Henriette Duch, Hanne Wacher Kjaergaard, Lene Mark,
Center for E-Learning and Media,
VIA University College,
Denmark.
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Blended learning as a solution to practice-related problems in vocational schools

Teachers at vocational schools face many challenges in their daily work. Some of these challenges center on planning the teaching so that the needs of each individual student are met, whereas others center on securing a better link and alignment between theory and practice. In order to find solutions to these challenges, teachers need to develop new designs in and for their teaching. ICT tools can present one type of solution, and this then requires teachers to engage in learning processes, pedagogically as well as technologically.

The results of the project at hand reveal the variation in the design complexity needed to solve the problems. Additionally, the study shows that the way ICT-based materials and solutions are used matters, e.g. whether materials can be produced in a generic form in terms of their use, or whether their use is tied to a very specific context. Collaboration across vocational schools is seen to support competence development.

Four different vocational schools have been working with blended learning in an R&D project supported by a grant from the Danish Ministry of Education. The basic assumption behind the project was that aspects of blended learning can solve problems that may otherwise be difficult to solve. The shared aim has been the development of a blended design.

Initial Vocational education and training programs (VET) in Denmark consists of a basic course and a main course.[1] The basic course lasts 20 to 116 weeks. After that students move on to the main course also called the VET specialization. The prerequisite for this is that they have a training agreement. The student is then apprenticed to e.g. a municipality or a small or large company. In the project at hand, the participating schools have focused on the main courses.

Two technical colleges, a social and health college, and a business college participated. A technical college can have ten basic courses and plenty of programs. A social and health college has one basic course and four programs and a business college has one basic course and eight programs. The article is mostly concerned with the latter two types of school. The project was carried out within the existing framework of VET in the main course

The participating students were socially and academically very diverse. One of the challenges of the project was to differentiate instruction so that it was possible to cater more for the individual student's specific needs and opportunities.

[1] For structure and terminology concerning the Danish VET system, see http://eng.uvm.dk/Fact-Sheets/Upper-secondary-education

Henriette Duch, Hanne Wacher Kjaergaard, Lene Mark,
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Blended learning is a broad term, but may be defined as "a teaching method where you use a variety of pedagogical approaches, different technologies and mix physical attendance and web-based teaching methods".[2] In American pedagogical research, the term blended designs is used when pedagogical planning is involved. The project was called Blended Designs, precisely because the focus was on the pedagogical planning rather than student learning, although this was, of course, the ultimate goal. The project centered on examining and experimenting with blended designs within a common framework.

In the main course, the students alternate between practical training at the company and school-based training at the college. The article is based on four case studies that have focused on solving a problem during school-based training or during periods of practical training using blended designs. Two cases aim at supporting students who find it difficult to reach the competence goals set for them, one aims to provide better linkage between school-based learning and learning through practical training through the use of logbooks and virtual meetings; and the final one aims at providing students with access to the theoretical education at the college during their practical training periods.

The project's basic assumption is that implementing aspects of blended learning can solve problems at vocational schools that may otherwise be difficult to solve. The staff at VIA University College have taken on the roles of framework consultants inspired by action learning, but leaving some leeway in terms of methodical approach. As framework consultants, we helped to structure the work and keep the agreed learning objectives in focus for the participants. Data collection has been carried out through observation in schools and through ongoing written and spoken dialogue with the participants. Inspired by grounded theory, data has been the starting point for the analyses. The results have been continuously developed in collaboration with the participants. Subsequently, theories or models have been applied, which have proven functional in terms of providing further structural frameworks for the analyses.

First, the article describes two instances of blended designs both of which aimed to find ways to help more pupils achieve the required competence goals. Common to the examples was that they solved a specific content problem through the use of ICT tools and ICT-based materials which were produced as general teaching materials that also other teachers could use.

It then describes two other examples of blended designs that were intended to make it easier to create coherence between the theoretical subjects in the context of the college and practical training in the company context. In these instances, the teachers wanted to solve a complex problem, and therefore the designs needed to be made up of several steps. The ICT tools used were programs that were applied and given “body” in the specific context, and hence, the

[2] Gynther, Karsten: Blended learning. Unge pædagoger, 2005 p. 11 - our translation

materials produced could not be immediately passed on for other teachers to use. However, the way they had dealt with and thought out the concrete design could be used by others.

Finally, the article considers the extent to which theories of blended designs can contribute to changing the actual teaching.

New paths to reaching competence goals

The two cases which focus on providing students with new ways of achieving the competence goals they meet in school-based training deal with problem areas which are closely related to what might be called a "basic subject understanding". [3] A basic subject understanding is based on the view that a subject is related to the basic sciences or branches of scholarship, which then form the basis of the subjects. In Danish, for instance, textual analyses are made based on scholarly methods and approaches. The teaching of Danish in the context of a social and health education relates itself to this type of understanding. In one of the cases, the content dealt with was numeracy and in the other, it was argumentational analysis.

The participating teachers in the project were experienced and professionally highly skilled. Therefore, they knew from experience which parts of the subject students would find difficult. The teachers conducted a thorough analysis of the reasons why students found various aspects difficult. Based on this analysis, they then chose the technological solutions that could be developed and incorporated into an appropriate design so that through blended learning, a new way for students to reach the competence goals might be achieved.

Educational contexts are difficult to investigate and develop since teaching is a so-called "wild" problem. In wild problems, it is not possible to isolate the significance of individual factors easily, and therefore it becomes difficult to look at causes and effects. [4] Wild problems are difficult to work with. When a student in VET experiences Danish as a difficult subject, is it then because she carries with her bad experiences from previous schooling, or is it because it's hard for her to work with abstractions and work on the top levels of Bloom's taxonomy? Depending on which of the two factors has the greater impact, the teacher needs to take different pedagogical approaches.

When working across different schools and contexts, investigations become even more difficult. The analyses in this article should therefore be read as our interpretation of the findings of the project. According to Koehler and Mishra, teaching may be characterized as an "ill-structured discipline with a high level of variability across situations as well as a dense

[3] Nielsen, Frede. V: Almen musikdidaktik. Christian Ejlers Forlag, 1994.
[4] Christensen, Torben Spanget. Formativ evaluering. In Gymnasiepædagogik, red. Damberg, Erik mf. Hans Reitzels Forlag, 2006.

context-dependent inter-connectedness between knowledge and practice".[5]

The TPACK model has proved functional to describe the analyses engaged in by the teachers in the project. In the model, Koehler and Mishra include three types of knowledge: content knowledge, pedagogical knowledge and technological knowledge. The three types of knowledge are context-bound. In the overlap between the different types of knowledge, intersections such as technological-pedagogical knowledge are found, and in the center, there is an overlap of all three areas of knowledge: technological, pedagogical and content knowledge.

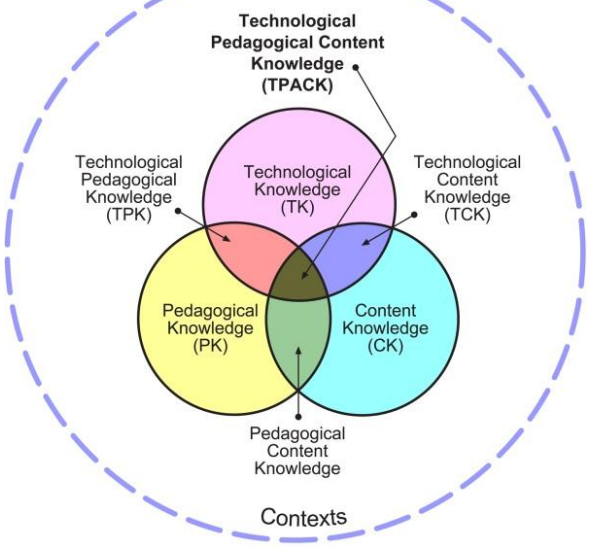

Figure 1: The TPACK model.
(Reproduced by permission of the publisher,
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In the terminology of the TPACK model, the teachers in the project initially had content knowledge. They defined technological knowledge in terms of what they wanted the technology to do for them, and they knew that the required technology existed.

One case is entitled ***numeracy***. The context is a business college, where in the module *The tools of the store,* students specializing in trade and retail training need to be able to deal with e.g. percentages. Many of the students carry with them negative experiences with maths from their previous schooling, and they struggle with academic content. However, they are motivated to learn the substance now because it makes sense for them. They need it both in the school-based training and in their practical training. The design in this case study aims at making it

[5] Koehler, M. og Mishra. P: Introducing TPCK. In: Handbook of Technical Pedaogical Content Knowledge (TPCK) for Educators. Routledge, 2008 p. 4.

possible for students to compensate for and acquire their lacking skills and knowledge.

The teachers developed different materials that students could use at home both for this module and later in the main program when they had to do calculations. The materials were first tested in the classroom and then adjusted. Thus it has been possible to study how students utilize of the materials. In class, students were introduced to the materials in order that they would be able to assess their individual needs and the options that were open to them.

The second case takes place at a social and health college. Some students find it difficult to achieve the set competence goals for argumentational analysis in C-level Danish as required for social and health care. The case will be referred to as ***argumentational analysis***.

Students are given the opportunity to work with film materials at home. In the films, the teacher presents the academic content, provides examples and exercises. The material is not directly included in the teaching of the whole group. However, the test run shows that it is essential that the material is thoroughly introduced in class in order for the students to even start using it at home. The teacher focused on providing extra support for particularly challenged students. These students were given individual suggestions to use the films, and their work with the material was further supported by individual help from a reading tutor.

In both cases, the teachers analyzed a problem area within their subject in terms of what students find difficult and why. Then they chose ICT-based solutions: In *argumenational analysis* it was film; in *numeracy*, it was a variety of offers: games, exercises, and answer booklets for tasks. The analyses, the choice of ICT tools, and the blended design were developed collaboratively by the team of teachers.

The materials were subject-specific and might be used by other teachers in similar contexts, e.g. the same course at another college or another Danish class at same social and health college. A lot of work went into the production of materials, but the teachers involved acquired the technological skills and understanding needed to make materials functional in their specific context. In TPACK terms, the teachers had content knowledge, they acquired technological knowledge, and - based on this and their pedagogical knowledge - developed a design for how the materials were to be used with students.

During test runs, new challenges arose: The project *numeracy* was developed and tested first. Pedagogically, it was difficult to integrate materials so that students used them at home. The teachers in the next scenario, *argumentational analysis* became aware of this in the knowledge exchange across contexts before conducting *their* test run, so they made sure to get students started with the use of the materials in their test-run. Therefore, in their design, they incorporated this in the role and tasks of the teacher.

Because teachers met across different types of programs and colleges and worked in a joint project, they learned from each other. Those who were involved in the second iteration integrated lessons learned from initial testing - their own and others' - and in this way, the project contributed to the competence development of teachers. This provides an explanation for why the test run with films in Danish got further in terms of helping students to achieve competence goals.

An additional explanation is that the complexity of the technology and the pedagogical contexts of the two cases differ. The materials at the social and health college consisted of a single offer, and students who had difficulty reaching competence goals were individually invited to use it. The teacher knew in advance which students were specially challenged. Furthermore, the teacher was resourceful enough to be able to handle individual follow-ups. At the business college, the ICT tools were more complex in nature: there were several different products, and the students had to choose individually from a variety of materials. The materials were developed with strong inspiration from in-house developed and applied concepts of learning styles and a simultaneous whole-school effort in relation to subject-specific reading, and this was included as a further element of the design. At the business college, the blended design became complex because students also had to learn to choose. Teachers had to deal with a pedagogically more complex situation.

In *argumentational analysis,* the teacher ended up with a design and a pedagogical approach where the ICT-based materials worked. Koehler and Mishra call it bricolage when teachers find their unique approach to practical teaching: "Teachers construct curricula through an organic process of iterative design and refinement, negotiating among existing constraints, to create contingent conditions for learning. This process, shaped by their personalities, histories, ideas, beliefs, and knowledge, has been called bricolage." [6]

According to analyses of the tests runs, the teachers learned from each other in the project, and it seems that individual students' subject specific problems in attaining the set competence goals could be solved through blended designs. In a video on his weblog, Ruben R. Puentedura presents the SAMR model (see figure 2). This model may be used to categorize the degree of change brought about by the introduction of ICT in education.[7] At the lowest level, the technology replaces a previously used tool with no functional change. At the next level, it replaces another tool or process, causing functional improvement. At the third level, the technology allows for modification, and at the fourth and final level, technology allows for redesign so that tasks that were previously impossible or unattainable can now be carried out.

[6] Koehler og Mishra s. 21
[7] http://www.hippasus.com/rrpweblog/ accessed 17 Jan 2013. The video is dated 7 Jan 2013. Figur 2 has been taken from http://www.hippasus.com/rrpweblog/ accessed 8 Jan, 2013

In the cases at hand, no substantial changes of the existing teaching occur, but a group of students experience improvement since they now get the opportunity to access blended elements that can support them in achieving competence goals. The extent of the change caused by the new designs is debatable, hence one can also discuss which SAMR-model category may be relevant for the description of the change. We will return to this at the end of the article.

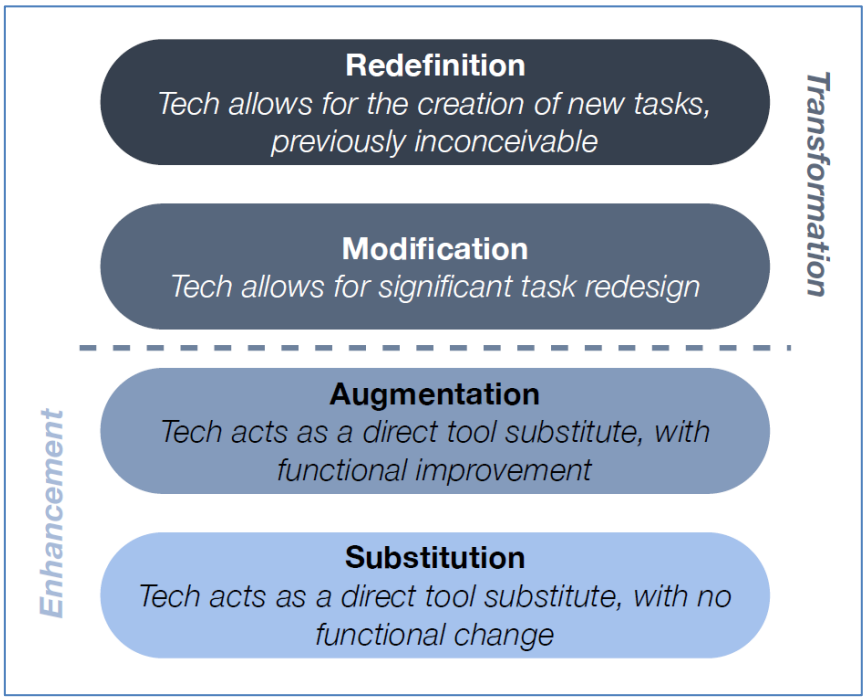

Figure 2: The SAMR-model
© Ruben Puentedura - http://www.hippasus.com/rrpweblog/

The relation between school-based training and practical training

The last two cases are contextually more complex as they aim to establish an increased connection between school-based training and practical training. During periods of practical training, students may need to access theoretical knowledge from the school-based program in order to be able to apply it in a practical context. Similarly, when at college, the student needs to establish a connection between the experience and knowledge from the practical training to be able to apply the theory in a practical context e.g. e-commerce in theory and e-commerce in their apprenticeship. Through flexible access to theory provided by ICT tools and through access to virtual guidance by teachers or contact teachers at the college, it is possible to creat new, meaningful connections between school-based and practical training.

The third case is called ***virtual meetings***. These meetings took place at a social and health college, and participants were the individual student and the apprenticeship supervisor, who were at one location, and the contact teacher, who was located elsewhere. The *virtual meeting*

was to enable the quick setup of a meeting when the situation called for it, since experience shows that the setting up of a face-to-face meeting at short notice can be extremely difficult. Sometimes what causes the need for a meeting may be personal problems facing a student, who therefore finds it difficult to attend the practical training. This increases the risk of the student dropping out of college.

In the *virtual meeting*, students were to present a logbook used during their practical training. The students knew this tool from the college setting. One intention with the logbook was to enhance the quality of the meeting by allowing events and experiences from the practical training to be included in a structured and qualified way; another intention was to help the students to reflect on their practical training, using knowledge and concepts from the school-based training as a basis for this reflection.

Although the *virtual meeting* made different demands on the parties involved than a traditional, face-to-face meeting, the form of the meeting helped qualify the student to work with new welfare technologies.

Work on the digital logbook in college before the student started practical training was intended to prepare the student for the *virtual meeting* and enhance the quality of the meeting. It is a recognized problem in practice meetings that students do not prepare well enough for them and find it difficult to link to experiences and incidents that occurred some time ago. In addition, the logbook was meant to make it easier for teachers to incorporate experiences and incidents from practical training into their teaching.

In their daily work, teachers at college included the logbook in their teaching in order to encourage students to use it. If students do not find sense in and establish routines for this work, it is difficult for them to write a log during their practical training. Central to the work with the digital logbook was the fact that it allowed students to work with a technology that could accommodate text, sound, and image, thus helping students who experience difficulties in dealing with written language by allowing them to rely on other forms of expression.

The fourth *case*, ***absent***, took place at a business college. Sometimes, during their practical training, students are offered to participate in a trade show or meeting. It may, however, prove impossible for students to participate if the event occurs during their school-based training due to the rules of attendance here. The blended design in this case wanted to provide students with the opportunity to participate in professionally relevant events with their place of practical training while getting get the necessary theoretical knowledge from the college context even though they were physically absent.

Teachers developed designs to guide the pupils in spite of physical distance. The guidance could be asynchronous through written electronic communications or teachers could follow

students' work by accessing a website where student analyses and presentations were available. Students who were absent could work synchronously or asynchronously with the other students.

In these last two cases, then, the contexts were more complex since they deal not only with student learning in an academic area but also with learning across two or more contexts. In *virtual meetings*, the contexts were school-based and practical training, and in *absent,* the college and its theoretical setting were involved as a known context, while students could be found in many different contexts.

Trainers worked with both their own and students' learning in several steps, subdividing the complex context into small, manageable steps, where it was possible to work problem solving as shown in figures 3 and 4. Whether one design sought to solve one or several problems is debatable.

Figure 3: Steps in *virtual meetings*

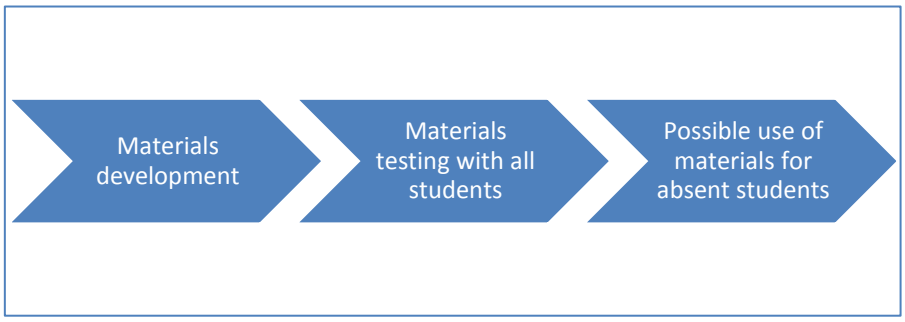

Figure 4: Steps in *absent*

In these last two cases, teachers discovered new opportunities not only relevant to the problem they were originally trying to solve. The new options could potentially occasion changes in their general teaching.

One might say that while the first two cases dealt with one academic problem in a well-defined context, the next two cases had many dimensions since they took place in complex,

multidimensional contexts.

Teachers in the first two cases learned through reflection-on-action in a pedagogical community of practice, whereas the last two cases proved much more challenging in terms of teachers' learning.[8] The *virtual meeting* shows a division into steps that allowed teachers to work their way through the complex of problems. In *absent*, the design ended up being tested on all students, and despite no students actually being absent, teachers discovered new opportunities, which washed back on their teaching in areas that had not originally been described as part of the problem. One might go so far as to say that the teachers were creative and found an innovative solution that might double as a solution to undescribed problems. Their learning and the importance of developing and testing the blended designs could mean that - in the terminology of the SAMR model - the teaching was or will be modified. Cognitively, in Bateson's terms, there was learning at Level 2. [9]

The relationship between technologies and the complexity of the design

In order to be able to pinpoint factors can have a change-initiating effect for teachers, it may prove interesting to examine the relationship between the technologies used and the complexity of the design that was developed to solve problems in teachers' practice. As previously mentioned, the first two cases dealt with the use of films at a social and health college and the use of a variety of technologies at a business college. Common to the materials developed in these cases is that they can be applied in a different context, once they have been developed. Other teachers of Danish could use the films, for example, but would have to thoroughly consider their educational use. Applying the TPACK model, however, a reservation would have to be made, namely that the pre-conditions will differ: the technological, pedagogical and content knowledge found in one teacher is not necessarily found in another, which would minimize the possibilities of immediate transfer. The materials and methods may be transformed from one context to another, but the knowledge of the individual may not.

There is a significant difference in terms of the technologies used in the two cases: In *argumentational analysis*, only one technology was applied, and students were not required to interact directly with the material. In *numeracy*, many technologies were placed at the students' disposal, and students had to interact with the materials produced. Thus the very application of the ICT tools was more complex and perhaps difficult to get to work in the classroom since, as a xconsequence, great pedagogical demands were made on the teacher, who saw the need for a different teacher role.

[8] Schön, Donald A: Den reflekterende praktiker. Klim, 2001
[9] Bateson, Gregory: De logiske kategorier for læring og kommunikation. In Hermansen, Mads red. Fra læringens horisont. Klim, 1998

In contrast, the cases *absent* and *virtual meetings* had complex designs because they had to solve complex problems.

In *virtual meetings,* a mind-mapping program was used. The program is quite simple to use, but getting students to adopt it - both in their daily lessons during school-based training and during practical training – proved difficult. In relation to the communications program - an online meeting program - the intention was to use it to test the general possibilities of virtual meetings. The program itself was just a tool for students and teachers to adapt and use actively in the relevant context.

At the business college, in the case *absent,* three ICT tools were used together: A program for the analysis of a company's e-commerce, a program for creating websites, and an instant messenger type program. Students applied the analysis program to the reality of their practical training, and the chat program afforded ongoing written dialogue between teacher and students. At the same time, students were able to see the teacher's dialog with and answers to other students. Finally, the student-produced websites allowed the teacher to regularly monitor the students' work. One teacher characterized what he did as "orchestrating" - i.e. to make the teaching work when students were at different locations while he still had regular contact with them, following their production processes on the website. This might be seen as another term for bricolage as mentioned above. In this case, both the situation and the tools were complex.

None of ICT products used here would be directly useful to and usable for other teachers because the tools were adapted to the specific design and were very much connected to the role and choices of the teacher in question. When teachers at the business college saw opportunities for a redefinition of their teaching (cp. the SAMR model), they probably did so because of their experience in the first test run (*numeracy)* and because of the general learning and knowledge sharing across the different participating colleges and their different contexts.

Table 1 below gives an overview of the four scenarios and their realizations. The relationship between design complexity and the general or context specific use of ICT tools and materials is shown.

ICT tools can be produced as general materials	**Simple design**	**Complex design**	**ICT tool is flexible in its applicability and flexible in relation to contexts**
Films	*argumentational analysis*	*virtual meetings*	Mindmapping, online meeting
Games, exercises, self-assessment	*numeracy*	*absent*	chat, website, e-commerce analysis

Henriette Duch, Hanne Wacher Kjaergaard, Lene Mark,
Center for E-Learning and Media,
VIA University College,
Denmark.
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Can *Blended Designs* change teaching practices?

In the project, blended learning was brought in to solve problems related to practice. Participating schools were obliged to include differentiation and blended solutions. There was a presupposition that aspects of blended learning could provide theoretically based answers to problems in practice. The test runs showed that teachers learned more than they had bargained for because a number of common pedagogical conclusions across vocational-school contexts became clear.

First, the relationship between theory - school-based training - and practice - practical training - was challenged: It proved possible to offer students flexible access to theory in the form of *virtual meetings* so that problems that could otherwise cause students to drop out could be addressed without long delays. Systematic logbook use in school-based training motivated some students to use it during their practical training. The logbook created a bridge between practice and theory both in the virtual meetings and later in the school-based training. Not all students benefited from the approach, but for some it was a possibility.

In *absent,* students who were given exciting opportunities in their practical training that logistically collided with their school-based training were given the possibility of accessing theory independently of their physical location, and maybe also independently of time.
By making parts of the communication between teacher and student into written communication, tacit knowledge had to be verbalized, something which teachers saw as a definite strength.

Furthermore, in order to share and spread their experiences with the blended designs they had tested at joint meetings, the teachers involved had to verbalize these experiences. They learned from each other's knowledge and paid close attention to what had not worked for the others, taking this into account in their own, subsequent test runs.

Secondly, the new initiatives required a new type of dialog between the places of school-based and practical training - a dialog that was started. Organizations providing practical training must understand and believe that students can get credit for a school day even though (s)he is at a trade show or meeting as in *absent*. And a nursing home providing a student with practical training needs to see the new opportunities opened by having virtual practice meetings that can be set up at very short notice - and which are not a formalized right for the students.

Thirdly, the blended aspects changed both teaching and work forms to a much larger extent than the teachers involved had imagined. To make the use of the extra offers at home a real option for students who have difficulty reaching competence goals, they had to be informed of this in the classroom as shown in *argumentational analysis*. It had to be integrated into the teachers' planning and pedagogical approach, and teachers must have an overview of the

needs of each individual student in order to be able to support and encourage students to take advantage of what is best suited for them - as seen in *numeracy*.

Therefore, fourthly, differentiation proved both natural and necessary. In the project, differentiation did not turn into individualization. Rather, through the application of technology and changes in their pedagogical approaches, teachers developed new possibilities for students. In some cases, as in *argumentational analysis*, students had to invest extra time at home watching the movies in order to succeed in learning. In other cases, as in *numeracy*, students needed to learn how to choose from the array of offers that could help them at home - based on their individual needs. At the social and health college, an additional practice meeting was subsequently deemed possible when necessary - without major additional resources being invested. At the business college, academically strong students could be allowed to participate in special offers from their place of practical training, without being excluded from attending the school-based training as illustrated in *absent*.

Fifthly, teachers claimed that the blended design occasioned a change in their roles as they had to have a greater focus on students' meta-learning to help students choose from and use the new options. New routines had to be established for the students to help them choose adequately as seen in *numeracy*. Whereas the project was based on theories of blended design, it turned out that teachers saw opportunities for changing their own *general* practice. One might say that there was a spill-over from technological knowledge to pedagogical knowledge. The overall result of the project is therefore a belief that applying aspects of blended learning challenges teachers to plan and organize their general teaching and classrooms differently.

In summary, teachers' learning outcomes in the project may be described in terms of professionalism. Dahle says, "Professionalism - in schools - requires communication with and construction of pedagogical theory (k3)"[10]. In this project, we believe that we have seen communication among colleagues as well as communication with and new constructions of pedagogical theory.

In relation to the conference theme, the cases in the project constitute examples of how theory has implications for practice. By seeing aspects of blended learning as tools for an increase of differentiated teaching, teachers define and exemplify solutions, thereby gaining new pedagogical insight.

[10] Dale, Erling Lars: Pædagogik og professionalitet. Forlaget Klim, 1998 p. 77

Henriette Duch, Hanne Wacher Kjaergaard, Lene Mark,
Center for E-Learning and Media,
VIA University College,
Denmark.
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