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Digital Didactical Designs – Reimagining Designs for Teaching and Learning

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Abstract
In order to progress in educational development, digital didactical designs are a promising approach. Our three studies show principles of new designs including a) new learning goals where more than one correct answer exists, b) focus on learning as a process in informal-in-formal learning using guided reflections, c) making learning visible in different products. The studies illustrate that it is time for re-considering established concepts of teaching – higher education moves from course-based learning into learning expeditions.

Introduction

In the era of Social Media, we have all information always with us in our pockets and handbags. Policies tend to say we have open learning cultures. But it is a myth that learning is open or becomes easier. Access to content does not necessarily mean a person learns. There is no learning progress without reflections. Secondly, educational institutions remain on the model of textbook readings in which students learn to reproduce the knowledge of the textbook. It supports surface levels like remembering and understanding and neglect to support deeper learning like critical thinking, intellectual development and a "conceptual change" (Kember 1997).

The use of ICT, hard- and software programs, is increasing more and more and doesn't stop in front of our classrooms. Technological concepts turn into our ordinary daily life. The new devices are small, flexible and portable, and moreover, our "friends" can also appear in different kinds of *cyborgs*. There is no need any longer, to think of a separate and optional virtual world to make short visits by login-procedures. "We are probably the last generation to make any difference between online and offline" (Floridi, 2007). Computing is really becoming wearable with Google Glass and with personal telepresence robots and avatars representing remote people and can become agents in our near physical environments. What implications do this have, especially for teaching and learning?

To make a difference, let's change the perspective. Instead of focusing on textbooks or technology, the pedagogical practice and its designs needs our attention. Instead of re-inventing textbook learning models, we need a) new designs for teaching and new ways of teaching, and b) new designs for learning, new opportunities to enable learning walkthroughs. In particular, such designs for student learning are required in which students will be able to become pro-sumers and learnerpreneurs, the designs help them to grow in their learning progress.

Framework – Digital Didactical Design (#DDD)

The approach of "Digital Didactical Designs" (Jahnke, Norqvist, Olsson 2013, Norberg & Jahnke, 2013) sounds promising to support such a changing perspective. It uses the European

tradition of Didaktik and scrutinizes teaching and learning as socially constructed forms of teaching practices. We define teaching practices as the creation and doing of sociotechnical-pedagogical designs in classrooms. The term 'design' highlights specific activities conducted by the teachers to help students to learn. A design includes a plan as well as the operative doing – it is process and product. A didactical design shapes a focus and key points for doing the teaching. The expression Didaktik (didactics) comes from the European tradition and does not only include the methods of 'how to' teach, but also embraces the question of 'what to' learn (curriculum and content), 'why' and 'when/where', in what kinds of situations.

In the Internet era, technology is always part of classrooms, courses and educational institutions – it is just a matter of how much it is integrated, from low integrated, teachers share documents, to a high integration, teachers use technology in a form of multimodality. The innovation of mobile technology and media tablets leads to a new situation in educational institutions on different levels. The use of such 'surf-plate' devices affect many layers in education, stretching from how humans act in the classroom, the content in courses, activities and agendas which taking place outside of the classroom, to decision making, both locally and national. The new situation affects three levels of Didactics a) the relation among teacher, students and content (didactical interaction, Klafki 1963), b) the digital didactical design (teaching aims, learning activities, assessment/feedback) as well as c) strategic institutional development, curriculum development (incl. program and examination design) and academic staff development (didactical conditions) and vice versa (figure 1).

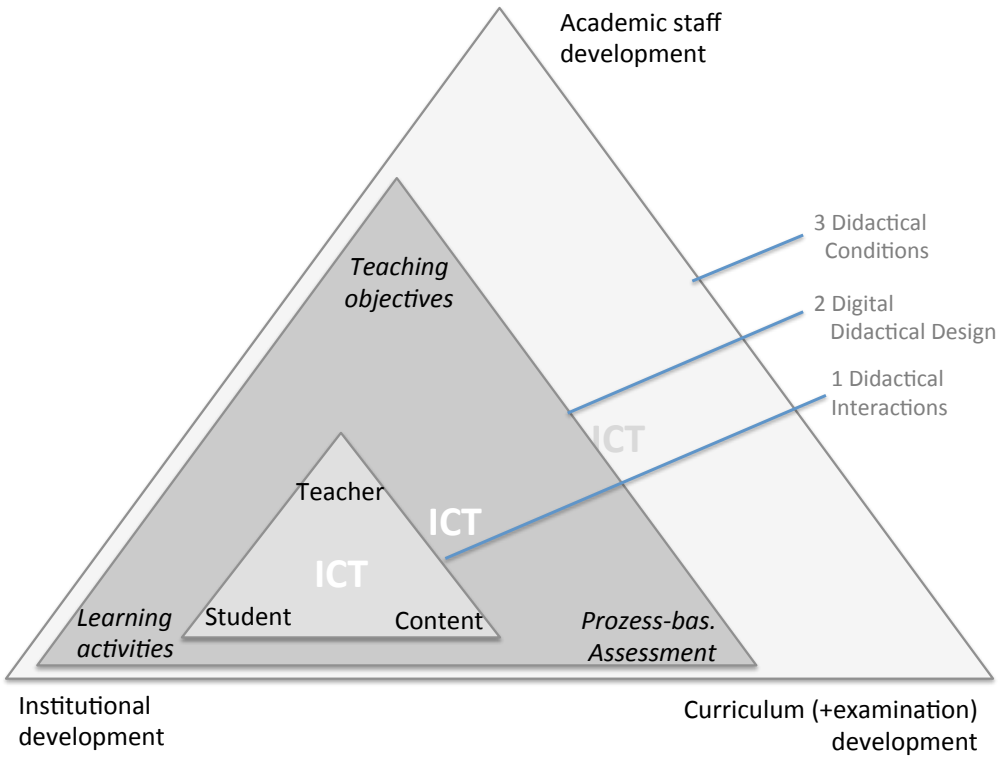

Fig 1. Three Layers of Digital Didactics

Following the constructivism approach, learning is knowledge construction defined as co-creation of new knowledge that is "an active process of constructing rather than acquiring knowledge" (Duffy & Cunningham, 1996, p. 171). This approach represent a shift in designing teaching towards learner-centered approaches (Barr & Tagg, 1995) which support

deeper understanding, reflections and boost several other skills like critical thinking and creativity. 'Active learning' is related to the role of learners, they are not only consumers (surface learning) but also active agents (producers) to co-construct new knowledge: *pro-sumers* (Johnson et al. 2013). We assume that teaching in a co-located arena is able to contribute to a form of deeper learning (not surface learning only), integrate opportunities for learning, where learners are able to expand their thinking beyond consumptive behavior and beyond traditional reproduction of existing knowledge ("conceptual change", Kember 1997).

The expression of "co-located rooms" is usually defined as traditional classroom enhanced by new technology and both together provide a co-location in the same place. Here, we enhance this meaning towards a co-located arena. We argue that we need a new conception on nowadays interwoven spaces and places – like Floridi's (2007) "infosphere" that is both physical and cloud-like content as well as communication at the same time; it permeates the teacher's and learner's roles on different levels.

The term digital didactical design is inspired by Hudson (2008) and Lund & Hauge (2011) who stress the differences of teaching concepts and learning activities. This view on didactics *and* design put teaching and learning into a new light: Teaching is not only a tool to reach the cognitive dimension; teaching is rather an activity-driven design to enable learning as activity for knowledge production instead knowledge consumption; "activity designs for learning" (Hauge & Dolonen, 2012). The *designable* elements (figure 2) are

- teaching aims (intended learning outcomes defined by the teachers)
- learning activities (to reach the teaching aims)
- process-bases assessment (by creating guided reflections and networked scaffolding)
- social relations (dynamics of social roles; Jahnke et al. 2005)
- technology integration (from low to high extent)

The central assumption behind a digital didactical design is the concept of "constructive alignment" (Biggs & Tang, 2007). When the five elements are constructively aligned by the teachers, then the likelihood is higher that learning really takes places with regard to the intended learning outcomes. A DDD is like a house built on building blocks or a puzzle where the different pieces complement each other to reveal the bigger picture.

Technologies can play an important role in making learning visible which is illustrated by two case studies by Mårell-Olsson & Hudson (2008). They illustrate different types of digital portfolios in which students develop the ability to "collect, organize, interpret and reflect on their own individual learning and practice, and become more active and creative in the development of knowledge" (p.73). The integration of mobile technologies in didactical designs and vice versa, however, is more complex as it seems (Granberg, 2011). Koehler et al. (2007) show how complex the integration of content, technical and pedagogical knowledge is (TPACK model). In addition, Loveless (2007) illustrates at the example of primary schools how the co-evolutionary development of subject knowledge and didactics needs the support of "improvisation".

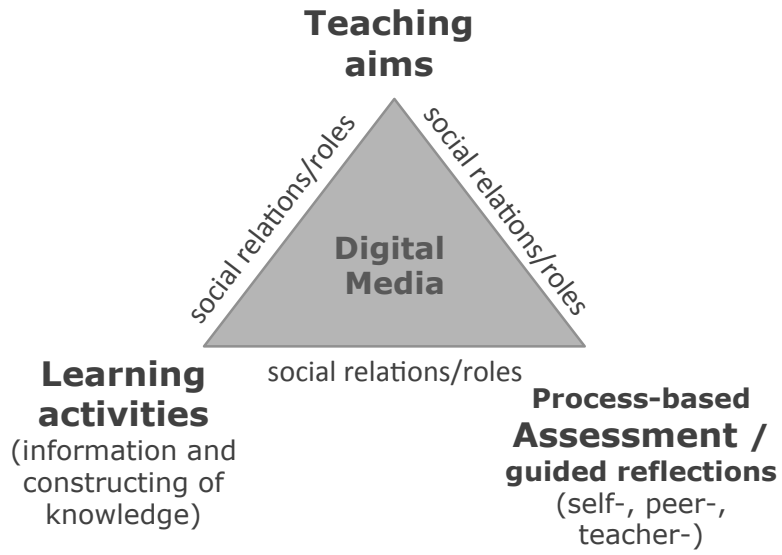

Figure 2. Digital Didactical Design (DDD)

The main research question (RQ) is: In a co-located arena, what kind of digital didactical designs do the teachers apply and to what extent do the designs contribute to what quality of learning (surface to deep learning)? How and why do the teachers apply their designs?

Method

We initiated several projects at Umeå University in Sweden, and studied the potential of media tablet integration into teaching and learning. In addition, we are part of a Danish community project that launched media tablets in a 1:1 program (each student one Ipad) for all their seven K-9 schools. In all studies, we have studied the digital didactical designs and used mixed research methods, in particular classroom observations, interviews and online surveys.

a) Teacher education at Umeå University and in Danish schools

A qualitative approach (Cohen et al., 2007) has been used to explore Digital Didactical Designs applied by teachers in Scandinavian courses and classrooms. To study the research question, we started to apply mixed methods, particularly, classroom observations, teacher interviews, student group interviews and surveys. In a rural municipality in Denmark and within the preschool teacher education at Umeå University in Sweden, we have conducted the study in 2012 and 2013. A third study will focus on Swedish K-9 schools and starts in 2014.

b) Google Glass in higher education at the example of a dental study program

In 2013, we got the opportunity to get Google Glass and wanted to explore its potential for higher education. Goggle Glass belongs to the category of wearable technology and is a head-mounted, voice-controlled device that the user wears like a pair of glasses. Through the prism on the right side (eye) graphical supported information is projected, so-called augmented reality, for such things the user currently observes. In other words, the person sees the real world and in addition some further information. For instance, the users see a street and the name of the street will be shown in Google Glass. It is also possible to take pictures, video filming, send messages, make phone calls, take notes, read and reply to emails, search for information and conduct video calls etc., all with voice commands. One advantage is that you command it with the voice and have the hands available for other things. The device is meant

to deliver additional information just-in-time for the user. It is not possible, for example, to browse for old emails.
We have integrated Google Glass as a device in dentistry program at Umeå University in Sweden. In particular, we focused on those activities where dentist students have their clinical practice with the patients. In this project, we are exploring how Google Glass may facilitate the communication between the students and their teacher during the student's clinical practices with the patient. 18 dentist students and one university teacher participated in the project. Data for the study has been collected through observations, video recordings where the students are reflecting on their experience. Interviews were held with the teacher.

- *Before Google Glass*. The dentist students were in practice and had patients in a booth. When a student needed help from the teacher, they wrote the number of the booth on a white board where they are located with their patient so the teacher would know, looking at the white board, that a student needed help with something.
- *With Google Glass*. The dentist students are in practice and have patients in a booth. The students use mobile devices (e.g., media tablets) and the teacher uses Google Glass to communicate with each other. The students send emails or a Google Hangout message to the teacher that describes where they are, in which booth and what they need help with. The teacher gets a notification through a sound, while wearing Google Glass that means that one of the students has sent a message. The teacher is then able to read the message through Google Glass and reply to the student by a voice message.

During this project, both students and the teacher expressed that the communication between students and teacher has been better facilitated through the integration of mobile devices and Google Glass. The students expressed that it feels good *not* to leave the patient alone when they need help from the teacher. They also mentioned that they get help faster than before and specifically they get in contact with the teacher faster since the teacher is able to reply to the students messages directly from Google Glass regardless of where in the clinic the teacher is. From the teachers reply via Google Glass, the students know when they can expect help, for example, soon or if they have to wait for a while and meanwhile can go on doing something else.
The teacher in this study pointed out that it is possible to prioritize which student need help first due to the content of the messages sent via the mobile device to Google Glass. Before, when only the booth number was written on the white board and not what kind of help the student needed, it was not possible for the teacher to make a priority. The teacher also said that when helping a student it is possible to know if there are another student waiting for help or at least want to be in contact with the teacher since a notification of a sound is given when a message is sent.
Even if both students and teacher express that communication is faster and facilitated there are some challenges occurring. First, sometimes when a student has sent a message to the teacher it takes longer than expected for the massage to arrive to Google Glass. That could make the students a bit insecure if the teacher has got the message or not. Therefore, it is important that the teacher reply to the student when the message has arrived. Secondly, both the mobile device and Google Glass is in great need of a wireless network that is working properly. When the signal is fluctuating the messages sometimes are not coming through.

c) Telepresence Robots
Three telepresence robots have been presented and showcased at Umeå University main campus in Sweden during winter 2013/2014. The first is a roaming robot (the Double) the second is a seminar robot (the Kubi). Both use media tablets, such as Ipads. The smallest and cheapest is a seminar robot that uses Iphones (the Galileo) and has some interesting other functionality.

The pilot studies show that the experiences of persons on another location attending by robot presence in an ordinary face-to-face meeting *changes* the social experience when having a robot in an ordinary seminar or meeting. This emergent technology cuts through many earlier separate discourses as videoconference, webinars, Skype conversations and virtual reality, but carries many limitations and problems as well, such as fear for surveillance, the development of humans into cyborgs and unclear understanding and use of identities. The philosophical and practical implications of personal proxy embodiment, access to other bodies at other locations for remote interaction, are reflected upon and discussed with the help of new ontological discourses in information science.
We assume that such present products are only to be seen as prototypes for coming more streamlined technology. In our project, ideas for future uses are discussed in interaction with participants using an audience response system. A provocative concept for an integrated use in a larger scale on campus is presented in draft and discussed, with its limitations as proportionalities between different embodiment types.

Findings

Based on the approach of digital didactical designs, we derived a sheet for analyzing the different forms of teaching practices illustrated in table 1. The main analysis has been focused of two issues, first how many elements are aligned to support intended learning outcomes, which has been defined by the teachers in advance, and secondly, what is the quality of the aligned elements and the design in total. A detailed description of the observed innovative classrooms is published in Jahnke & Kumar (2014).

Table 1. Scheme for data analysis (per classroom)

	Description - data based	Element has been aligned? Y/N	**Details of the design - To what extent does the element support the intended learning outcomes defined by the teacher?** 5=strong alignment 4=aligned 3=in between 2=weak aligned 1= no alignment at all
Teaching objectives are visible/ clear? Are expected learning outcomes visible/clear?			
Learning activities are clear and appropriate, and correspond to teaching objectives?			
Feedback: assessment is process-based or summative or both?			
Design of social relations: visible in communication & collaboration among peers and teacher-student interaction; degree of collaboration.			
How media tablet is integrated into the whole learning scenario.			
Overall analysis per classroom	Brief summary	How many addressed elements in total?	-Summary and -Extent of tablet use as high (3) medium (2) low (1)

We here report the findings from our recently 24 classroom observations. Table 2 illustrates at the example of 3 cases the total amount of the aligned design elements in combination with a low, medium or high extent of the technology use.
The data indicates different themes of digital didactical designs. For example, ID 6 has 5 aligned elements plus a high extent of the tablet use (3) makes 8 in total. We then defined that 7-8 is one theme, 5-6 is another theme, 3-4 is the third theme and 1-2 is a theme. Together, we explored 5 themes, described below marked as MD, DD, BT, PD, RE.

Table 2. Analyzed cases (excerpt)

ID	**Subject**	**How many of the 5 elements (DDD) are designed in (strong) alignment to support learning?**	**Media tablet extent** high=3; medium=2, low=1	**Theme**
6	Preschool class	5	+High (3)	=MD
11	Physics (9th grade)	5	+High (3)	=MD
5	Math (2nd grade)	5	+High (3)	=MD
…	…	…	…	…

MD = Media-tablet-Didactics
DD = Digital Didactics
BT = Benefit of Tablet integration
PD = Potential for digital Didactical design
RE = RE-alignment required

Analyzing all 24 cases in detail such as in table 2 is indicated, five themes across all 24 cases have been explored:

Theme of media tablet didactics (MD).
11 of 24 classrooms (ID=4, 5, 6, 10, 11, 17, 18, 20, 21, 23, 24) show an innovative use of media tablets for teaching and learning. In these cases, all of the five didactical elements including technology are aligned to each other with a high extent of tablet-use. The result of the aligned elements together with extent of tablet use is 7 or 8. These cases illustrate a specific Media-tablet-Didactics and show the full potential of a digital didactical design where the elements are aligned to increase the possibilities for learning through the added value of the media tablet integration. The five elements of a DDD are aligned in such a combination that they foster the expected learning outcomes and increase the likelihood to enable learning towards the teaching objectives.

Theme of digital didactics (DD).
There are 5 classes (ID=7, 8, 15, 16, 22) that have applied aligned digital didactics. The aligned elements include a high to medium extent of the tablet-use, which have the result of 5 or 6. The difference to theme MD is, that the teachers didn't use the unique potential of a media tablet as multi-modal device (like in theme MD). These five classes used the media tablets as laptop substitute to reach the intended learning outcomes. The cases show that the tablet is also useful when not using its full potential of a multimodal device but more as a laptop function. The teachers said, however, when using the tablet like a laptop for writing assignments, there are some obstacles, for example, there is no keyboard for writing and that makes a tablet slower than a laptop (or an external keyboard for the tablet is required).

Theme of weak alignment but benefit of tablet-integration (BT). The case ID 3 is an interesting case. The elements of a digital didactical design are not aligned but through the use of media tablets the learning process has been enabled stronger than without the media tablets; it is a high extent of tablet-use (1 case). Although there is a weak alignment, there is a benefit of the tablet-integration: The aligned elements are only 4 (from 8) in total but with a

high extent of tablet use. The class started as a traditional class where process-based feedback and the design of social relations were not aligned. The digital didactical design elements were in a constructive alignment to foster traditional teaching (Instruction-Response-Feedback, IRE; Mehan 1979) and less collaboration. The observers reported that the whole classroom was in a rather bad quality and the weakness of not creating a supporting learning culture was obvious during the observation. But the media tablet-integration made then the difference. The students got the task to create a movie or a book (students' choice) about the historical person called Kristian IV in order to show the teacher what they have learnt. The collaborative production of a movie by using the iMovie app was an added value to foster learning by producing. Through the phase of producing the students also reflected on what they created and discussed changes.

Theme of potential for tablet-didactics (PD).
There are four cases (ID=1, 2, 12, 13) in which the alignment of the five elements of a DDD differ and the technology integration ranges from a medium to low extent of tablet-use, but it does not limit learning (the result of the (non-)aligned elements together with the extent of tablet use is 3 or 4. There is a potential to develop a stronger alignment to enrich the student learning experience (4 classes). In this theme, the classes have in common that the alignment of the five DDD elements differ and range much and the added values of and why using media tablets were not clear. It showed a rather weak connection. The classes did not limit learning but did not apply a constructive alignment rather a non-constructive alignment. The classes used the media tablets in a medium to low extent to enhance learning and the potential for a stronger constructive alignment was obvious.

Theme of re-alignment of a digital didactical design; better without media tablets? (RE).
The data reveals three cases (ID=9, 19, 14) in which the integration of media tablets reduced the students learning experiences and restricted instead of enhanced learning. The elements of a DDD are not aligned or very weak connected, and a low extent of tablet-integration (the results of the aligned elements together with the extent of tablet use is only 1 or 2). The applied designs reduced the possibility of learning and restricted learning (3 classes). The use of the media tablets and the didactical designs in those classes where not connected in such a way that it would be beneficial for students learning. Instead it seems that the media tablet was applied in a way that restricts the learning activities to reach the teaching aims. Either a re-alignment of a DDD is required or it is better without media tablets.

Discussions

The findings reveal a richness of different forms of digital didactical designs (DDD) in practice. It is not a surprise that the usage of technology in some of the classrooms and courses did focus on enhancing deeper learning and others supported surface learning. In some cases the applied design even limited the chance that learning can take place (as in theme "RE"). As any new technology, the adoption of new technology matters and lead or doesn't lead to different digital didactical designs – this is what our study illustrates.

Our research studies illustrate how teachers create new designs to do teaching and to support learning. They show new design principles and themes of Digital Didactics in co-located arenas where ICT and the classroom have been merged into new teaching spaces. The different projects contribute to a revised understanding about designs of digital didactics and inform new designs for learning from the perspective of "Didaktik". Our findings illustrate three key principles.

The teachers' digital didactical designs embrace (Jahnke et al. 2013)

a) new learning goals where more than one correct answer exists (it supports deeper learning),
b) focus on learning as a process in informal-in-formal learning spaces using guided reflections,
c) making learning visible in different products (e.g., text, videos, podcasts, digital stories).

These key points can be called a change from traditional course-based learning into learning expeditions. We argue that in order to progress in educational development of surface and deeper learning, its needs a change towards *digital didactical design thinking*.

However, secondly, there are the other teachers who don't apply digital didactical designs. From them the project learnt that there is a gap in the didactical designs, what teachers "want" and really "do", a gap between their didactical design *thinking* and *doing* with and without ICT. The study reveals that there is a practice of a teacher-students-loneliness in educational institutions. There is the trend to neglect the importance of having and creating a reflective teacher's community of practice where teachers discuss their situations, didactical designs and learn from it. We argue that in order to progress in educational development towards both professional teaching as well as surface and deeper learning, it needs a change towards teacher's learning and that they can learn how to create and apply didactical design *thinking*.

We just started with using the emergent technologies in different contexts and settings and we see some advantages but also challenges and problems. Technology might have an important impact on re-imagining and re-designing higher education.

- The advantages from wearable technology is that it is voice controlled and the hands of a person a available to do other things while being online at the same time. This offers an opportunity for dental education and other professions where the teacher needs the hands to do the ordinary activities. Through Google Glass, s/he shares her activities on an online screen and also is capable of coordinating the other student, too.
- One advantage is that new technology helps to reflect established teaching routines and supports the re-thinking on new didactical designs towards learning expeditions.
- A teacher needs to have a clear purpose for the technology, what it will support or facilitate in an activity when designing the teaching activity. The add-on of a technology needs a clear benefit within a teaching and/or learning activity.
- One must be prepared to that bringing IT and new forms of technology into known work processes often generates the need to break through established routines and/or adapt the work processes to new ways of working, teaching and learning in higher education.
- A teacher needs to be flexible and have different solutions when problems occur; teachers become jongleurs of different design elements – didactical and technical solutions.

Practical implications – A radical new design thinking on education

We have heard a lot of predictions about what ICT technology or ICT-enabled culture will mean for education and higher education in particular, during the last 15-20 years. Computer-based training, e-learning, digital natives, learning objects, blended learning (Norberg & Jahnke, 2014) and the possible impact of global MOOC-structures are just few examples.

Things surely change, however often neither as fast as expected nor as total in a short perspective but maybe in a little longer perspective it is more interesting and disruptive development.

Higher education is like an old building repaired, augmented, patched and partly rebuilt many times (Jahnke & Norberg, 2013). The elements don't harmonize so well any longer. It is like a really big unfinished puzzle where the small pieces don't fit to each other.

We feel that some higher order discussion about what ICT in the long run means for higher education is urgently needed, instead of just using ICT tools for specific tasks within an old frame of perception about what university teaching is about. For instance, the *room* for learning is still a very dominating idea. Even when it is not there, as in asynchronous web-based courses, the room is the dominating idea. Although, ICT integration helps digitalizing lectures, it also recreates classroom structures in a virtual learning environment, talking about the classroom 2.0, envisioning a "virtual" university, sometimes very concrete as in Second life and similar environments but still has a "room" as central metaphor for learning.

Due to our research in different studies, we argue, we need a more all-in-one design what we call Digital Didactical Design that is useful to design teaching towards student learning expeditions. We envision a more thorough retake on how to turn from course-based learning into learning expeditions.

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