the video recordings in all three iterations has revealed some ethical perspectives relating to obese students' body appearance when wearing the T-shirt with the image versus the image printed on paper, because the T-shirt must be very narrow or else the AR picture does not appear.

These empirical findings were becoming apparent after three iterations, when the obese students were being modest and would not wear the T-shirt and have the same participation in the group as the other students with normal body appearance. This will have an impact on the way technology wearables are designed in the future and needs to be considered so as not to exclude certain users.

The problem could be solved with an AR technology that is real-time sensor-based and not dependant on a T-shirt, but rather on small tags that are placed on the body. The ethical considerations of bodily inclusion and obstacles would be interesting to investigate in further studies.

The three iterations indicate that there is visual-learning potential in the use of AR as a wearable technology when it is connected with an IBSE approach where the students are supported in an explorative and problem-solving practice of learning.

Results from the first iteration are further described in Rahn and Kjærgaard (2014), and results from first and second iterations are described in Buhl and Rahn (2015).

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Challenges in designing for horizontal learning in the Danish vet system

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As part of an on-going research project (2015-2017) at The National Centre for Vocational Pedagogy, Metropolitan University College, we are studying why and how vocational teachers understand and design for boundary crossing through the use of ICT-based artefacts. The research project is based on a sociocultural framework with cultural-historical activity theory (CHAT) guiding the initial phases. In this short paper, we present preliminary findings based on six ethnographic interviews with vocational teachers, and we zoom in on the teachers' experiences with central elements of their bounded systems. We found that these teachers use ICT as mediating tool within a single system, but rarely as boundary object in and between systems.

Keywords: Vocational Education and Training, CHAT, boundary crossing, boundary objects, ICT

VERTICAL AND HORIZONTAL LEARNING IN THE DUAL VET SYSTEM

In the Danish dual Vocational Education and Training (VET) system, students oscillate between school and workplace periods throughout their education. Making sense and use of learning in and from different contexts and experiencing continuity between school and work has long been considered a major pedagogic-didactic challenge in Danish VET research resulting in a continuous focus on the transfer phenomenon (Aarkrog, 2010). Based on a pre-study of vocational teachers' use of ICT conducted in 2014 (Riis, Bergstedt, Rasmussen, *unpublished*), we noticed how the teachers attributed a transfer (and sometimes boundary crossing) potential to the use of ICT in teaching and learning processes across different contexts, leading to our current research project.

The main research question investigates why and how vocational teachers understand and design for boundary crossing through the use of ICT-based artefacts.

Both in research (Lobato, 2006; Engle, 2012) and among practitioners transfer is a contested concept. In this study, we adopt Engeström and colleagues' concepts of vertical and horizontal learning, polycontextuality, and boundary crossing (Engeström, Engeström & Kärkkäinen, 1995; Tuomi-Gröhn, Engeström & Young, 2003), as a way of challenging the traditional notion of transfer understood mainly as a one-time and one-directional transition between a context of acquisition and that of application. As stated by Engeström et al. *(ibid.),* learning can be conceptualized as both a vertical and a horizontal process. In the former, focus is on learning in a single social system (e.g. in a school) often times based on a narrow, hierarchical view of knowledge and expertise. Conversely, in the latter perspective, learning is based on a broader, multidimensional view of knowledge and expertise and focus is on transitions or crossings in and between multiple social systems (e.g. in and between school and workplace). A horizontal view on learning and transfer understood as boundary crossing, seeks to find productive ways of relating intersecting dissimilar practices (Akkerman & Bakker, 2012), potentially accommodating the inherent contradictions of a dual education system.

BOUNDARY CROSSING AND BOUNDARY OBJECTS

According to Akkerman & Bakker "(...) a boundary can be seen as a sociocultural difference leading to discontinuity in action or interaction." (2011, p. 133), and boundary crossing generally refers to an individual's transitions and interactions across different contexts. Although discontinuity may be perceived negatively at a glance, in the third generation of CHAT, boundaries understood as contradictions in and between elements and systems, are seen as carrying potential for learning, change, and development. In any activity system, activity is object-oriented, and artefacts (signs or tools) are attributed mediating properties. Whether a mediating artefact functions as a boundary object depends on the purpose and use. In order to function as a boundary object, the artefact needs to inhabit and bridge intersecting practices (Star, 2010), which is not necessarily the case for all mediating signs and tools.

METHOD

The research project is designed as a multiple case study (Yin, 2009) with interviews, observations, and design experiments as primary methods to generate and collect data in different phases of the project. In this short paper, we focus on findings from six ethnographic interviews conducted in the preliminary research phase of the project. Building on Spradley's (1979) ideas of descriptive questioning, and questions loosely structured around the elements in a third generation activity system, we interviewed six vocational teachers from the three dominant strands of the Danish VET system (technical, business and social- and health schools). As stated by Spradley (*ibid.*), descriptive questioning aims at uncovering the informant's personal experience with the practice and phenomenon under study by way of having the informant elaborate through thick descriptions and examples, often times by repeating and rephrasing questions.

In our analysis, we have been inspired by Rogoff's (1995) three planes of sociocultural analysis, meaning we have focused on the personal, the interpersonal, and the institutional/community levels respectively. Here, we zoom in on the personal plane, concentrating on the teachers' experiences with transfer and/or boundary crossing in their particular bounded systems settings.

PRELIMINARY FINDINGS

We are still in the process of analysing data, but preliminary findings show that the teachers predominantly work with and design for transfer as a vertical learning process. All teachers use different types of ICT in their teaching, however, mainly as mediating tools within the school's educational logic. Video is a preferred tool when trying to establish a connection between theoretical and practical activities at school - not between school and workplace. Another example is an electronic platform called "Student plan", which was designed to function as a boundary object with the possibility for students, teachers, and trainers to contribute. All six teachers use this platform as an administrative tool, not as learning or transfer tool. Their students do not contribute to the platform, and according to the teachers, most trainers do not find the tool useful.

While the teachers fully understand the need for boundary crossing, and thus also consider transfer as a horizontal learning process, they highlight different system boundaries, they find

difficult to handle. Some of the challenges, the teachers experience when trying to move from a vertical to a horizontal view of learning and transfer, will be presented.

FUTURE DIRECTIONS

Based on the aforementioned interviews, we have chosen three different VET schools as field sites. Currently, in the second phase of the research project, we conduct classroom and workplace observations combined with student and trainer interviews. While observations and interviews provide valuable data, we anticipate creating design experiments focusing on ICT as boundary object with the VET teachers, in order to better grasp and understand not least the sociomaterial aspects (Fenwick, Edwards & Sawchuk, 2011) of designing for boundary crossing.

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Designing a Visual Programming Platform for Prototyping with Electronics for Collaborative Learning

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This paper presents the on-going design and development of a new prototyping platform for physical computing that provides tools for practice-based collaborative learning. The research aim is to design an easy to use and more collaborative platform to support explorative educational activities. The prototyping platform is part of a larger project that consists of a purpose-built learning environment with multiple sensors to collect data during practice-based activities and provide learning analytics. The paper reports on three iterative phases from paper prototype to initial working system. The results point towards to a more collaborative and easy to use prototyping platform that shows the potential of supporting learners.

Keywords: Design Methods, User studies, Prototyping, Physical Computing, & Learning Analytics

INTRODUCTION

Over the last decade, researchers and practitioners have provided strong cases for the value of hands-on activities with physical computing as a key part of the toolbox that brings powerful ideas, literacies, and expressive tools to learners (Blikstein, 2013). Physical computing in the context of education can be broadly defined as using microcontrollers for building digital devices and interactive objects (Kushner, 2011). This process, also known as 'building with hardware', requires working in two disciplines at once: programming and electronics. This dual challenge provides an opportunity to create tools that enable learners to prototype their projects and to realize their visions more easily, which can inspire deeper learning and exploration (Friesel, 2013). The objective of this paper is to present the on-going design and development of a new prototyping platform for physical computing. In this paper, we focus on the design of the prototyping platform with electronics with the aim to explore the following research aim:

What design knowledge to we from the investigation of how to create an easy to use and more collaborative system for physical computing that can support explorative educational activities?

In order to investigate the research aim, we present TALKOO, a prototyping platform that combines tangible programming blocks with a visual programming environment. In the paper we present the evolution of the concept from a paper prototype to first working release and report on how the involvement of learners has helped shape the process of design and development.

PROJECT BACKGROUND

TALKOO is an educational platform that combines physical prototyping with a visual programming interface to allow learners to rapidly prototype ideas. TALKOO is part of the PELARS[1] project that consists of a purpose-built learning environment with multiple sensors to collect data during practice-based activities. The PELARS project learners are university students in design and engineering, and high school. The learning environment is a designed workshop table connected to a freestanding wall with a built-in display (see Figure 1l). The learning analytics system (LAS) collects data from a computer vision system with facial and object tracking (fiducial markers), log files from the programming of physical prototyping platform kits. There is a mobile system that allows the learners to document their work in a form of annotation of different phases during the activities. TALKOO is designed to automatically recognize physical blocks (new Arduino based boards) connected to it. Those blocks are reprogrammable sensors and actuators. When recognized, a visual programming interface will display them allowing the users to directly map and control the relationships between the blocks (see figure 1).

[1] http://www.pelars-project.eu/

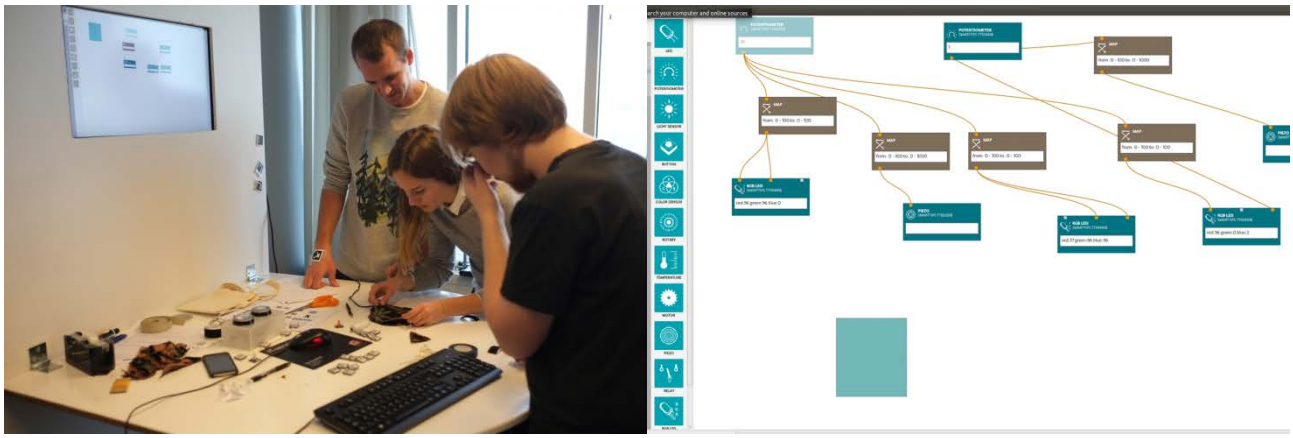

Figure 1: PELARS workstation on the left and the visual programming interface on the right

BACKGROUND

There are several research efforts that combine physical prototyping with different visual programming approaches. Adapting and building from existing designs is a common practice for learners when learning physical prototyping and this includes programming. (Petrelli et al., 2014) point to the importance of prototyping and how using existing designs to improve the process helps learners expand the understanding of their design. Yet, breadboards, wires and soldering are intimidating to learners, making both realizing and iterating designs a challenge (Chan, Pondicherry, & Blikstein, 2013). Booth and Stumpf (2013) argue that learners using visual programming languages (VPL) have an easier time adapting code from other projects and have a more positive experience than learners using traditional text-based interfaces. Using physical representations of the code also helps the learners think about how to code. While the above efforts contribute to the state of the art in this area, their impact on collaborative learning has not been fully explored. TALKOO brings together the visual programming paradigm with tangible user interfaces to support collaborative learning and rapid prototyping a well as it provides analytics based on the learning activities.

METHODOLOGICAL APPROACH

The overall project that, TALKOO is part of, adopts a design driven approach that brings together design-based research efforts (Mor & Winters, 2007) and human-centred interaction design (Björgvinsson, Ehn, & Hillgren, 2010). For the development of the platform this paper reports on three key phases that start with a low-fidelity paper prototype, a beta product, and version 1 of TALKOO. Once the initial concept was developed, we conducted a user study with a low-fidelity prototype. From these results, we designed and developed a high-fidelity prototype that was tested at an event where designers and developers worked directly with learners to get feedback. The next version was then developed and put into the user trials of the main project where learning analytics data was collected and a software usability scale test was conducted. The details of the product design phases and different approaches are presented in table 1.

No	Phases	Context	Level	Approach	Users
1	Low-fidelity	University Research Lab	Paper Product	Wizard of Oz, User Study interviews and survey	10
2	Beta Product	Ars Electronica Festival	Prototype hardware software	User study - Design analytics and conversations	14
3	Product	University Research Lab and Informal Learning Center	Product v1	User study - Analytics, survey, interviews	27

Table 1: Product design phases and approaches

Phase 1: Low-fidelity Prototype

For the first study a low-fidelity TALKOO kit was created. The kit contained foam-core versions of the hardware blocks with strings to act as the cables connecting them and was designed to facilitate the initial exploration of affordances and requirements. The visual programming environment was simulated by manually placing the virtual representation of the connected blocks on the magnetic board representing the programming interface by a researcher (Wizard of Oz). The virtual blocks were ‘connected’ on the screen using a whiteboard marker (see figure 2). Ten university students from engineering and design were recruited into 5 low-fidelity sessions.

Figure 2: Low-fidelity sessions

Each session took around one hour and consisted three brief tasks to introduce the system along with one larger task to design a musical instrument. Afterwards the students filled out a questionnaire and participated in a semi-structured interview.

Phase 2: High-fidelity Prototype

During the Ars Electronica 2015 festival, we conducted several interventions. We recruited 14 participants (high school students) for 3 workshops. Each of the workshops was shaped as 'a design challenge', where the participants received the task to protect a candy shop from fire, earthquake, robbery or any other possible calamity. The participants were introduced to TALKOO in a 15-minute session. The teams had 40 minutes to prototype their solutions. At the end each group presented their ideas as well as how they went about implementing it, and after a brief discussion among a small jury (composed of four researchers from the project) the winner was decided.

Phase 3: User Trials

The project has conducted its first round of users test of the system with 27 participants, nine groups of three students (except one group had 2 students). The user trial procedure was for the trials was a pre-survey to determine the students experience with elements of physical computing and experience with group work, an introduction to the TALKOO system. Then the students were

given the same design challenge of designing an interactive toy. After the session, the students were given a post-survey (see figure 3).

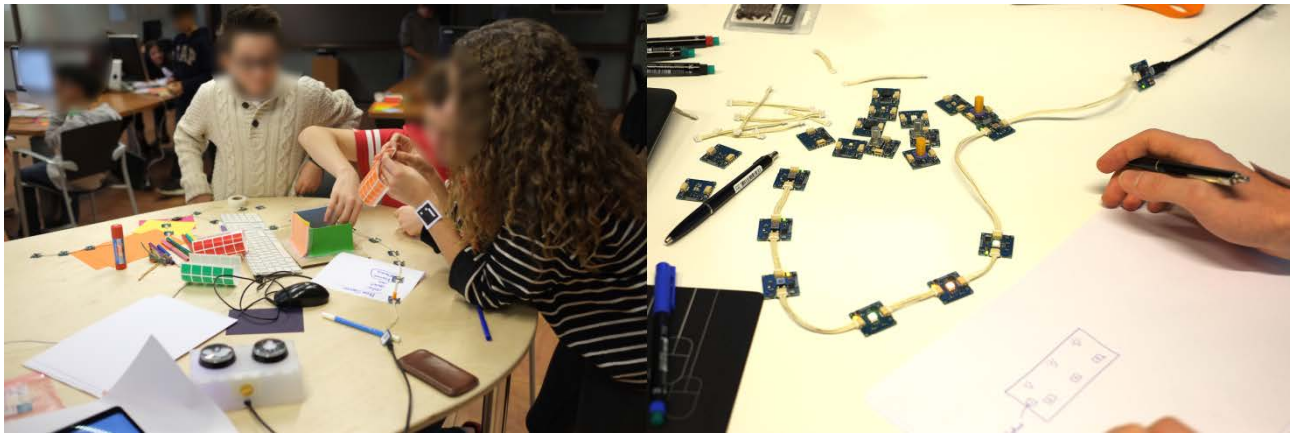

Figure 3: PELARS user trial and close up of the TALKOO components

The PELARS system captured the motion of the hands and the position of the faces, the log files of the TALKOO platform, and the learner created documentation via the mobile system.

ON-GOING FINDINGS

The paper prototyping and the "wizard of Oz" approach of phase 1 provided insight and feedback from university students on their perception of prototyping with the blocks and the visual metaphor. These sessions illustrated the potential of TALKOO to support stronger communication and quicker prototyping in the pairs. From the Ars Electronica Festival we explored the interaction data from the TALKOO platform and observed from the analysis of the design challenges and the system was able to support successful means of interaction.

From the user trial results with TALKOO integrated into the PELARS LAS together with the surveys point towards that the learners were successfully able to prototype interactive toys. From the analytics perspective, the PELARS system collects data from the interaction of the TALKOO system, the movement of the arms, where the faces are looking, and how the learners split up their tasks based on the mobile tool (see figure 4), namely, planning, building and reflecting. The data

currently being analysed from the LAS show that different groups with good or poor solutions have related but different patterns of collaboration similar to the results of Atman and colleagues (2013).

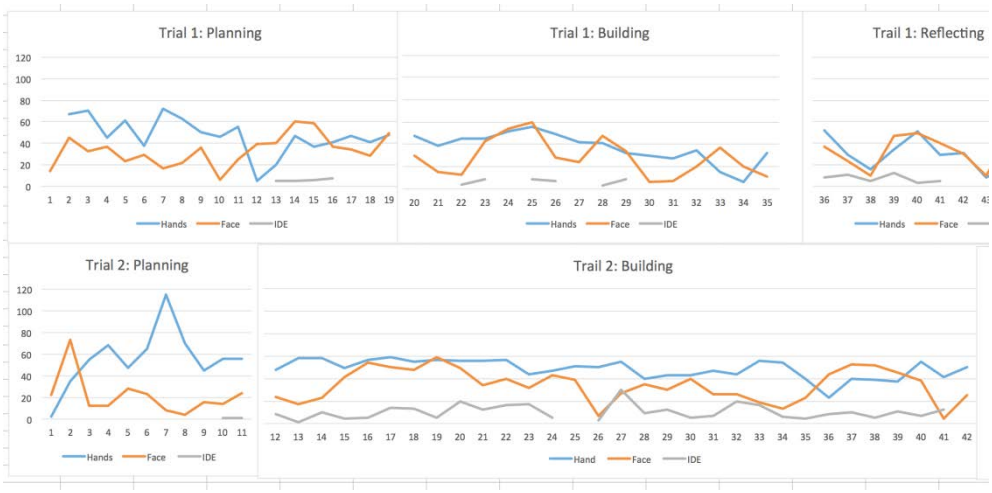

Figure 4: Initial comparison of two groups split of and analytics

DISCUSSION

We set off to investigate the design knowledge and outcomes in the creation of an easy to use and collaborative system for physical computing and to provide support with meaningful learning analytics. Across the different interventions users found TALKOO engaging and beneficial for communication and collaboration when prototyping with physical computing. More technically experienced participants in our studies consistently requested more advanced features, and the opportunity to construct more complex projects. This leaves us with the challenge of creating a visual programming platform that provides easy entry for beginners but rich features for advanced users. Which in turn is presents itself as a design challenge for the next part of the project.

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Dimensions of Usability as a Base for Improving Distance Education: A Work-In-Progress Design Study

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This educational design study investigates a Master's Degree programme for engineers, in which a third of the programme is undertaken as online studies. The aim is to improve the efficiency and the learning and teaching experiences of both students and lecturers by, for instance, reducing technical constraints and manifesting a new learning culture grounded in the affordances of digital tools. The results from the first phase of the study show five dimensions of usability brought forth by participant interviews: technological, pedagogical, social, metareflective, and collegial.

Keywords: educational design research, distance education, higher education, ICT

INTRODUCTION

Distance education is more demanding for students, as it provides new kinds of responsibilities and forces them to be active learners in other ways than in traditional classrooms (Cilezis, 2014). This educational design study investigates and develops a distance education design of a Master's Degree programme for engineers by evaluating and iterating the educational design. The aim is to improve the design by, for instance, reducing technical constraints and manifesting a new learning culture grounded in the affordances of digital tools (cf. Watters, 2012).

Energy and Environmental Technology (EET) is one of the main subjects at the Faculty of Science and Engineering at Åbo Akademi University (ÅAU), in Turku, Finland. The M.Sc. programme on energy technology has developed as a partnership between ÅAU and Novia, University of Applied Sciences in Vaasa, due to the demand by the local industry representing Finland's largest energy cluster. The programme has to this day had 56 enrolled students. Approximately one third (120

ECTS) of the compulsory courses are delivered via Adobe Connect, which affords recording lecturers and various options of content display, video, quizzes, polls, notes, PowerPoints, etc. (see Figure 1).

Figure 1: Screenshot example

RESEARCH DESIGN

An educational design research approach was applied, which involves iterating and improving an educational design through phases of problem analysis, redesign, and evaluation. It is referred to as “messy research”, as data is collected from many sources to form a thorough understanding of problems (McKenney & Reeves, 2012). Presently, we are at the first phase of problem analysis focusing on unveiling difficulties and needs of lecturers and students. It also involves a literature review of how similar problems have been solved in previous research. This phase has engaged a team of IT-pedagogues and educational researchers, media production experts, study advisor, professors, lecturers, and students. Multiple methods were used, such as questionnaires, observation, and interviews. During the interviews participants (4 students; 7 lecturers) watched 14 short examples of recorded lectures to guide the discussion.

In this paper, we present the findings from the qualitative content analysis of the interview transcripts, aiming to unfold the meaning of students' and lecturers' experiences. Repeated listening to the recorded interviews preceded transcription (28,144 words), and was then read by two researchers. Meaning condensations (n=377) were made for selected content units and were then coded and categorised.

RESULTS PHASE 1: FIVE DIMENSIONS OF USABILITY

The findings from the interview data during Phase 1 of the study revealed needs for improved usability of the distance education. In the context of learning, the term usability refers to more specific needs than the general usability concept implying ease-of-use, functionality, and satisfaction (Nokelainen, 2006). We separate the concept of usability into five dimensions: technological, pedagogical, social, metareflective, and collegial.

Technological usability

This dimension highlights how end-users are able to use the technology for the intended function to a satisfactory level (Bevan, 2008). Both students and lecturers experienced technical problems, of which audio problems dominated. This was accentuated by the fact that lecturers had to juggle two or more groups simultaneously, including both face-to-face students and distance students.

Pedagogical usability

This dimension includes how teaching the content is enabled in relation to the affordances and constraints of the distance learning context (Nokelainen, 2006). Here, issues of adapting didactical and pedagogical content knowledge to the digital context was highlighted (cf. Mishra & Koehler, 2006). A major concern pertained to difficulties created by having face-to-face students and distance students present simultaneously during a lecture. This situation was not only technologically and didactically problematic, but presented issues of inequality between the two groups. For instance, the distance students were often referred to as a group called "Vaasa", while the face-to-face students were called by their individual names.

Social usability

This dimension involves how the setup supports social interaction, which is essential for learning (Mörndal & Révay, 2005) and for creating a feeling of social presence in distance education (Richardson & Swan, 2003). Participants stressed that ICT creates anonymity as the faces of the students are often not visible to the lecturer. The distance students are hesitant to ask questions during class. Communication problems are generated by the fact that no feelings of community have been established between the separate groups. However, the distance group has compensated for this lack of connection by creating a tight internal community. According to the lecturers, the presence of interactive students who ask questions benefits the whole group. But whenever there is no interactive student present, the lecturer has to trigger the interaction. However, there seems to be a certain hesitance towards demanding interactivity of students during lectures. Although, students themselves comment that it creates positive acknowledgement whenever the lecturer asks questions of them.

Metareflective usability

Metareflection entails the ability to reflect on our patterns of thinking (Brown, D'Emidio-Caston & Benard, 2000). Students need support in building metareflective awareness in their learning process (Hagström & Scheja, 2014; Wiklund-Engblom, 2015). The most important affordance of the distance education was the opportunity for students to repeatedly view or listen to recorded lectures. This enabled reflection on learning and finding gaps in knowledge. Students often reviewed lectures before exams and checked recordings from earlier courses to clarify questions. Students searched additional material online, although this was seldom encouraged by the lecturers. Furthermore, students emphasized the importance of being able to ask questions. One thing that surprised some lecturers was that the distance students often were more engaged and took advantage of time dedicated to supervision in comparison to the face-to-face students. This may be linked to the fact that the distance group reflected on the importance of their own responsibility for learning and took pride in their experience of autonomy. They stated both pros and cons of being a distance student and were aware of how it requires diligence and being proactive.

Collegial usability

This category pertains to the university lecturers' need of support regarding teaching strategies and collegial discussions with others having experiences of the same teaching situations. The lecturers had received some technical support, but no organised support on how to didactically adapt their teachings to the distance situation. Most of the lecturers were isolated in their teaching. Many of them felt that the technical problems left less time to reflect on the didactical aspects of teaching. In the interviews, the lecturers found it interesting to see examples of how others were using the technical equipment in teaching. This gave rise to reflections on the need for transparency and discussions regarding digital didactic designs and synchronization of course content within the faculty. Some lecturers discussed technical problems with colleagues, however, there was a demand for this to be formally organised. Lecturing is not prioritized enough at the faculty, emanated as one concern. This could be counteracted by colleagues sharing best practices and raising the level of communication around the topic. Hence, there is an evident need for a forum for collegial sharing of technological pedagogical knowledge (cf. Mishra & Koehler, 2006).

PHASE 2 OF THE STUDY

Phase 2 of the study involves developing a second iteration of the educational design, in which all usability dimensions are targeted. There is a need to update the audio equipment, in addition to building technical competencies and decreasing the technical burden of the lecturers.

Teaching distance courses is a complex instructional engagement requiring new ways of acting (Hara, 2000). The pedagogical and collegial dimensions will be targeted through workshops in which lecturers can share and brainstorm solutions. This is an attempt to empower lecturers by co-creating ideas for a new digitally enhanced learning culture. One of the most important aspects of designing this new learning culture involves the social dimension. Relationships and communication need to be consciously designed for (Mörndal & Révay, 2005). Communication problems easily arise due to weaker social cues, which are usually inherent in the distance setup (Hara, 2000). Challenges may also arise due to student diversity and varying preferences for learning (Beldarrain, 2007).

The metareflective and social dimensions, are targeted by addressing the students' perspectives on and attitudes towards learning (cf. Mörndal & Révay 2005). In order to empower students, we plan to organise group discussions that focus on the specific situations in distance learning (cf. Hagström & Scheja, 2014). The aim is to provide tools for metareflective and collaborative practices to support learning involving self-regulation and social regulation (Järvelä, Näykki, Laru & Luokkanen, 2007).

CONCLUSIONS

The interviews gave insights into problems, but also indications on how to design a new learning culture for distance education. Students wanted to be activated, to be seen and heard (cf., Jonassen 1995). They wanted the lecturers to give feedback, repeat conversations in class, ask questions, and provide them with options to repeat content and exercises. Support structures not only include the technical side, but also how to create distinct routines for interaction, communication, collaboration, help, and supervision. Especially calculation exercises, with or without programming, seem to demand increased teacher presence. Inequality between the groups was highlighted and is an issue that needs to be meticulously addressed. Opportunities to meet in person would eliminated some social distance and may create feelings of social presence and belonging (Ali & Leeds, 2009; Beldarrain, 2007).

In Phase 3 and 4, the new iteration will be investigated and evaluated in accordance with the improvements made and the impact this has had on learning and teaching experiences, as well as the perceived pedagogical usability. The study is estimated to continue during 2016-2017.

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