Digital Production and Students as Learning Designers

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Abstract

Today's digitalization allows users to interact, collaborate, communicate and create user-generated content. The technology is intuitive and easy to use even for young children, and new learning opportunities emerge. Particularly, students' production as a learning form benefits from digitalization as the new opportunities enable young students to integrate their playing competencies and skills into the formal school learning.

This paper presents and discusses a theory regarding students' digital production from a learning and design-for-learning perspective, which is generated based on the project Netbook 1:1 (2009–2012), where information and communication technology (ICT) was readily accessible for each child at school and at home in grades 1–3 at two Danish public schools. The paper presents a *Four Levels Design for Learning Model,* which can be used for both design for learning and analyses of learning processes. The discussion is supported by empirical examples from the project, which explored emerging relations amongst ICT, production and subject matter-specific practice (Danish, mathematics and interdisciplinary activities). We understand *design for learning* as related to both process and agency, and in the study, we have examined and found that students are capable of operating as learning designers.

Keywords: design for learning, digital production, students as learning designers, four designs for learning levels

1. Digitalization as the basis for students' production

In the Danish primary school, students' production as a learning form has a long tradition that is represented by three major trends. The first and oldest trend was related to handicraft, art and students' narrative production in relation to mother tongue education. In the 1970s, a second trend emerged as tools for media production became accessible. In the beginning, the students produced Super 8 motion pictures, which were later substituted by analogue video technology. However, analogue video was a challenge to use for both teachers and students. Parallel with media production in school, we find project work as the third trend, where the learners' verbal language production is at the core.

Over the last decades, research has demonstrated that students' production and collaboration have a positive impact on learning, and students' reflection and learning increase when they take on the shared responsibilities of organizing and performing the collaboration, production process and the product, which are the focal point of project work (Dirckinck-Holmfeld, 2000). Based on these findings, project work has become widely accepted in educational systems, especially of the Nordic countries at all levels, from primary school to higher education. As project work began to integrate with information and communication technology (ICT), we see various examples of how the principles and practices of project work have been further developed. The oldest trend that went back to the 1950s was instructional design and computer-assisted learning (CAD), based on behaviouristic learning theory (Reigeluth, 1983) and aiming to make the acquisition of knowledge and skills more efficient, effective and appealing (Merrill et al., 1996). In 1980, Seymour Papert published his book *Mindstorms: Computers, children, and powerful ideas,* based on Piaget's constructivist learning theory and in opposition to Iinstructionalual design and CAD. Papert focused on children's production as the programming of the movements of a digital turtle in relation to mathematics. However, Papert failed to document a convincing learning impact (Misfeldt, 2008). For a long period, Papert's experiments challenged the idea that ICT-integrated student production may facilitate the students' learning processes and qualify their learning results. In the 1990s, computer-supported collaborative learning (CSCL) challenged the idea from a new perspective by changing the focus from a direct link between a specific digital resource (the turtle) and subject (mathematics) to ICT as a general mediator in various learning practices. The CSCL rests on the assumption that learning occurs when humans in their social interaction and practice use computers or the Internet, and this technology is increasingly embedded in our surroundings (Dillenbourg, 1999; Dirckinck-Holmfeld, Hodson, & McConnell, 2012; Koschmann, 1996; Littleton et al., 2005). The extensive research into the impact of collaboration and ICT on students' learning documented a positive relation (Dillenbourg, 1999; Dirckinck-Holmfeld, Hodson, & McConnell, 2012; Koschmann, 1996; Littleton et al., 2005) and CSCL, collaboration and production became an integrated element of educational approaches. However, where Papert had focused on materialized production as the movement of the turtle, CSCL emphasized written production performed in asynchronous discussion fora (Fibiger & Sorensen, 2008).

In recent years, the communicative and the materialized digital productions have begun to merge again in informal contexts, as digital technology becomes increasingly intuitive and user friendly, and the digital debutants become increasingly younger. The research follows this trend, and we see a growing research interest in digital production. We especially see that the expanded space for creativity relates to self-produced and shared computer games, fan productivity and fan fiction (Jenkins, 1992). The young and media-literate users voluntarily get involved in a broad variety of digital creative practices (Buckingham et al., 2005; Wirman, 2007), for example, by creating transmedia narratives (Albrechtslund, 2010; Klastrup & Tosca, 2004, 2011, 2013). Thus, digital production changes our understanding and use of media and raises a demand for new concepts. We already see new concepts such as *produsage*, *mashup* and *remix* (Navas, 2007; Sonvilla-Weiss, 2010) emerge in the attempt to verbalize the new practices that empower the users with direct agency and participation in digital production.

These technologies and digital productions have only just begun to gain acceptance in school. Therefore, the research into their impact on subject-matter learning is scarce and primarily directed towards language subjects (Gilakjani, Ismail, & Ahmadi, 2011; Jewitt, 2011). Some studies document that learning occurs in the actual construction of digital products, where the students search for information and experiment, and related reflections are transformed into subject-matter learning. These studies focus on youth and adult education in the UK where students produce podcasts and videocasts using Web 2.0 services and smartphones. Lee, McLoughlin, and Chan (2008), Miller (2006), and Cebeci and Tekdal (2006) demonstrated how the learning potential of podcast and videocast technologies is embedded in the process where the students produce knowledge for their productions. They also found a potential for use, since student productions can be distributed as learning objects for other students. Atkinson concluded, "The emerging developmental and research direction seems…to be learning through creating podcasts and similar, in contrast to learning from podcasts" (2006, p. 21). Smith et al. (2005) and Lazzari (2009) found a significant increase in students' grades when they produced their own podcast lectures. Furthermore, Lazarri (2009) found that educational activities involving student productions improved the students' cognitive processing of materials and their critical thinking. These findings support and re-actualize Papert's theory as it was formulated in 1990: "The computer has a theoretical vocation: it can make the abstract concrete; it can bring formality down-to-earth" (Turkle & Papert, 1990, p. 131).

As earlier mentioned, the accessibility and the intuitiveness of present digital resources have caused the age at which children debut with the Internet to drop to an average of 4 years (Medierådet, 2010). This means that young students show up in primary school being digital experienced, displaying basic computer skills (Martin, 2006) and multimodal competencies such as knowledge of genres and means of expression (Buckingham et al., 2005). Accordingly, they arrive in school with the expectation that the technology is present there. Therefore, the need is obvious to create space for these competencies in formalized teaching, by incorporating informal learning strategies stemming from the students' play culture into the schools' formalized designs for learning (Selfton-Green, 2006; Sørensen, Audon, & Levinsen, 2010).

Apart from inviting students' informal learning strategies, play forms and creativity, digital technology offers another significant opportunity. With wireless and mobile accessibility, Web 2.0 and cloud technologies, the school is no longer unambiguously limited by brick and mortar. The students navigate in an expanded space – a hybrid space – where the physical and digital spaces have become an inseparable whole (Sørensen, Audon and Levinsen, 2010) in the hybrid space, the formalized school will inevitably encounter the students' informal learning strategies, being connected to the local and global outside world where students can share their products online and mirror one another (Ito, 2010).

Recent studies have found that students' digital production is a way of learning, which produces solid, subject-matter learning results, but only if the teachers' frame design includes clear objectives and evaluations (Jewitt, 2011; Sørensen, Audon, & Levinsen, 2010). When students produce within an appropriate frame design, the design supports the fact that they organize/reorganize the process and negotiate meaning through a mutual explorative dialogue (Littleton et al., 2005; Turkle & Papert, 1990) and reflection (Levinsen & Sørensen, 2013) that facilitate learning. Additionally, productive processes support creative learning processes and challenge students to produce their own original syntheses, where their knowledge about the world and the subject matter are integrated in new combinations (Gauntlett, 2011).

2. Project Netbook 1:1

The research project Netbook 1:1 had its outset in the presented research regarding students' digital production within a frame designed by the teacher. The project explored the combination of ICT, production and subject matter-specific practice in grades 1–3 at two Danish public schools where ICT was readily accessible and where each child received a personal Netbook tablet which was used both at school and at home. The research project was conducted during the 2009–2012 period as an interventional and transformative project inspired by design-based research and action research. The researchers participated in the development of ICT-integrated designs for learning and studied their impact on learning outcomes and learning processes in the subjects of Danish, mathematics and interdisciplinary learning activities. The data was collected using mixed methods (Creswell, 2003) in a blend of anthropological methods, formal and informal interviews with teachers and students, videos (short clips made using mobile phones) and photos, materials as objective contracts, teachers' frame designs, student work, etc. All research involving the students was performed with both the child's and the parents' permission and all data were anonymized.

The data analysis was performed as an annotation of keywords, using a combination of open and predefined categories, in order to identify related themes and analyze and produce knowledge about important research parameters (Creswell, 2003). These parameters included formal and informal learning processes, knowledge sharing, learning environment, student and teacher competencies and relations, and students and teachers as learning designers.

We are inspired by Dale´s three educational competence levels: practice, organizing and planning, and theoretical reflection (1989, 2000). We also attach great importance to *reflection in action* (Schön, 1983) due to our understanding of the term *design for learning* as both a process and an agency-related concept. Following Dale and Schön, Netbook 1:1 actualizes both the teachers and the students as learning designers. Traditionally, design for learning is solely the teachers' domain. But when the students – within a frame designed by the teacher – produce learning objects for other students, this frame paves the way for the students to become learning designers of their own learning processes.

This approach is new in relation to research into learning design, and it contributes to the development of digital integrated design for learning. In our understanding of design for learning, both students and teachers act as learning designers. Therefore, it was essential for us in project Netbook 1:1 to explore the students' design for learning competencies and how these make an impact on their subject and interdisciplinary learning.

In this paper, we present and discuss students' production and students as learning designers, based on the Netbook 1:1 study. In the following sections, we present the theoretical framework and focus on the students as learning designers.

3. Theoretical framework

Our understanding of design for learning is based on a German-Nordic interpretation of the relationship between teaching and learning called *didactics* (*Didaktik).*[i] Within this tradition, the formation of democratic citizens is central. We also draw on Allan Martin's (2006) concept of digital literacy and Mauel Castells' (2000) concept of *self-programmable labour* to enhance our understanding of design for learning that humans are able to develop competencies that empower them to manage their own competence building. By understanding design for learning as situated, contextual and negotiable, we avoid the danger that it may congeal into standardized and prescriptive models for teaching practice. Intentionality is inherent in design for learning: the teacher wants to achieve something with the students' learning and his/her teaching; the students want to achieve something through their learning.

We understand Dale's (1989, 2000) three levels – practice, organizing and planning, and theoretical reflection – as each other's prerequisites, as an integrated and dynamic whole that changes in a continuing process of interaction. Dale related the levels to the teachers' domain. Our concept of design for learning provides agency to both the teacher and the students. Thus, the concept belongs to the domains of both of them, who mutually become learning designers. We define design for learning as a theoretical and situation-based activity and process that aims to:

- establish learning objectives and content;
- frame the organization and planning;
- stage the activities and the arena for teaching and learning where modalities, media, learning resources, mode of production and mode of presentations are selected; and
- frame the evaluation.

The actual operationalization and *doing* of design for learning are often more complex than the learning designers' prior conceptualization of their intentions. Therefore, design for learning as both a process and an agency has to be understood from a time perspective (see Figure 3). Similar to traditional *Didaktik,* there is a PRE-activity of planning and organizing and a POST-activity of synthesizing and evaluation. However, doing learning design also takes place during teaching and learning as a reflective interaction in practice – often involving redesign. This means that we emphasize the PRACTICE – activity IN CLASS – the teacher's reflection in action (Schön, 1983) as a professional teacher competence.

4. Students' production and students as learning designers – two complementary processes

It is important to distinguish students' digital production and learning design as separate but complementary processes. As digital producers, the students acquire knowledge about a subject, whereas as learning designers, they define (sub)goals, select content and organize their learning process in relation to producing learning objects for other students. The processes run parallel in an ongoing complementary interaction, where the students continuously position themselves as either producers or learning designers (see Figure 1).

In this section, we focus on digital production and the students as producers; in the next section, we provide a closer look at the students as learning designers.

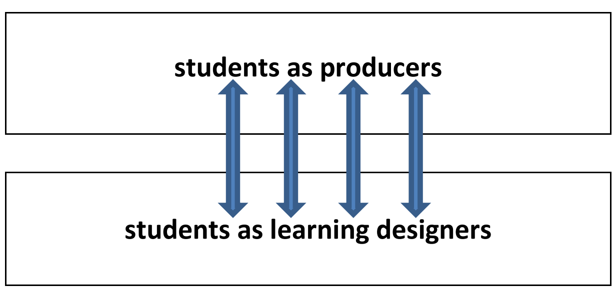

Figure 1. Interrelation between the complementary processes and roles

Students as producers

Students' digital and Web 2.0-based productions are new to the school and a novel object for research. As mentioned earlier, students' productions represent a long tradition in school, but the new media landscape creates a unique situation where multimodal and other digital resources are at hand and easy to process, edit, remix and circulate in online social networks (Lange & Ito, 2010). Additionally, new genres of production tools provide new options for production. The interaction design of these tools is intuitive and easy for children to handle.

Digital production actualizes the concept of multimodality as multimodal resources are integrated into both subject matters and interdisciplinary activities. Gunther Kress defined a mode as “a socially and culturally shaped resource for making meaning” (2003, p. 45); for example, an utterance or a text creates meaning. When different modes such as images (live or static), sound (music, speech, noise), written text and graphic illustrations are combined in an expression, the concept is called multimodality. Multimodality challenges Vygotsky’s (1962) theory of the dominant impact of verbal language on thinking and learning. For Kress (2010), multimodality opens a new Vygotsky approach to learning that rests on the assumption that concepts and knowledge belonging to a subject matter, when uttered as multimodal representations, are mediated through a range of modalities, with each having its own logic for cognition that differs from the verbal logic of cognition as presented in Vygotsky’s original theory.

The multimodality of digital media accommodates a variety of modalities or means of expression, which allows for a range of learning strategies that empowers the students to approach learning processes in various ways. Multimodal means of expression thus become a dimension of a differentiation perspective in school. In this sense, working with multimodal digital resources is understood as less segregating than if the students were restricted to verbal language alone. All subjects have a tradition of representation with a preferred set of modalities, and accordingly, Elf (2012) raised the question of whether the use of digital modalities may challenge these conventions. This also points at the importance of the students acquiring multimodal literacy.

During the production process, the students construct and structure their productions using various modalities as means of aesthetic expression and as communication. While doing so, they develop competencies in selecting the best suited modalities for representing certain content in relation to an intention to communicate that content to somebody else. On one side, the process is spacious as it invites creativity, experiments, empathy and analysis. On the other side, the process is demanding regarding multimodal literacy and the ability to combine modalities.

Students as learning designers

As argued above, design for learning is a concept that embraces both process and agency aspects, and as a scientific approach, it operates with the coupling of teaching and learning, where both teacher and student act as learning designers.

Originally, the concept of *design* means to draw, plan and mould; etymologically, it originates from the Latin *designare,* which means to delineate, sketch and plan (Ordnet, 2013). Design as a concept has a long tradition within domains such as architecture, crafts, industrial design, graphic design, etc., where functionality, aesthetics and later, ethics are central aspects. Eventually, design spread to other domains and has become an umbrella concept that assembles information from many disciplines and expert domains.

According to Kress and Sidiropoulou (2008), our increasingly complex society generates an increasing number of citizens as actors who possess the power to design, change and influence their environment. This tendency is further enhanced by the omnipresent digital resources (Dourish, 2001). As the second-generation Internet offers new opportunities for users to become participants, producers and co-creators – that is, designers of content – the relation between teaching and learning, on one hand, and ICT, on the other, has become a new factor in school, which demands development and innovation of the educational categories and their mutual relations. According to Kress and Sidiropoulou (2008), the encounter between social change and ICT as an educational factor causes design to emerge as a co-shaping practice in school. In this process, the concept of design is transformed into the domains of teaching and learning, communication and social relations – that is, design for learning:

- For the teacher, design for learning as an agency means designing frames in which students are empowered to act as learning designers, facilitated by the teacher.
- For the students, design for learning as an agency means that they define (sub)goals, select content and organize their learning process in relation to producing learning objects for other students.

We argued above that design for learning is inherently intentional. Therefore, when the teacher designs for learning, the task is to design a framework that provides an arena where the social and collaborative agency unfolds in ways that allow the students to become learning designers. Thus, the challenge is to design a dynamic frame where the teacher and students continuously interact, construct and stage teaching and learning aimed at the students' construction of subject or interdisciplinary knowledge.

5. Four educational competence levels – a new model

In our previous research (Sørensen, Audon, & Levinsen, 2010), we have documented that students are able to operate as learning designers at Dale's (1989, 2000) first two levels: practice, and organizing and planning. In project Netbook 1:1, we find that the students also operate at the third level of reflection, due to the teacher-designed frame, which centres the students' learning process and subject-related reflections. The frame defines an arena, where the students take on responsibilities and act as learning designers under the teacher's supervision. We find that students reflect on their practice during the process using everyday language, while the teachers' reflection in action is based on their professional theoretical knowledge and competencies.

1. Practice	teacher	student
2. Organization and planning	teacher	student
3. Situated and practice-based reflection	teacher	student
4. Theory-based reflection	teacher	

Figure 2. Four levels of the Design for Learning Model

From a design-for-learning perspective where the students' learning is driven by their reflections as learning designers, it makes sense to further develop Dale's model (1989, 2000) and operate with a four-level *Design for Learning Model*. In the new model (Figure 2), the fourth level belongs solely to the teachers' domain.

6. The relation between teacher and students as learning designers

When students within the teacher's frame define (sub)goals, select content and technology, and organize their learning process in relation to producing learning objects for other students, the teacher's position transforms into classroom management where the teacher facilitates, supports and challenges the students based on a situated and profession-based fourth level, reflection in action.

When both the teacher and the students are learning designers, the process can be described from a time perspective that allows a subdivision of the process into three phases with different focuses and activities. The three phases are introduced above from the teacher's perspective as PRE-activities (preparation), POST-activities (evaluation) and PRACTICE activities (IN CLASS). The students work within the same phases, but from the teacher's perspective, the full student cycle is often embedded in the teacher's PRACTICE as IN-CLASS activities, while the students' PRACTICE is called PRODUCTION (Figure 3).

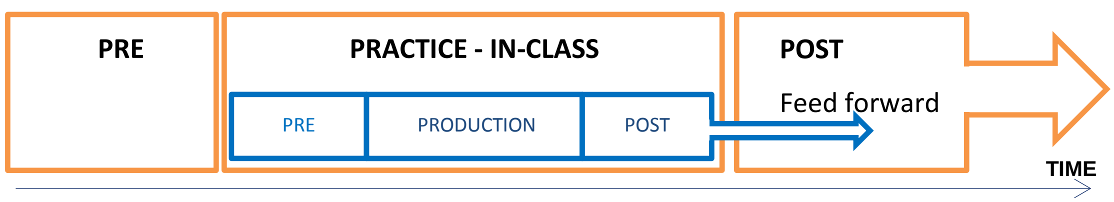

Figure 3. In a schematic form, illustration of the chronological relationship between teacher and students as learning designers regarding the work. Orange = teacher; blue = students

The teacher's frame design may incorporate the fact that students sometimes prepare before practice in class and work on their projects at home or in the preschool arrangement.

In the PRE-phase, the teacher plans and organizes his or her own role and activities in the PRACTICE/IN-CLASS phase, along with setting the entire framework for the students. In the POST-phase, the teacher evaluates and shares knowledge with colleagues in order to improve or innovate future learning designs. When the teacher performs reflection in action at the third and fourth educational competence levels while the students are working, it paves the way for the teacher to modify concurrently the original design and from a differentiation perspective, to adapt feed forward and feedback to the students' zone of proximal development (Vygotsky, 1962). This means that design for learning is an iterative and dynamic process, even though the full life cycle can be subdivided into phases defined by focus, milestones and deadlines. As both the teacher and the students are learning designers, they mutually possess the agency to iterate and perform ongoing modifications as learning, experience and reflection emerge.

In the following section, we exemplify our theory and findings through one case regarding mathematics from project Netbook 1:1 (Levinsen & Sørensen, 2013).

7. Mathematics

With digital aids such as calculators and spreadsheets, machines can solve mathematical problems for us. Therefore, the focus of mathematics teaching is gradually changing towards how students acquire mathematical knowledge as concepts, which can be applied in practice to “figure something out” and instruct the machines to perform the calculations for us (Misfeldt, 2008, 2013a, 2013b). In this case, in a second-grade class, students constructed problem-based mathematics stories that must incorporate the four basic forms of arithmetic and the mathematical concepts of differentials, sums and decimals. The topic was commerce, and the students defined the articles for sale and used authentic prices and pictures found online. They produced their mathematics stories using construction and presentation software of their own choosing. It was required that the students would be able to explain how to complete the assignment in their mathematics stories, both orally and in writing. The students collaborated in pairs but produced their own mathematics stories. They were allowed to move about freely and to discuss, observe and share ideas. The final mathematics stories were collected on the class intranet in order for the students to produce reasoned, subject-related peer feedback and feed forward regarding improvements.

The teachers’ IN-CLASS PRACTICE involved full sessions every day. At the sessions, the tasks for the day were discussed: “How far have we achieved? What is important? What is missing?” The first session functioned as part of the students’ PRE-activities, established their ownership to the process and introduced them to mathematical language and concepts. Together, the class agreed on the framework and the learning objectives. The agreements were written in the students’ learning objective contract. The students’ PRE-activity continued as they decided how to proceed with the task. The subsequent full sessions framed the students’ PRODUCTION activities and focused on the iterative aspects of the production process where the students were at the helm, while the teacher facilitated and checked whether “all bases had been covered”. At the end, the mathematics stories were delivered on the class intranet, and everyone could try one another’s assignments. The teacher organized the peer evaluation in terms of who would evaluate whom. The students’ POST-activity was peer evaluation of whether the mathematics stories functioned as intended by the producer and whether they learnt something about mathematics. As part of the peer evaluation, they also offered suggestions for improvements and examples of what worked well.

Following the case, we found that when students constructed assignments for other students, they were able to apply their existing competencies in a subject-related and creative process and to explore their knowledge. At the same time, they gained experience in reading subject literature and in applied mathematics. The frame forced them to reflect as learning designers on the subject matter in order to create good, fun and educational mathematics story assignments for their classmates.

The case is an example of design for learning, which was developed and practised during the project. With its strong focus on the iterative production process, the case studies in this project offered the teachers and researchers ample opportunity to observe and challenge the students throughout the project. An important finding was that differentiated learning and varying approaches automatically emerged out of the process. The content and level of complexity reflected the students’ academic competencies, while the iterative production process reflected their academic progression. The students’ cognitive breakthroughs occurred during discussion and reflection regarding their ideas about and experiments with multimodal means of expression, aesthetic design and the actual learning design of the mathematics stories, thus confirming both Kress' theory of multimodality and modes as "a socially and culturally shaped resource for making meaning" (2003, p. 45) and Papert's claim, "The computer has a theoretical vocation: it can make the abstract concrete; it can bring formality down-to-earth" (Turkle & Papert, 1990, p. 131).

The awareness that other students would have to solve their mathematics stories helped students maintain focus on the subject matter. The students realized that unrealistic or irrelevant assignments would be either too difficult or uninteresting for their peers. We also found that when students were expected to complete their own mathematics stories and explain their methods both orally and in writing, this activity had considerable cognitive impact. During this process, the students often realized that their mathematics stories were unclear or too complex in relation to their own mathematics level and adjusted them accordingly. Completing assignments designed by their classmates also demonstrated the students' mathematical competencies.

Multimodal representations, communication and dialogue using mathematical language became a necessity in order for the students to express their own way of thinking and understanding of classmates' ideas and proposed solutions. The products provided numerous examples of students exceeding the stipulated learning objectives for their grade group and working at a level not expected until later in their schooling. For example, the *number of units* and *set* concepts were indirectly introduced, represented by pictures of two piles of sweets (sets) and the number of sweets in each pile (number of units belonging to the set). The assignment in this mathematics story was to find the total number of sweets. Such a level of abstraction far exceeds what is generally expected of students in grade 2. Another example was how students' interest in football led them to form arithmetic problems using large figures such as millions, based on football players' salaries.

8. Concluding discussion

The vast majority of the students were able to produce unique assignments with varied subject matters and attractive and aesthetic layouts. The task of creating productions using multimodal means of expression demonstrated the students' academic potential by stimulating and incorporating their powers of imagination. By imagining an assignment that they had to produce, the students learnt the subject-related content and, in many cases, simultaneously learning content exceeding the learning objectives for their grade level. The students' multimodal work offered the teacher numerous opportunities for differentiation as learning spaces were established, providing students with the latitude to approach the tasks in various ways and at different levels.

Based on the analysis of our empirics using the three levels of educational competencies and the design for learning phases as analytical categories, we have found a convincing relationship that confirms our theoretical assumption. The teachers are able to operate at the four levels of practice, organizing and planning, situated and practice-based reflection, and theory-based reflection. The students use the first three levels due to the teachers' design for learning frames. However, it is evident that the students reflect on their practice using everyday language, while the teachers' reflection in action is based on profession-based theoretical and practical knowledge.

In Table 1, we present the students' agency and reflections within the analytical framework.

Table 1

Summary and Illustration of the Relationship between the Production Process and the Three Levels of Educational Competencies

Phases / Three levels	PRE-activity	PRODUCTION	POST-activity
Practice	Students envisage and describe their respective tasks and solutions on the basis of the agreed requirements and learning objectives. Students plan their respective multimodal products and presentations of the assignment.	Students implement and concretize their tasks while discussing subject-related challenges and methods of multimodal communication with the teacher and their peers. Students test and redesign their products.	Classmates provide feedback on the shared products based on the criteria set out by the teacher and on their own appraisals.
Planning	Students agree on how they will organize their tasks so as to be relevant to others in terms of subject-specific content. They discuss what would be a good sequence of activities and good questions to ask. Students negotiate and agree on how to collaborate.	Students discuss and try out different ways of constructing and formulating their tasks so as to be meaningful for others.	Students give feedback to classmates. Students address/apply the feedback they receive.
Reflection	Students consider which subject-related elements and combinations to focus on in their respective tasks.	Students formulate methods for completing their tasks and reflect on how they can improve their work, based on the subject knowledge they already possess. At this point, many students exceed the specific curricular/learning objectives for the subject for their grade level.	Students speak of their understanding of why it is important to listen to and embrace critique. In the dialogue, ideas are created for how everyone can continue the work and what each student needs to focus on in the future.

The project demonstrates that ICT-integrated student productions in conjunction with the developed designs for learning can both facilitate students' learning processes and qualify their academic learning outcomes. The project has provided experience with and insight into the importance of using students' ICT-integrated production as a base. Moreover, the project has developed and tested tools for organizing lessons that accommodate individual students' learning abilities, learning processes and competencies. Ongoing evaluation and sparring allow the teacher to root academic content or to challenge students' competencies. When students have the opportunity of working on the basis of their own abilities and levels, they are not hampered by assignments that are either too easy or too difficult for them. Through differentiated learning, students are able to work independently, take the initiative and be creative and innovative, thereby developing the competencies which, from a knowledge society perspective, are crucial to develop from the earliest stages of schooling. As illustrated by the mathematics case, learning designs give the teacher the time to focus on managing learning processes and organizing lessons into different processes, framed by iteration, feed forward and student ownership of the learning processes.

Our research set out to explore the emerging relations amongst ICT, production and subject matter-specific practice; the students' design for learning competencies; and how these competencies impact on their subject and interdisciplinary learning. We find that the project succeeds in doing so and that our findings and elaboration of Dale's educational competence levels are documented in the analysis of the students' operation at the three levels, leaving the fourth as the teachers' domain. The project also points out the need for further studies on the relations amongst ICT, production and subject matter-specific practice. The authors are currently involved in a large-scale project with this focus, under a grant by the Danish Ministry of Education.

References

Albrechtslund, A. M. (2010). Gamers telling stories understanding narrative practices in an online community. *Convergence*, *16*, 112–124.

Atkinson, R. (2006). Podcasting: do you really need to know? *HERDSA News*, *28* (2), 20–22.

Buckingham, D., Carr, D., Burn, A., & Schott, G. (2005). *Videogames: text, narrative, play*. Cambridge: Polity Press.

Castells, M. (2000). *The rise of the network society*. West Sussex: John Wiley & Sons.

Cebeci, Z., & Tekdal, M. (2006). Using podcasts as audio learning objects. *Interdisciplinary Journal of Knowledge and Learning Objects*, *2*, 47–57.

Creswell, J. (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage

Dale, E. L. (1989). *Pedagogisk profesjionalitet.* Oslo: Gyldendal.

Dale, E. L. (2000). Professionalisering og læring i organisationer. In P. Andersen & P. Frederiksen (Eds.), *Innovation, kompetence, læring.* (pp 123–130). Frederiksberg: Dafolo..

Dillenbourg, P. (1999). Introduction: What do you mean by "collaborative learning". In P. Dillenbourg (Ed.), *Collaborative learning: Cognitive and computational approaches.* (pp 1-19). Oxford: Elsevier Science.

Dirckinck-Holmfeld, L. (2000). Virtuelle læringsmiljøer på projektpædagogisk grundlag. In S. Heilesen (Ed.), *At undervise med IKT*. Frederiksberg: Roskilde Universitetsforlag/Samfundslitteratur.

Dirckinck-Holmfeld, L., Hodson, V., & McConnell , D. (Eds.) (2012). *Exploring the theory, pedagogy and practice of networked learning.* New York, Dordrecht, Heidelberg, and London: Springer.

Dourish, P. (2001). *Where the action is*. Cambridge, MA: MIT Press.

Elf, N.F. (2012). Verbalisering, visualisering, multimoddalisering! in Elf, N.F. & Ebbensgaard, A.B. *Visuel hf og virkelighed*. Viborg: VIA University Collage.

Fibiger, B., & Sorensen, E. K. (2008). Medierede læreprocesser: Fra sproghandling til samhandling. In Andreasen, L. B., Meyer, B. & Rattleff, P. (Eds.), *Digitale medier og didaktisk design: brug, erfaringer og forskning* (pp. 235-251). Copenhagen: Danmarks Pædagogiske Universitetsskole, Forskningsprogrammet Medier og IT i Læringsperspektiv.

Gauntlett, D. (2011). *Making is Connecting*. Cambridge: Polity Press.

Gilakjani, A. P., Ismail, H. N., & Ahmadi, S. M. (2011). The effect of multimodal learning models on language teaching and learning. *Theory and Practice in Language Studies*, *1* (10), 1321-1327.

Ito, M. (2010). *Hanging Out, Messing Around, and Geeking Out*. Boston: MIT Press.

Jenkins, H. (1992). *Textual poachers. Television fans and participatory culture*. New York: Routledge.

Jewitt, C. (2011).The changing pedagogic landscape of subject English in UK classrooms. In K. L. O'Halloran (Ed.), *Multimodal studies*. (pp 184-211). New York: Routledge.

Klastrup, L., & Tosca, S. (2004). Transmedial worlds – rethinking cyberworld design. In *CW2004 Cyberworlds Conference Proceedings.* Los Alamitos: IEEE.

Klastrup, L., & Tosca, S. (2011). When fans become players: LOTRO in a transmedial world perspective. In Krzywinska, I. T., MacCallum-Stewart, E. & Parsler, J. (Eds.), *Ringbearers. The Lord of the Rings online as intertextual narrative*. Manchester: Manchester University Press.

Klastrup, L., & Tosca, S. (2013). A game of thrones : Transmedial worlds, fandom & social gaming. In Ryan & Thon (Eds.), *Storyworlds across media*. Nebraska: University of Nebraska Press.

Koschmann, T. (1996). *CSCL: Theory and practice of an emerging paradigm*. Mahwah, NJ: Lawrence Erlbaum Associates.

Kress, G. (2003). *Literacy in the new media age*. London: Routledge

Kress, G. (2010). *Mulimodality. A social-semiotic approach to contemporary communication*. Oxon: Routledge.

Kress, G. & Sidiropoulou, C. (2008). Klasserumsdesign. I: A.-L.Rostwall & S. Selander, *Design för lärande*. Stockholm: Norstedts Akademiska

Lange, P. G & Ito, M. (2010). Creative Production. I Ito, M. (Red.) *Hanging Out, Messing Around, and Geeking Out,* kap. 6, 243-295.

Lazzari, M. (2009). Creative use of podcasting in higher education and its effect on competitive agency. *Computers & Education*, *52* (1), 27–34.

Lee, M. J. W., McLoughlin, C., & Chan, A. (2008). Talk the talk: Learner-generated podcasts as catalysts for knowledge creation. *British Journal of Educational Technology*, *39* (3), 501–521.

Levinsen, K., & Sørensen, B. H. (2013). Students as learning designers. In McBride, R. & Searson, M. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2013* (pp. 5142–5149). Chesapeake, VA: Association for the Advancement of Computing in Education.

Littleton, K., Mercer, N., Dawes, L., Wegerif, R., Rowe, D., & Sams, C. (2005). Talking and thinking together at key stage 1. *Early Years: An International Journal of Research and Development*, *25* (2), 167–182.

Martin, A. (2006). A European framework for digital literacy. *Digital Kompetanse*, *2*, 151–161.

Medierådet (2010). *Småungar & Medier – Fakta om små barns användning och upplevelser av medier.* Retrieved from http://www.statensmedierad.se/upload/Rapporter_pdf/Smaungar%20och%20 Medier%202010.pdf

Merrill, M. D., Drake, L., Lacy, M. J., Pratt, J., & ID2_Research_Group. (1996). Reclaiming instructional design. *Educational Technology*, *36* (5), 5–7.

Miller, D. B. (2006). *Podcasting at the University of Connecticut: Enhancing the educational experience*. Connicticut: Campus Technology.

Misfeldt, M. (2008). At skrive matematik under påvirkning af nye medier. In Andreasen, Meyer, & Rattleff (Eds.), *Digitale medier og didaktisk design: Brug, erfaringer og forskning***.** Copenhagen: Danmarks Pædagogiske Universitetsforlag.

Misfeldt, M. (2013a). Mellem læringspotentiale og skuffelse – it didaktik og matematik. In Weng og Wahl Andersen (Ed.), *Håndbog for matematikvejledere*. Dansk Psykologisk Forlag.

Misfeldt, M. (2013b). Kreativ digital matematik: Hen imod en værktøjsbaseret matematisk innovationskompetence. *Matematik, 2*.

Navas, E. (2007). The three basic forms of remix: A point of entry. In *Remix Theory*. Retrieved from http://remixtheory.net/?p=174

Ordnet.dk (2013). Retrieved November 30, 2013 from ttp://ordnet.dk/ddo/ordbog?query=design

Organisation for Economic Co-operation and Development (OECD). (2001). *Meeting of the OECD education ministers,* Paris, 3–4 April 2001. Retrieved from www.oecd.org/ dataoecd/40/8/1924078.pdf (04.01.08)

Papert, Se. (1980). *Mindstorms: Computers, children, and powerful ideas,* Basic Books

Reigeluth, C. M. (Ed.). (1983). *Instructional-design theories and models: An overview of their current status*. Hillsdale, NJ: Erlbaum.

Schön D. (1983). *The reflective practitioner – How professionals think in action*. New York: Basic Books.

Selfton-Green, J. (2006). *Literature review in informal learning with technology outside school: A report for Nesta Futurelab*. Bristol: NESTA Futurelab.

Smith, K. A., Sheppard, S. D., Johnson, D. W., & Johnson, R. T. (2005). Pedagogies of engagement: Classroom-based practices. *Journal of Engineering Education*, *94* (1), 87–101.

Sonvilla-Weiss, S. (2010). Introduction: Mashups, remix practices and the recombination of existing digital content. Sonvilla-Weiss, S. (Ed.) *Mashup cultures* (pp. 8–23). New York: Springer Wien.

Sørensen, B., Audon, L., & Levinsen, K. (2010). *Skole 2.0*. Aarhus: Klim.

Turkle, S., & Papert, S. (1990). Epistemological pluralism: Styles and voices within the computer culture. *Signs*, *16*, (1), 128–157.

Vygotsky, L. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Wenger, E. (1998). *Communities of practice. Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice: A guide to managing knowledge.* Boston, MA: Harvard Business School Publishing.

Wirman, H. (2007). I am not a fan, I just play a lot – If power gamers aren't fans, who are? In *Situated Play* (pp. 377–385). *Proceedings of DiGRA 2007* Conference.

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[i] *Didaktik* is difficult to translate into English. *Didaktik* means the sciences of teaching and is often translated as *Design for Learning.*