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# HOW A ONE-TO-ONE COMPUTING LEARNING ENVIRONMENT CHALLENGES TEACHER-STUDENT RELATIONS

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## **Abstract**

In 2010 the Danish government launched a digitalization strategy for 2011-2015, concerning all parts of the Danish society including the Danish school system. The initiatives for the Danish school system were mainly focused on digital teaching aids, access to internet, accessibility to a digital device for every student and research in teaching with digital devices. [6] The effect of the digitalization was that several municipalities invested in different digital devices. It was estimated that a way to educate the students of the Danish "Folkeskole" (age 6-16) was a one-to-one computing environment where each student always has his/her own personal device. [6] In many municipalities much focus has been on the technical issues in the integration of the digital devices. Only little attention seems to have been given the pedagogical and didactic development of teaching in the classrooms using ICT (Information Communication Technology). [12]

The aim of this paper is therefore to understand, how ICT may be integrated in the classroom in form of the one-to-one computing environment. Theoretically the paper is inspired by the concept of affordances [8] in order to analyze the hidden and perceived affordances of the ICT-solution. [4] Further, the concept of teacher agency [3] is used to discuss how the student-teacher relation is influenced and challenged by a technology-rich classroom, and to outline a perspective on ICT integration with focus on increasing the teacher's and students' co-creation of learning.

This paper is based on a qualitative study of how 19 teachers from 10 public schools in two municipalities in Denmark create meaning in teaching and learning in a one-to-one computing environment. The two municipalities have chosen different devices, respectively Laptops and iPads. In our empirical research we used Future Workshop [9] as a method to get the teacher's voice heard in the study and to make them address what are the most challenging issues in their everyday work teaching the students. With the knowledge from the empirical research analyzed through Engeström's [7] Activity System Analysis to analyze the empirical data, we address the issues of teacher agency and affordance to see how the concepts influence the teachers at hand.

Our findings document a double bind in the relation between teacher agency, students of today's society and the affordance of the technology, because of lack of a mutual understanding between teachers and students about what teaching should aim at. This creates a need for expansive learning. Another finding is that the teachers' agency is challenged by the lack of knowledge of the devices' affordances in a one-to-one computing learning environment. The students' participating in online social worlds external to the work in classes, enhanced by the affordance of the devices, are so strong that it challenges the teachers' agency.

There is a difference between laptop and iPad, whereas the laptop affords going further into details and the use of more complex programs. The iPad supports intuition, creativity and experimental work.

In 2010 the Danish government launched a digitalization strategy for 2011-2015, concerning all parts of the Danish society including the Danish school system. The initiatives for the Danish school system were mainly focused on digital teaching aids, access to internet, accessibility to a digital device for every student and research in teaching with digital devices. [6] The effect of the digitalization was that several municipalities invested in different digital devices. It was estimated that a way to educate the students of the Danish "Folkeskole" (age 6-16) was a one-to-one computing learning environment where each student always has his/her own personal device. [6] In many municipalities much focus has been on the technical issues in the integration of the digital devices. Only little attention seems to have been given the pedagogical and didactic development of teaching in the classrooms using ICT (Information Communication Technology). [12]

The Danish school culture is characterized by a democratic view on communities and learning and therefore the hierarchical distance between teachers and students isn't wide. [15] This underpins many good dialogues in which the students feel seen and heard. This school culture imply that the teachers to a great extent should expect their students to question the teaching positively. Also the teachers have the responsibility and the methodological freedom in the making of good and meaningful teaching. If the students experience a loss of meaning and relation, they choose to do something else which can seem disturbing in the teaching.

A new culture is growing around the one-to-one computing learning environment and with it many new ideas and initiatives which can support the students' learning. [5] On the other hand, teachers experience, we found in this project, that the teachers' agency is challenged by the lack of knowledge of the devices' affordances in a one-to-one computing learning environment. The students' participating in online social worlds external to the work in classes, enhanced by the affordance of the devices, are so strong that it challenges the teachers' agency.

Therefore, the aim of this project is to understand, how teacher's agency is under influence of the affordances of technology and how the student-teacher relation is influenced by a technology-rich classroom.

Theoretically the paper is inspired by the concept of affordances as defined by Gibson [8], and with the expansion of the term as suggested by Trettvik and Bærentsen [4] to analyze the hidden and perceived affordances of the ICT-solution. Further, the concept of agency based on Kaptelinin and Nardi's expansion [10] and Preistly, Biesta and Robinson's model of teacher agency [3] is used to discuss how the student-teacher relation is influenced and challenged by a technology-rich classroom, and further to outline a perspective on ICT integration with focus on increasing the teacher's and students' co-creation of learning.

## **2 METHODOLOGY AND RESEARCH DESIGN**

The two municipalities which we study had chosen each their device and approach to implement a one-to-one computing learning environment. The one municipality had chosen the laptop as their device and had launched a network of educators who were involved in a rethinking of the teaching with ICT. This network was closed down in 2015 due to inactivity. The other municipality had after a pilot project chosen the iPad as their device. These iPads were handed out in the fall of 2015 followed by four short hands-on courses of 3 hours. Both municipalities had chosen to allow the students to take home the devices to be able to impart an important element in relation to the students' digital

To address the challenges the teacher experiences in a technology rich classroom we have chosen a constructivist and dialogical approach for this study. To ensure the voice of each individual teacher we have selected Future Workshop [9] as our method. The aim of using the Future Workshop is to clarify which elements the teachers find most challenging. Thereafter we used the method to allow the teachers to think in solutions, using their creativity. The statements and the participants discussions in the future workshop made up the data for this study.

## 2.1 Data

To have a broad foundation we asked the headmasters to appoint for 2 teachers from each public school in the two municipalities to participate. We had 83% positive responses and started up two future workshops, one in each municipality all in all with 19 participants. At FW 1 we had 11 teachers from 6 different schools consisting of 5 males and 6 females. FW 2 consisted of 8 teachers, 3 males and 5 females from 6 different schools.

The role of the authors was to facilitate the workshop (2 authors) and to make field notes (1 author) The Future Workshop was documented through the statements and post-its worked out by the participants and by video recording all the sequences of the workshop. As a foundation for the analysis, a content log of the video has been worked out, followed by a condensation of meaning. [1; 11]

## 2.2 Analysis

To analyze and categorize the information from the Future Workshops we have used the Activity System Analysis [7] building on the Activity Theory developed by Yrjö Engeström focusing on contradictions in an activity system.

Based on this we have among others identified the following tensions and contradictions [1]:

**Table 1.** Tensions and contradictions.

ASA	Subject	Rules	Object	Contradictions
Influence of iPad	The teacher	The teachers want to teach but are disrupted by the students playing games on the iPad	Teaching with iPads	Tool -- Object Tool -- Division of labor
Influence of laptop	The teacher	The teachers do not know what the students do on their laptop	Teaching with laptops	Rules -- Object Object -- Division of labor Communities -- Division of labor
Teaching competences	The teacher	The teacher lacks knowledge of ideal ways to teach with ICT	Teaching with ICT in all subjects	Rules -- Object Rules -- Division of labor
Managing the classroom	The teacher	Lack of student focus on learning as the device attracts all attention	The students are actively involved in the	Subject -- Rules Rules -- Object Communities -- Division of labor

When a municipality introduces a one-to-one computing learning environment with iPads or laptops, there is a massive change, which can create contradictions in relation to former teaching practices. Through Activity System Analysis it is possible first to identify the existing contradictions and opportunities for development by analyzing the critique phase of the Future Workshops and then using the same principles to analyze the fantasy and implementation phases to identify a possible development.

### *2.2.2 Teacher agency*

To further analyze the data from the Future Workshops, we have used the concept of Teacher Agency. [3] The concept includes a continuous interaction and development process. Teacher Agency is viewed as process [3], which emerges in connection with preparation of teaching, collaboration with colleagues, the teaching itself and professional development with a focus on direction and aims. The teachers gain teacher agency when they act consciously and qualified in specific situations and at the same time are aware of the past (iterational dimension) [3], present (practical-evaluative) [3] and future (projective dimension) [3]. Teacher Agency is something you achieve and develop in specific situations and not something you have or do not have.

### *2.2.3 Affordance*

In order to find the influence of the device in the teaching we have been guided by the term affordance, which originally was created by psychologist James J. Gibson. [8] Affordance refers to both the environment and the animal, and it implies a relation between the two. Affordance is the property and potential the device feature. [1] In this paper, we are especially drawing on Bærentsen & Trettvik's [4] further expansion of affordance. Building on activity theory they suggest the terms of operational, instrumental and need related affordance, terms which we have been using to analyze the data and discover the different ways the teachers look upon and use the devices.

## **2.3 Example of an analysis**

Below we are providing an example of the analysis of the two Future Workshops. Building on the contradictions (see Table 1), we have done an ASA analysis (inserted subject, object, tool, rules, division of labor, community and outcome) of the teachers suggestions and articulations from the Fantasy and Implementation phase. These suggestions we have put in boxes connected to the challenge with pointing arrows. The teachers' proposed modifications are marked with deletions and words marked with red. We utilize the ASA model to find contradictions but also to suggest solutions.

Statements from the critic phase in both our FW addressed the issue that the teachers would like to use the technology in their teaching, but they experience that the student's lack focus on the learning process, which creates a contradiction between the teachers, subject, and the rules. The disturbing element is the device both in relation to notification, passwords which are not working and other technical challenges. This has influence on the teachers approach to the mediating artifact, the device. Several statements indicate frustration and even powerlessness. Also, we see a contradiction between division of labor and the rules, because the students are supposed to be co-players and the teachers see them as not focused on what they think is important learning.

The object, that the students participate actively in the lessons with ICT, creates a contradiction to the teacher's experience of the rules. The outcome is frustrated teachers who see that their teaching with

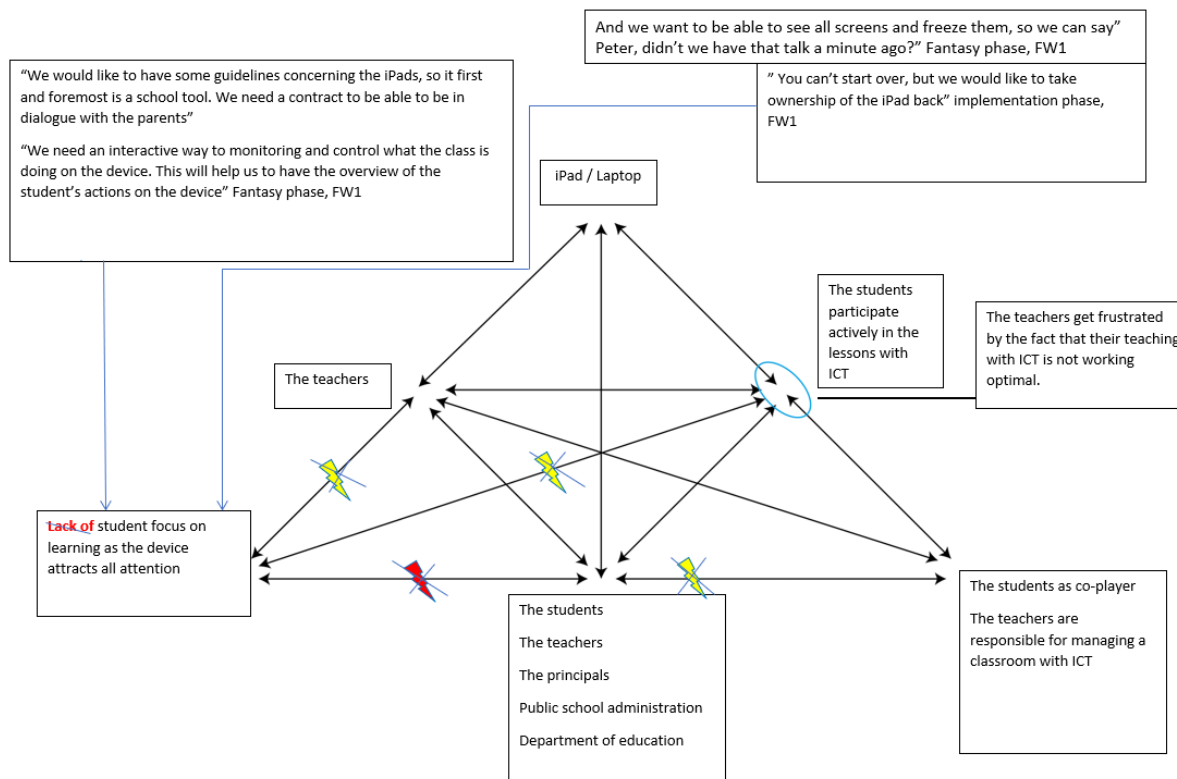


Figure 1 ASA Classroom management

Concerning management of the classroom especially teachers from the municipality which had iPads expressed concerns that the students lack focus on the teaching because the device takes too much attention. The students use the iPad to fulfil their need for being online. This need turns out to be stronger than the urge to be a part of the teaching the teacher has prepared. Several of the teachers look upon the device as an extension of the analogue book, and the affordance which is seen from that point of view does not match with the one of the students. Our empirical research implies that the teachers are not aware of the significance iPad affordance has for the teaching. Thereby it is also a co-factor to the teachers' comprehension that their teaching fails. The teachers' answer to that challenge is monitoring and control as well as guidelines. [1]

As such the Teacher Agency was influenced by a lack of rules from the school management/public administration as the students were allowed to use it for private purposes. They have taken ownership of the device which is good seen from a digital literacy point of view, however as the students (especially the iPad-users) primary looked upon it as a gaming device and not a school tool, it challenged the teachers. Further the teachers lack of pedagogical experiences as well as projective dimensions of ICT use effect negatively the international dimension of teacher professional agency in the classroom.

### 3 RESULTS

The master project that this paper is based on uses the ASA to analyze all the contradictions. Furthermore, all results from the Future Workshops are described. [1] In this paper we focus on the results that are relevant to the student/teacher relations in a one-to-one computing learning environment.

#### 3.1 Affordance

In our results we see different understandings of affordance depending of the type of device chosen, iPad or laptop. By far the majority of our teachers look upon the device from the Gibsonian point of view, where they teach from the basis of their own ICT experiences and understanding. [1] The students bring the device into their own world which gives the students their own understanding of the affordance of the devices. They look upon it merely as a prolonged part of their social network and as entertainment rather than a learning device.

Despite the fact that, in relation to affordance, iPads and laptops have a wide range of attributes in common, we also found differences. The iPad is developed for multiple use in the commercial market and is easy to use and supports among other things creativity. The natural affordance of the iPad is the same for teachers as well as students but concerning the cultural affordance we see a diverging view of the device. The students think of the iPad as a prolonged part of their universe, while the teachers expect the students to know while operating in the classroom the iPad is a learning tool and not entertainment. This creates tensions between students and teachers.

In our findings the teachers view of affordance concerning the laptop is that it is a tool which can support teaching based on their former ICT experiences. [1] The laptop affordance is built upon a broader base of experience, as the device has been used a work tool over a long period of time. The laptop's operation system is more difficult to setup, use, and understand, which makes it more complicated for the teachers to use.

From an activity theory approach the involved teachers' dominant view of both devices are the operational affordance where teachers use the device to support their ordinary teaching practice. The students on the other hand are aware of need-related affordance, as the devices give them direct access to social network and entertainment, especially the iPad. The challenge consists of the fact that the teachers are not aware of the instrumental and need-related affordance, and which effect they have on their teaching. This is also to be seen in our empirical research, where by far the most statements are about topics which are operational-affordance-related. [1] Some of our empirical findings are shown here in table 2.

*Table 2. Device affordance*

	iPad	Laptop	Common
Need-related affordance			Teaching with digital possibilities. Learning in a multimodal interaction
Instrumental affordance	Social interaction Installation of apps	Installation of programs Includes many standards	Remediating Differentiation

### 3.2 Teacher Agency

In our empirical results we see that the teachers experience that more players influence the teaching they are in charge of, and hereby their teacher agency. Whereas it previously was the teacher, the students, and the curriculum which formed the framework for planning and execution of the teaching, the teachers now point out that by the introduction of the one-to-one computing learning environment, teaching, both technically and socially, as well as professionally, is influenced by municipalities, parents, colleagues, principals, students, and the devices. [1]

Especially in one of the municipalities, the teachers experience a lack of framework and aims for the implementation of the one-to-one computing learning environment. The teachers require more backup formed by rules, as they are challenged in their authority, and they think that a tighter control will help. The lack of aims impact the projective dimension of teacher agency and makes the teachers insecure in their actions in the practical-evaluative dimension. In the other municipality there has been a focus on the didactic implementation of the one-to-one computing learning environment, but as it wasn't used enough it was dropped due to cut downs, and the teachers now ask for that kind of work. They wish for an official ICT-agenda for action. They offer to write it themselves, but at the same time they indicate a lack of competences. Again we see a need for more knowledge and backup from the municipality, but the teachers themselves would like to be a part of this development. [1]

The parents can, maybe without intention, undermine the teacher's teaching. Especially in the municipality where they have iPads, the parents have acquired the opportunity to contact their children at all times. There are examples of parents contacting their children during lessons via FaceTime to give them a non-essential message. The parents are not aware of the fact that these actions signal to the students that their message is more important than the teaching of the teacher, thus undermining the teacher agency. If the students come to school without a charged device, it will also influence the teaching and the student's ability to participate. [1]

The colleagues have now an object in common, the device, which can be spoken of in different ways, which is significant for the mutual understanding of the process of development, that has been initiated.

The leaders of the schools are very little mentioned in our empirical results. The teachers say that they have no expectations that the school leaders know anything about the one-to-one computing learning environment and they accept that fact. Instead they address their frustrations to the public administration/the politicians who have chosen the one-to-one computing learning environment. Still, the teachers wish for the school leaders to organize the teacher's work time so there is time to develop the competences needed. [1]

The teacher-student relation is challenged, as the students now have an easy access to their whole social network. They can communicate almost unnoticeably, and through notifications they repeatedly become aware that others want their attention. As many of the students create their self image in these online communities, it becomes essential for them to answer back. The teacher sees these disruptions as disturbing elements and that leads to frustration. The teachers then look upon the students as unfocused and ill-mannered. The students, on the other hand, just follow the unwritten rules of online communities and are afraid of losing acceptance, and thereby self-esteem, if they don't answer. Because the students in their spare time "live" in these online communities, it is more important to them to be a part of those than of the class.



### 3.3 Double bind

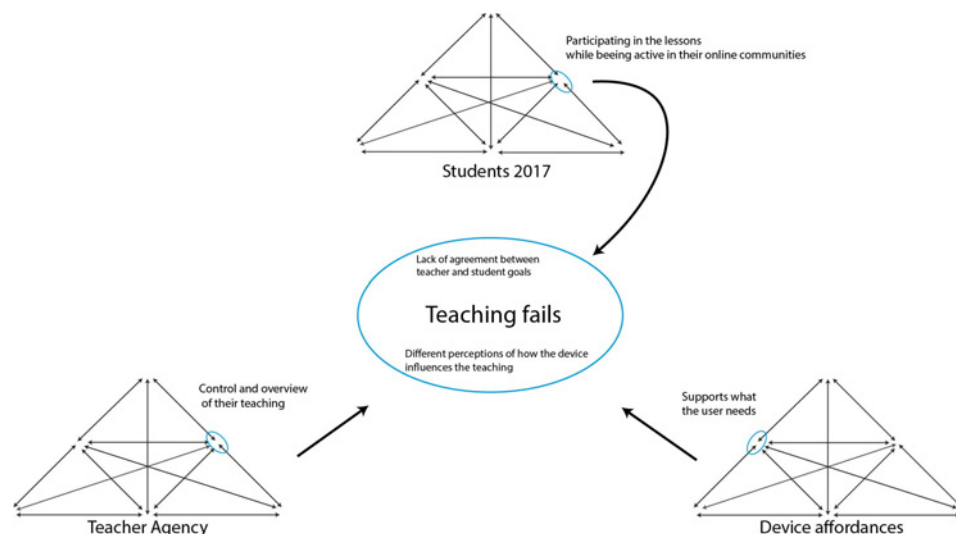


Figure 2 ASA Double bind

Teacher Agency is challenged by the many players and technology. The technology creates many different possibilities within work methods and sources of knowledge, which the teacher hasn't an overview over and knowledge on. Many teachers have no education in utilizing ICT as the main work tool and therefore they haven't had didactic discussions about the usage of ICT in teaching – especially not iPads. The teachers are trained to have an opinion on teaching materials in their teaching but previously there were a range of publishers that offered didactic teaching materials which they could choose from. Everything had been thought of and there was a progression built in the materials.

By using technology, the teacher and the students get access to a massive amount of material, which is not didactically worked with. Therefore, they themselves have to create a progression in. Previously the teachers made the decisions when a new teaching material was to be bought but despite from that the daily teaching followed the teaching systems.

Technology demands that teachers on a daily basis have to face new elements, programs, apps, methods etc. The students can contribute with programs, apps and methods they know from their spare time. Our research indicates that the teachers lose the overview and want to go back to known practices - they want the control back.

The students on the other hand enjoy, according to the teachers, that the new possibilities give them access to their online gaming and social medias. They wish to be able to participate in the lessons and their online social world simultaneously.

The device can support both the wishes of the students and teachers. Although we find larger tensions between students and teachers in the classes taught with iPads. A double bind emerges between Teacher Agency, the students and the affordance of the devices, which effects the teaching that

The participants of the Future Workshops point in two different directions as ways of releasing the tensions of the contractions: control or a new mindset.

Control in the form of a surveillance system, where the students' online activities are monitored and controlled by the teacher is suggested but collides with both the aim of working on the digital literacy of the students and the teacher's own wished focus in the teaching. If the students are not given the opportunity to notice their own activities online, they will not be able to regulate it themselves in the future, and if the teacher has to spend time and attention on regulation of student behavior, focus is withdrawn from the essence of teaching: the students' learning process.

Another direction the teachers point out in the Future Workshops is something they are less able to explain specifically. They are insecure concerning the structure of online teaching resources and miss a teacher's guide which they are used to having in analogue teaching materials. The suggestions of the participants from the two municipalities have in common that the teachers seek networks where they can share knowledge and learn together. They sense that a one-to-one computing learning environment demands a new teaching culture and see a learning community as the place, where they can develop new knowledge together.

The students are to us essential discussion partners for the teachers, who are fumbling in the work with ICT in the learning process, because these students, who have had these devices their whole life, have a more experimental approach to the device. We therefore suggest teaching with the students as co-creators of their own learning in a one-to-one computing environment.

The article "Switching perspectives from a language teacher to a designer of language learning with new technologies" [12] suggests a teaching environment where the teachers work together on creating a teaching design which forms the framework of the development and redesign together with the students. The new design and the new experiences are included in new design procedures in an on-going process. We believe, that this gives both teachers and students the feeling of ownership.

Such a teaching requires that both teachers and students join learning communities.

## **4.2 Professional Learning Communities**

When it becomes the task of the teachers together with the students to be didactic designers, when the aid of the analogue teaching materials' teaching guides disappears, there is a need for the teachers to find guidance elsewhere, and we see Professional Learning Communities [PLC] as the answer to the participants' request for a network and team of subject teachers. The term Professional Learning Communities is described by Albrechtsen as a community founded on five columns. [2]

Common visions and values focus on the students' learning, reflective dialogues, deprivatization of practice, and collaboration – these columns in different ways support teacher agency, as common visions & values and focus on learning support the Projective Dimension, when aims are set for the students' learning.

Deprivatization of practice ensures different views on the teaching materials in connection to a certain group of students and the collaboration and reflective dialogues ensure a follow-up and rethinking in an on-going process. This cannot be done without a foundation consisting of backup from and co-operation with the school management and municipality administration.

All decisions must support the PLC, so the composition of teams, schedules and time for joint teaching

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