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Cover Page Footnote

Acknowledgments. The author would like to thank the students of the Digital Video course for being enthusiastic students, research subjects and co-workers in the refinement of the course.

Promoting Meaningful Learning through Video Production-Supported PBL

Päivi Hakkarainen

Abstract

This paper reports on a design-based research for designing, implementing, and refining a problem-based learning (PBL) course on educational digital video at the University of Lapland's Faculty of Education. The course builds on a combination of problem solving in small group tutorial sessions and realizing a practical hands-on project during which the students design and produce educational videos about the topics they are studying. The research has a dual goal of refining the PBL course and designing a pedagogical model that combines video production with PBL to support students' meaningful learning. The data were collected through a questionnaire for the course students, audio recordings of students' interviews, and students' performance results. Results and their implications for the course design and for the video-supported PBL model are presented.

Introduction

Providing students with opportunities for multimodal design and expression of ideas is a central rationale for this research (see also Peppler & Kafai, 2007). Jonassen and colleagues (Jonassen, Howland, Moore, & Marra, 2003) consider the "students-as-video-producers" model (p. 133) to be a powerful tool in promoting meaningful learning (see also Shewbridge & Berge, 2004). A growing number of university teachers outside the traditional fields of video production (e.g., art, media studies, communication sciences) are advocating teaching practices in which students take on the role of video producers (e.g., Masats, Dooly, & Costa, 2009; Schwartz & Hartman, 2007).

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Previous Research

Integrating university students' video production into project-based learning (Hung, Keppell, & Jong, 2004), case-based teaching (Hakkarainen, Saarelainen, & Ruokamo, 2007), and drama pedagogy (Hakkarainen & Vapalahti, 2009) has been shown to be beneficial for meaningful learning. Research results from the field of participatory design of multimedia or hypermedia learning materials suggest that engaging university students in the design and production processes can increase their understanding of the subject matter (Kiili, 2005; Strobel, 2006). In the college context, Ellis, Lee, and Tham (2004) studied the use of student video production in an engineering mechanics course and concluded that video production helped students improve their communication skills while they learned about mechanics. However, they reported that in order to successfully implement the use of video production, close interaction between the subject-matter teacher and the media-production teachers was needed.

In university teaching, there are few instances in which the integration of PBL and students' own video productions about the subject matter have been reported. Leahy and Walshe (2005) reported on the design of a speech and language therapy module where students were encouraged to present their problem resolutions through a variety of presentation formats, including video productions. Within the PBL approach, research has focused more on the use of video cases and triggers (e.g., de Leng, Dolmans, van de Wiel, Muijtjens, & van der Vleuten, 2007) than on students' own video productions.

Kolodner et al. (2003) have proposed a project-based inquiry approach—Learning by Design (LBD)—in which middle school students learn science in the context of designing working artifacts or devices. The approach is based on case-based reasoning and PBL and sees design as a vehicle for promoting collaborative, learner-centered, and inquiry-oriented learning. Even though the approach does not involve video production, its focus on design makes it relevant for the video production-supported PBL approach. Kolodner et al. (2003) provided strong evidence that LBD students learned science content as well or better than comparison students. In addition, LBD students performed better than non-LBD students on collaboration and metacognitive skills. However, Kolodner et al. identified several teacher and system challenges, such as creating a classroom culture that valued collaboration, iteration, reflection, abstraction, and discussion.

Findings from the first cycle of the present research (see Hakkarainen, 2007, 2009) suggest that integrating video production about problem areas being investigated into a PBL course either moderately or strongly supported most of the process characteristics of meaningful learning used in the research, including students' emotional involvement (see figure 1). The results indicated that students' emotional involvement in learning carried a positive tone: satisfaction, feelings of challenge, interest, and sense of community were the most intense emotions reported by the students (Hakkarainen, 2007, 2009). Previous

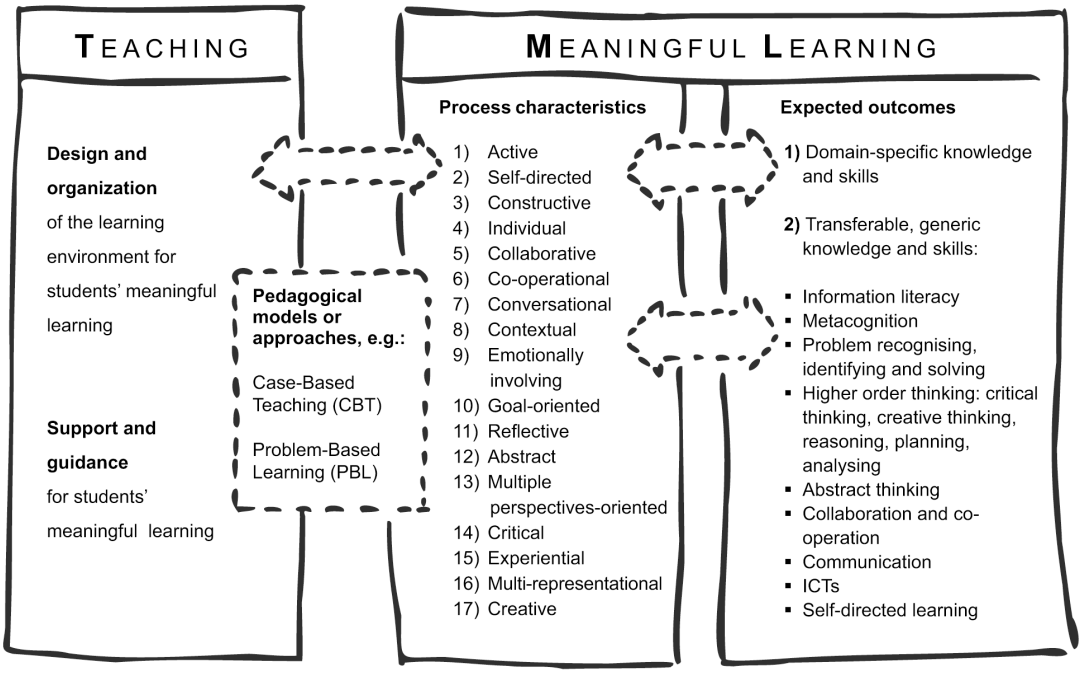
meta-analytical research results on PBL indicate that students generally report greater satisfaction with the PBL approach than with the more traditional approaches (Strobel & van Barneveld, 2009).

Emotions are an integral but under-researched part of learning (Kort & Reilly, 2002; Pekrun, 2007; Pekrun, Goetz, Titz, & Perry, 2002; Schutz & DeCuir, 2002). Previous research has even shown that, based on students' perceptions, emotional involvement is the most important feature of good learning situations (Soini, 1999). Theoretical considerations and the existing research evidence suggests that the emotions students experience in academic settings play a central role in their motivation to learn (Meyer & Turner, 2002; Pekrun et al., 2002; Pekrun, 2007), self-regulation in learning (Pekrun et al., 2002; Pekrun, 2007; Schutz & DeCuir, 2002), and academic achievement (Pekrun et al., 2002; Pekrun, 2007). Pekrun et al. (2002) proposed the term *academic emotions* to denote emotions that students experience in school or university settings and "that are directly linked to academic learning, classroom instruction, and achievement" (p. 92). Based on their research using samples of university and K-12 school students, Pekrun et al. (2002; see also Pekrun, 2007) concluded that frequently experienced positive emotions included enjoyment of learning, hope, pride, and relief, whereas frequently experienced negative emotions included anxiety, anger, boredom, and shame. With the exception of relief, positive emotions predicted high achievement, and negative emotions predicted low achievement. Other models addressing emotions experienced in learning settings include, for example, Kort and Reilly's (2002) Four Quadrant Model, which relates phases of learning to the following six emotion axes: anxiety-confidence, ennui-fascination, frustration-euphoria, dispiritment-enthusiasm, terror-excitement, and humiliation-pride.

Findings from the first cycle of the present research indicated that students also reported occasional negatively toned emotions such as stress, tension, and frustration (Hakkarainen, 2007, 2009). However, the effect of negatively toned emotions on learning is not simply negative: a successful learning process may also include occasional negatively toned emotions (Kort & Reilly, 2002; Op't Eynde, De Corte, & Verschaffel, 2001; Pekrun et al., 2002; Pekrun, 2007), although boredom and hopelessness were suggested by Pekrun et al. (2002) to be "detrimental for students' academic motivation" (p. 99).

Findings from the first cycle of the present research indicated that the abstract, critical, and creative aspects of learning were not, according to the students' experiences, realized to the same extent as the other characteristics of meaningful learning, and that students' learning outcomes merit further research (Hakkarainen, 2007, 2009). With respect to the abstract characteristics of learning, this finding echoes the findings of the Learning by Design approach by Kolodner et al. (2003), who found out that the design and construction of a practical artifact tended to become the primary focus of the teacher and students, while connecting the practical activity to the targeted scientific content matter received less attention.

Figure 1. The TML Model (Hakkarainen, 2007, 2009; Hakkarainen, Saarelainen, & Ruokamo, 2009).



Research Strategy and Questions

This research was conducted as a design-based research (DBR) process (see also Hakkarainen, 2007, 2009). DBR involves developing, testing, investigating, and refining learning-environment designs and theoretical constructs, such as the pedagogical models that support learning as well as illustrate and predict how learning occurs (Barab & Squire, 2004). The dual goal of meeting local needs and advancing theory is critical to DBR (Barab & Squire, 2004; Edelson, 2002; Wang & Hannafin, 2005). A DBR process proceeds through iterative cycles of design and implementation, and the researcher uses each implementation as an opportunity to collect data to support subsequent design (Edelson, 2002). According to Wang and Hannafin (2005), design-based research leads to "contextually sensitive design principles and theories" (p. 7).

The research questions were the following: 1) How does the video production-supported PBL model applied in the Digital Video course support meaningful learning? 2) What kind of emotions do students report, having experienced during the Digital Video course, and what reasons do they give for these emotions? 3) What kind of unique learning profiles do student video-production teams report having experienced in the Digital Video course from the viewpoint of meaningful learning?

Method

Participants

The participants were graduate students of Media Education. Seven students (4 female, 3 male) between 22 and 41 years of age enrolled in the Digital Video course in spring 2008. Prior to Digital Video, all students had attended one university course on moving-image education, during which they had produced two short films. In addition, three students had shot and edited home videos and one student had produced videos in previous courses. One student had produced videos when working as a teacher.

Digital Video Course

Digital Video is an optional course in the master's degree program in Media Education. The students receive five ECTS (European Credit Transfer System) credits for completing the course, which is graded pass/fail. Besides attending the PBL tutorial sessions, the students produce, in pairs or small groups, educational digital videos either as a commissioned work for faculty teachers or to be used by their peers enrolled in later offerings of the Digital Video course. The students take care of the whole production process: writing the manuscript, shooting, editing, and negotiating the copyright issues. The problems solved during the course require interdisciplinary knowledge. The aim is that the students will be able to analyze the pedagogical functions of producing and using videos from the viewpoint of meaningful learning, and produce and use videos in a way that supports meaningful learning. In addition, students need to develop adequate expressive, technological, copyright, and journalistic skills. The aim is not to make professional educational video producers out of the students, but rather to prepare them to work as media pedagogical experts, for example, on video production teams. The author served as the designer, researcher, responsible teacher, and the PBL tutor of the course under discussion.

Course Materials

The Pedagogical Model for Teaching and Meaningful Learning (TML)

The pedagogical model for teaching and meaningful learning (TML) (Hakkarainen, 2007, 2009; Hakkarainen, Saarelainen, & Ruokamo, 2007, 2009) was used as the general design framework in the Digital Video course. The underpinnings of the model include the ideas of meaningful learning put forward by Ausubel (1963) and Jonassen (1995). A more detailed description of the model, its underpinnings, its design process, and its previous applications are provided elsewhere (Hakkarainen, 2007, 2009; Hakkarainen, Saarelainen, & Ruokamo, 2007, 2009). The TML model embraces teaching and meaningful learning,

which is defined in terms of 17 process characteristics and their expected outcomes; that is, domain-specific and generic knowledge and skills (see figure 1).

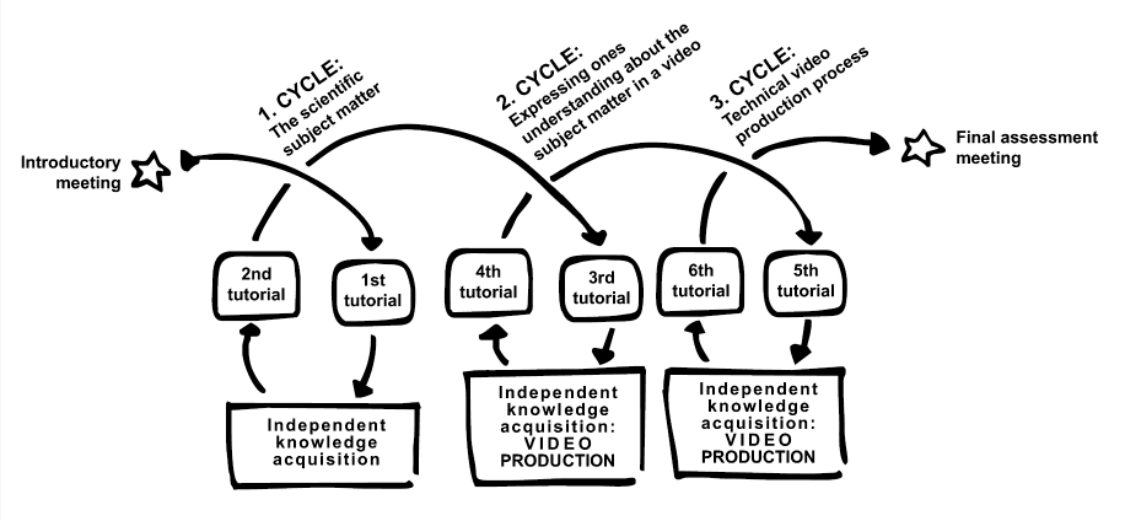
In the model, teaching and meaningful learning are viewed as processes triggered by various pedagogical models or approaches, PBL being one of them. Central to application of the TML model is that not all of the 17 characteristics of meaningful learning processes need to be present at any given time. Moreover, the characteristics can be intertwined, interdependent, interactive, partly overlapping, and synergetic (Jonassen, 2000a).

Video Production-Supported PBL

The video production-supported PBL model used in the Digital Video course was developed on the basis of the Swedish Linköping University PBL model, as modified by Poikela and Poikela (2006; see also Hakkarainen, 2007, 2009). The video production-supported PBL model provides an operational procedure to organize teaching and learning activities. The PBL model has potential in promoting meaningful learning through a wide range of the characteristics included in the TML model. I discuss the relationship between the components of the TML model and the procedures of the PBL model below.

A PBL cycle (see figure 2) consists of collaborative learning achieved in two tutorial sessions in which the tutor meets with seven to nine students. In terms of the TML model, the tutorials specifically address the collaborative, cooperational, conversational, emotionally involving, multiple perspectives-oriented, and abstract characteristics of meaningful learning. Independent knowledge acquisition is situated between the two tutorial sessions. The problems that are dealt with arise from professional practice, which supports

Figure 2. The video production-supported PBL model applied in the Digital Video course.



the contextual characteristics of meaningful learning. Learning and problem solving are supported by the dynamic interaction of the tutorial sessions and students' independent knowledge acquisition. Outside the PBL cycles, an introductory meeting and a final assessment meeting can be scheduled.

The model consists of three problem-solving and learning cycles. The problem area that students deal with during the first PBL cycle focuses on the subject matter under investigation. During the second cycle, video production is integrated into the problem-solving cycle as a form of independent knowledge acquisition about the subject matter. Other forms include, for example, acquiring knowledge through libraries, the Internet, or attending workshops or lectures. Subsequently, the problem that students solve during the second cycle focuses on how to express one's understanding of the subject matter in a video. The problem area for the third cycle then is how to realize the technical processes of shooting and editing the video.

The first tutorial sessions within each cycle aim at engaging students in active, self-directed, constructive, goal-oriented and creative learning described in the TML model. During the session, students work through setting the problem (phase 1), brainstorming (phase 2), structuring the ideas generated during the brainstorming (phase 3), selecting the problem area (phase 4), and setting the learning task (phase 5) to which students seek answers during the independent knowledge acquisition (phase 6) (Poikela & Poikela, 2006; see also Hakkarainen, 2007, 2009). The second tutorial session, which takes place after students' independent knowledge acquisition, focuses on sharing the knowledge acquired to tackle the learning task and assessing how well students have succeeded in their knowledge acquisition (phase 7). At the end of the session, students clarify the constructed knowledge and compare it with the original problem (phase 8). Unlike in several other tutorial scripts (see Hmelo-Silver, 2004), assessment is not included as a separate phase; rather, it is part of each phase (Poikela & Poikela, 2006). Tutorial sessions close with a feedback and assessment discussion, during which students get information and feedback about their own learning, group dynamics, and problem-solving skills (Poikela & Poikela, 2006). With respect to the TML model, these practices aim at supporting the individual and reflective characteristics of meaningful learning.

In terms of the TML model, the aim of the video production is to support especially the experiential, multirepresentational, creative, and collaborative aspects of meaningful learning. The pedagogical rationale is that video production may promote students' domain-specific knowledge and skills through the cognitive and social processes involved in designing the video about the subject matter. The affordances of ill-structured and complex design problems and related design decisions for learning the subject matter as well as improving communication, collaboration, and decision-making skills have been widely acknowledged (Edelson, 2002; Erickson & Lehrer, 1998; Jonassen, 2000b; Jonassen & Hung, 2008; Kolodner et al., 2003). Designing a video about the subject matter of

the Digital Video course may involve the cognitive process of transduction, which Kress (2004) defines as the cognitive process related to reconfiguring and reshaping knowledge representations. Transduction involves shifts across modes, as knowledge originally presented in a specific mode or modes (e.g., written language) is represented in another mode; for example, a video. In addition, designing and producing a video about the content matter may promote students' digital literacies (e.g., Buckingham, 2007), which is one of the expected learning outcomes of the Digital Video course and can be seen as part of information literacy described in the TML model.

Procedures and Measures

Course Implementation

The eight-week course started with an introductory meeting (3 hours), after which the students and the PBL tutor participated in three PBL tutorial cycles that were realized through five tutorial sessions (4 hours each). The course employed, following Jonassen's (2000b) typology, a combination of strategic performance problems and design problems. During the first cycle, the students solved the following problem: How can you use and produce digital videos to support meaningful learning? During the first PBL cycle, students did not yet engage in video production as a means of knowledge acquisition, but instead were instructed to search for solutions to the problem through reading the suggested course literature and through attending a lecture on the role of video in meaningful learning.

During the second and the third cycles, the students solved the following problems: How can you use creativity to break the mold of traditional educational videos? How do you make sure that the target audience experiences the video the way in which you would like them to experience it? During these cycles, students engaged in independent knowledge acquisition through video production and related workshops on scriptwriting (8 hours), filming (8 hours), and editing with Adobe Premiere software (8 hours). The workshops were supervised by a teacher whose expertise was in the area of video production and video expression, whereas the PBL tutor's expertise was more in the area of the educational use of video. In addition, students used the library and Internet in their knowledge acquisition. Students were asked to represent in the video their understanding about the subject matter of the course, that is, the relationship between video and meaningful learning. Students produced three educational digital videos in groups of two or three students. The videos included a mock advertisement, a news story, and a mini-documentary. All videos related to the same topic, that is, the relationship between video and meaningful learning. The length of the videos varied from one to three minutes, and they were produced for use as streaming videos over the Internet. In addition to producing the videos, the students wrote a critical analysis of the video. The analysis was included as

a design modification to the course (see Hakkarainen, 2007, 2009) to promote the abstract characteristics of meaningful learning and to promote students' digital literacies (see also Buckingham, 2007). At the end of the course, a final assessment meeting (4 hours) was organized, during which the videos were viewed and assessed.

Data Collection and Analysis

The data were collected and analyzed through the following procedures and measures:

Questionnaire for the students enrolled in the Digital Video course. A 57-item questionnaire, devised and used in the author's previous research (see Hakkarainen, 2007, 2009), was used in the present research. All of the students (n = 7) enrolled in the course completed the questionnaire after the final assessment meeting. The questionnaire included 23 statements concerning the meaningfulness of the learning process. Out of these statements, twelve have been devised, previously used, and statistically tested by Nevgi and Tirri (see Nevgi & Löfström, 2005). In addition, the questionnaire included 13 statements concerning the learning resources and learning outcomes. The students were asked to evaluate the statements using a five-point Likert scale. Twenty-one five-point Likert scale questions (0 = not at all, 4 = to a great extent) focused on the emotions students experienced during the course. The students were asked to indicate to what extent they had experienced a given emotion during the course, and to specify the reasons for this emotion. Twelve of the emotions appearing on the questionnaire were chosen from those proposed by Kort and Reilly (2002) as possibly relevant to learning: worry, comfort, boredom, interest, frustration, uncertainty, dispiritedness, disappointment, satisfaction, enthusiasm, tension, and embarrassment. In addition, the questionnaire included the following emotions: trust, sense of community, irritation, joy, stress, relief, feelings of inadequacy, and challenge. The data were analyzed quantitatively (means, standard deviations, percentages). The reasons given by the students for the emotions were analyzed qualitatively and placed into thematic categories.

Audio recordings of students' interviews. The interviews were group interviews for the video production teams, therefore the term *team interviews* will be used. The teams were interviewed twice; first in the middle of the course, and then at the end of the course after the students had received their grades. The topics and part of the questions of the interviews were specified in advance. The topics for the first interview included previous experiences in video production, knowledge acquisition, generating ideas about the content of the video, writing the manuscripts, learning outcomes, collaboration, and emotions. The topics for the second interview included knowledge acquisition, learning outcomes, collaboration, emotions, and media literacy. Interview questions included, for example, the following: How did you generate ideas for the content of the video? What are the most significant things that you have learned in this course? How has your collaboration succeeded?

The lengths of the interviews were as follows: Team 1 (3 students), 65 minutes and 31 minutes; Team 2 (2 students), 35 minutes and 20 minutes; and Team 3 (2 students), 33 minutes and 19 minutes. The interviews of Team 1 were longer than the other teams because the team included three students and because, contrary to the other teams, problems in group dynamics were discussed during the interview. Students were interviewed by the author, who was also working as the responsible teacher and the PBL tutor of the course. The audio data were first transcribed verbatim by the author. The analysis approach can best be characterized as deductive. The author read the transcripts several times to identify interview passages in which the students talked about issues relating to the TML model, that is, the characteristics and outcomes of meaningful learning identified in the model. Thereafter, passages that revealed unique learning profiles that the questionnaire data did not reveal about students' meaningful learning experiences were identified and coded.

Digital Video course students' performance results. The performance results included the student-produced videos and written analysis of the videos. These were analyzed qualitatively by searching instances that provided evidence about the abstract characteristics of students' meaningful learning process.

Results

Support for Meaningful Learning

The analysis of the questionnaire suggests that, according to the students, the video production-supported PBL model supported meaningful learning as defined and operationalized in this research. Most of the process characteristics of meaningful learning were either moderately or strongly supported by the analysis of research data. Table 1 shows the students' ratings of the practical realization of the meaningful learning process both in the 2006 and 2008 implementations of the Digital Video course.

The mean values of students' ratings remained approximately the same for most of the characteristics of meaningful learning between the two implementations. Exceptions to this tendency included critical, creative, and experiential characteristics of meaningful learning. There was a positive change between students' ratings for the critical characteristics of learning between the 2006 and the 2008 implementations of the Digital Video course. However, the research data don't provide enough evidence for arguing that this was due to design modifications, that is, the critical analysis assignment that was added to the course. In the interview, the video production teams assessed that the course had only moderately supported their digital literacies, which can be seen as one central aspect of critical thinking (Buckingham, 2007). The positive change in students' ratings for the creative and experiential characteristics most likely resulted from the fact that, contrary to the 2006 implementation of Digital Video, students were now free to choose the content

Table 1. The students' ratings of the practical realization of the meaningful learning process in the 2006 and 2008 implementations of the Digital Video course.

Process characteristic of meaningful learning	Mean value		Standard deviation		Statement in the questionnaire focusing on the process characteristic
	2006	2008	2006	2008	
Active	4.67	4.57	0.50	0.53	Students' role was to actively acquire, evaluate, and apply information.
	4.89	4.71	0.33	0.49	My partner and I were personally responsible for our video production process.
Self-directed	4.67	4.29	0.50	1.11	I was able to influence the content and realization of our video assignment.
	4.44	4.29	0.53	0.49	The students directed their own studying process in the PBL sessions.
	4.00	4.57	0.00	0.53	I was able to evaluate my own learning during the course.
	4.89	4.71	0.33	0.49	My partner and I were personally responsible for our video production process.
Constructive	4.67	4.57	0.50	0.53	I was able to utilize my prior knowledge about the course topics.
	4.44	4.57	0.73	0.53	The course deepened my understanding of what I had learned before.
Individual	4.22	4.14	0.97	0.69	It was possible for me to study according to my own personal style that suits me.
	4.22	4.71	0.97	0.49	I was able to apply my own practical experiences during the course.
	3.89	4.00	1.27	0.58	Studying enabled the achievement of my personal goals.
Collaborative Co-operational Conversational	4.89	4.57	0.33	0.53	The students were committed to collaboration.
	4.44	4.29	1.01	1.11	Cooperation with my partner was successful.
	4.56	4.29	0.53	0.95	Cooperation with the commissioner of the video was successful.
Contextual	4.44	4.57	0.53	0.53	The course promoted the learning of skills and knowledge needed in working life.
Goal-oriented	3.89	4.00	1.27	0.58	The studying enabled the achievement of my personal goals.
Reflective	4.00	4.57	0.00	0.53	I was able to evaluate my own learning during the course.
Abstract	3.44	3.57	1.13	0.53	On the course practical examples were studied in a theoretical framework.
Multiple perspectives –oriented	4.33	4.29	0.71	0.76	The course helped me to understand different perspectives related to the topics under study.
Critical	3.56	4.14	1.24	0.69	The studying developed my critical thinking skills.
Experiential	4.22	4.71	0.97	0.49	I was able to apply my own practical experiences during the course.
	4.44	4.29	0.73	0.76	I was able to utilize my own experiences as starting points for learning in the PBL tutorials.
Multi-representational	4.33	4.14	0.71	1.07	The targets of learning were examined through several forms of presentation (text, diagrams, pictures, video, etc.).
Creative	4.11	4.86	1.05	0.38	The PBL sessions encouraged creative thinking.
	4.00	4.43	1.00	0.79	Our video assignment enabled creative thinking.

n = 7
5-point scale: 1 = disagree, 2 = moderately disagree, 3 = neither disagree or agree, 4 = moderately agree, 5 = agree

and genres of the videos. In the 2006 implementation, these were decided beforehand by the faculty teachers who were commissioning the video productions.

In the questionnaire, students gave high ratings for the statement measuring the experiential and individual characteristics of meaningful learning: "I was able to apply my own practical experiences during the course" (M = 4.71, SD = 0.49). It seems that the transduction process, that is, reshaping knowledge represented in spoken or written language and graphics into moving images (see Kress, 2004) forced the students to search for exemplifying practical experiences of the given theoretical concepts in their own lives. In the team interviews, the students described the transduction process as "difficult," "somewhat puzzling," or "challenging." Victoria (pseudonyms used for all students) said in the questionnaire that the process felt like "combining two things from different worlds." Furthermore, she explained that the task was "awfully wide-ranging, but still limited area and like . . . yet . . . a little bit vague, not having strict limits." Interestingly, in this puzzling situation—trying to figure out how to present the abstract concept of meaningful learning in a video—the students turned to their own practical experiences. They searched for examples of the concept from their own lives, and these found their way into the videos. In the team interviews, all video production teams reported having had some problems in trying to find a way to represent abstract theoretical ideas in a video instead of a traditional essay.

Analysis of the questionnaire data revealed that the abstract aspects of meaningful learning were not, according to the students' experiences, realized to the same extent as the other characteristics of meaningful learning. The realization of the abstract aspects was measured through the statement: "On the course, practical examples were studied in a theoretical framework," which the students did not rate favourably (M = 3.57, SD = 0.53). Further evidence of the lack of theoretical reasoning is based on the analyses written by the video production teams, which demonstrated rather weak theoretical reasoning. The written analyses of Team 1 and Team 3 included a reference list of two research publications, to which they made some references in text. However, in justifying their design decisions, Team 1 and Team 3 used theoretical arguments rather superficially. In the following excerpt, Team 1 used the learning theoretical concept "constructiveness," but failed to explain in more detail how it relates to viewing or producing videos:

> Team 1: The pedagogical goal of our digital video is to evoke constructiveness in the viewers through critical assessment as they produce their own videos.

In some instances students misinterpreted learning theoretical concepts. The following excerpt demonstrates a partial and limited understanding of two theoretical concepts used in the analysis, namely, the active and self-directed characteristics of meaningful learning:

> Team 3: In the following scene the actor watches a YouTube video clip about Nordic walking and observes the correct walking technique. Inspired by this clip, he goes and tries Nordic walking. This demonstrates the realization of active and self-directed characteristics of meaningful learning . . . .

The analysis of Team 2 did not include any references to scientific publications and the learning theoretical reasoning was altogether lacking from the analysis. When justifying their design decisions and explaining the pedagogical functions of their videos, Team 2 did not use theoretical arguments. In both team interviews, Team 2 reported having altogether avoided reading the suggested course literature and, therefore, having designed the videos only on the basis of their discussions with their peers and the course instructors and on the basis of their own conceptions and experiences about the subject matter. Interestingly, though, the analysis of the questionnaire indicated that according to the students, the course had enhanced their skills in and knowledge of the subject matter of the videos (M = 4.57, SD = 0.53).

Emotions Reported by Students

The analysis of the questionnaire showed that the students reported positive emotions during their learning process. In the questionnaire, the students indicated the extent (0 = not at all, 4 = to a great extent) to which they had experienced a given emotion during the course. According to the students, enthusiasm (M = 3.91, SD = 0.30), joy (M = 3.73, SD = 0.47), feelings of interest (M = 3.70, SD = 0.48), and sense of community (M = 3.55, SD = 0.69) were the most intense emotions. Of the negative emotions, tension (M = 2.00, SD = 1.18), stress (M = 1.73, SD = 1.27), and frustration (M = 1.55, SD = 1.04) were given the highest values. They were associated with meeting new people and presenting one's viewpoints (tension), keeping up with the timetable of the course, and group processes within the video production group (stress, frustration). The mean values of the other negative emotions were very low (M = 0.09–1.27, SD = 0.30–1.34).

However, the questionnaire is only able to provide rather limited evidence about the unique learning profiles of the video production teams. In the following paragraphs, I will draw on the questionnaire and the interview data, and report on the unique emotional, collaborative, cooperational, conversational, and multiple perspectives-oriented characteristics of students' meaningful learning.

Unique Learning Profiles

Collaborative, Cooperative and Conversational Characteristics of Meaningful Learning

In the questionnaire, students rated the course as highly collaborative, cooperational, and conversational (M = 4.29–4.57, SD = 0.11–0.95). Students nearly unanimously reported in the questionnaire that collaboration, both in the PBL tutorials and in the video production teams, was associated with enthusiasm, joy, and sense of community. In addition, they reported that the course had enhanced their skills in and knowledge of cooperation and collaboration (M = 4.43, SD = 0.79).

However, the present research indicates that the PBL tutorials (7 students and tutor) involved different group dynamics than the video production teams (2-3 students). This was most clearly seen in the case of Team 1—Beth, Jane and Susan—for whom the collaborative, cooperative and conversational characteristics of meaningful learning turned out to be problematic. Team 1 disagreed about several design decisions. Especially for Beth, the small-group collaboration was the major reason for negative emotions and for her self-reported "underachievement." In the questionnaire, she reported high levels (0 = not at all, 4 = to a great extent) of stress (4), irritation (4), dispiritedness (4), and feelings of inadequacy (4). She cited "personal chemistries in the video team" as main reasons for these emotions and reported in the questionnaire that "when designing the video, all my ideas were dismissed." For her, the PBL tutorials were the primary sources for comfort (4), joy (3), and sense of community (3) during the Digital Video course. In the second team interview, Beth stated that she was pleased with the different kind of group dynamics and presentation of self that took place in the PBL tutorials:

> you can present yourself differently there [in the tutorials] than in the small group. We behave differently there [in the tutorials] because there are more people and . . . and the concepts are different there. Then you can get a broader picture or at least to me that's important.

Interestingly, for the Team 1 members, the problems in group dynamics encountered in the video production project had taught important lessons about collaboration, work life, and about themselves as group members. Jane and Susan reflected on their learning outcomes at the second team interview:

> Susan: This style or way of learning helped me see the big picture; after all, when you get a job, you have to work with other people. I think this at least brought out pretty well what all you might end up having to do with others. You have to show flexibility in quite a lot of things.

> Jane: I agree and this especially brought out all the different phases of and feelings connected with forming groups. We didn't show all the feelings we had, but we did experience the full range of them.

Multiple Perspectives-Oriented Characteristics

In the questionnaire, the students rated favorably the multiple perspectives-oriented characteristics of the learning process. They agreed with the statement "The course helped me to understand different perspectives related to the topics under study" (M = 4.29, SD = 0.76). Analysis of the interview data indicated that students' ratings resulted mainly from the PBL tutorials that functioned as a space to learn about fellow students' perspectives, which Beth described in the following way:

> The tutorials have been incredibly insightful in my opinion. They've shown how you have to listen to other people such that you really understand what they mean. And this has been a very rich learning experience in itself, because it's very rare that I have felt I have had interaction like this here in school.

However, the team interviews revealed that Team 2—Victoria and Steve—were having difficulties grappling with multiple perspectives resulting from the interdisciplinary nature of the course. The two instructors represented a different discipline and this seemed to cause difficulties. In the first team interview, Team 2 reported that the PBL tutor prioritized the content of the video, while the workshop teacher prioritized the technical and expressive quality of the video. In the interview, Team 2 talked about the PBL tutorials and the video production workshops as being detached parts of the whole course:

> Victoria: But somehow there are two different things going on here. There's the technical part, where you make the video on this course and then there's the part where you think about this research question. The two have perhaps got a bit detached from one another.
>
> Steve: Especially at the point where the first part stresses "technical quality, technical quality, technical quality" the whole time and that the content doesn't make any difference as long as everything is technically correct. We kept trying to get the opposite message across to the instructor—that it was the content and the overall production we should be focusing on.

Discussion

The results of the second cycle of the ongoing design-based research confirm the results of the previous research cycle (see Hakkarainen, 2007, 2009), such that the results indicate that the video production-supported PBL model applied in the Digital Video course either moderately or strongly supports most of the process characteristics of meaningful learning used in this research. Students rated the course as highly collaborative, cooperational, and conversational. This is no surprise, considering that collaboration is a core feature of PBL (see, e.g., Hmelo-Silver, 2004).

The results also confirmed the results of the previous research cycle (see Hakkarainen, 2007, 2009), in that students reported a wide range of emotions (see also Kort & Reilly, 2002; Pekrun et al., 2002), their emotional involvement in learning was positively toned and values given to negatively toned emotions were low. The positive emotional involvement of the Digital Video students is in accordance with the previous synthesis of meta-analytical research results on PBL by Strobel and van Barneveld (2009), indicating that students generally experience PBL as an enjoyable learning environment. On a general level, the positive emotional involvement of the students in the Digital Video course can be argued to be beneficial for their motivation to learn, their learning process, and outcomes (Meyer & Turner, 2002; Pekrun et al., 2002; Pekrun, 2007; Schutz & DeCuir, 2002; Soini, 1999). Making detailed causal interpretations of students' self-reported emotions and their learning outcomes is beyond the scope of this paper (see also Pekrun et al., 2002).

However, the learning profiles of both the video production teams and students within the teams were unique. One student in Team 1 reported high levels of negative emotions and even underachievement related to the problematic small-group collaboration. The implication of this for the course development is that adequate support in problematic group situations should be provided for students in order to avoid the occurrence of detrimental negative emotions such as hopelessness (see Pekrun et al., 2002).

There is clearly a need to refine the Digital Video course. The design modifications have to do primarily with promoting the abstract and multiple perspectives-oriented characteristics of meaningful learning by integrating theoretical reasoning about the content, form, and educational uses of the video more tightly into the video production workshops (see also Kolodner et al., 2003). Helping students grapple with the multiple perspectives in educational video production and supporting them in the expression of their understanding about the subject matter in a video requires that the subject-matter teacher (i.e., the PBL tutor) and the video-production teacher collaborate, preferably through shared teaching practices (see also Ellis et al., 2004). Future research cycles should therefore concentrate on designing and implementing these collaborative teaching practices. Furthermore, future research should also investigate the usability of the video production-supported PBL model in the teaching of other subject areas. The model may

be of interest to academic teaching staff interested in providing students opportunities for multimodal design and expression of their understanding of the subject matter.

The present research has shed more light on the specific affordances that a hands-on design project may offer to students' learning within a PBL context. The results indicated that a hands-on design project about the subject matter of the course can involve students in group dynamics, which teach them important lessons about collaboration, work life, and about themselves as group members. These lessons might not be learned to such an extent in the PBL tutorials and other forms of independent knowledge acquisition only.

The study has limitations. The reliability and validity of only twelve of the twenty-two statements formulated to operationalize meaningful learning processes have been previously statistically tested (see Nevgi & Löfström, 2005). Future research should address this lack and validate the internal consistency of the subscales in the questionnaire. A challenge in carrying out DBR arises from the joint role of the researchers as designers and researchers. The researcher influence in this research could be better addressed by drawing on standardized measures (Barab & Squire, 2004). It must be kept in mind that claims of this research are based on researcher-influenced contexts and, as such, may not be generalizable to other contexts of implementation where the researcher does not so directly influence the context (Barab & Squire, 2004). The descriptions of the research procedures and interpretations aim at helping the readers to evaluate the credibility of design decisions and the quality of the implications of this research.

References

Ausubel, D. (1963). *The psychology of meaningful verbal learning*. New York: Grune and Stratton.

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences*, *13*(1), 1-14.

Buckingham, D. (2007). Media education goes digital: An introduction. *Learning, Media and Technology*, *32*(2), 111-119.

De Leng, B. A., Dolmans, D. H. J. M., van de Wiel, M. W. J., Muijtjens, A. M. M., & van der Vleuten, C. P. M. (2007). How video cases should be used as authentic stimuli in problem-based medical education. *Medical Education*, *41*(2), 181-188.

Edelson, D. C. (2002). Design research: What we learn when we engage in design. *Journal of the Learning Sciences*, *11*(1), 105-122.

Ellis, G., Lee, K. S., & Tham, A. (2004). Learning engineering mechanics through video production [Electronic version]. *Proceedings of the 34th ASEE/IEEE Frontiers in Education Conference*.

Erickson, J., & Lehrer, R. (1998). The evolution of critical standards as students design hypermedia documents. *Journal of the Learning Sciences*, *7*(3), 351-386.

Hakkarainen, P. (2007). *Promoting meaningful learning through the integrated use of digital videos*. Doctoral dissertation, University of Lapland. Acta Universitatis Lappoensis 121. University of Lapland, Faculty of Education, Finland.

Hakkarainen, P. (2009). Designing and implementing a PBL course on educational digital video production: Lessons learned from a design-based research. *Educational Technology Research & Development*, *57*(2), 211-228.

Hakkarainen, P., Saarelainen, T., & Ruokamo, H. (2007). Towards meaningful learning through digital video supported case based teaching. *Australasian Journal of Educational Technology*, *23*(1), 87-109.

Hakkarainen, P., Saarelainen, T., & Ruokamo, H. (2009). Assessing teaching and students' meaningful learning processes in an E-learning course. In C. Spratt & P. Lajbcygier (Eds.), *E-Learning Technologies and Evidence-Based Assessment Approaches* (pp. 20-36). New York: IGI Global.

Hakkarainen, P., & Vapalahti, K. (2009). Meaningful learning throuht digital video-supported forum-theatre. In O. Ylitapio-Mäntylä & M.-L. Porsanger (Eds.), *14th Biennial Conference of International Study Association on Teachers and Teaching (ISATT). Abstracts* (pp. 25-26). University of Lapland Publications in Education 20, Finland.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266.

Hung, V. H. K., Keppell, M., & Jong, M. S. Y. (2004). Learners as producers: Using project based learning to enhance meaningful learning through digital video production [Electronic version]. In R. Atkinson, C. McBeath, D. Jonas-Dwyer, & R. Phillips (Eds.), *Beyond the comfort zone: Proceedings of the 21st ASCILITE conference* (pp. 428-436).

Jonassen, D. H. (1995). Supporting communities of learners with technology: A vision for integrating technology with learning in schools. *Educational Technology*, July-August, 60–63.

Jonassen, D. H. (2000a). *Computers as mindtools for schools. Engaging critical thinking*. New Jersey: Prentice-Hall.

Jonassen, D. H. (2000b). Toward a design theory of problem solving. *Educational Technology Research & Development*, *48*(4), 63–85.

Jonassen, D. H., & Hung, W. (2008). All problems are not equal: Implications for problem-based learning. *The Interdisciplinary Journal of Problem-based Learning*, *2*(2), 6-28.

Jonassen, D. H., Howland, J., Moore, J., & Marra, M. (2003). *Learning to solve problems with technology: A constructivist perspective*. Upper Saddle River, NJ: Merrill Prentice Hall.

Kiili, K. (2005). Participatory multimedia learning: Engaging learners. *Australasian Journal of Educational Technology*, *21*(3), 303-322.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J. Puntambekar, S., & Ryan, M. (2003). Problem-based learning meets case-based reasoning in the middle school science classroom: Putting Learning by Design into practice. *Journal of the Learning Sciences*, *12*(4), 495-547.

Kort, B., & Reilly, R. (2002, June). Analytical models of emotions, learning, and relationships: Towards an affective-sensitive cognitive machine. *Proceedings of the ITS 2002—Intelligent Tutoring Systems Conference* (pp. 955–962). Biarritz, France. Retrieved from http://web.media.mit.edu/~reilly/its2002.pdf

Kress, G. (2004). *Literacy in the new media age*. London: Routledge, Taylor, & Francis.

Leahy, M., & Walshe, I. (2005). Designing a problem-based learning (PBL) module: A case study of a speech and language therapy module at Trinity College Dublin. In T. Barrett, I. Mac Labhrainn, & H. Fallon (Eds.), *Handbook of enquiry & problem based learning: Irish case studies and international perspectives* [Electronic version] (pp. 55-63). All Ireland Society of Higher Education and Higher Education Authority.

Masats, D., Dooly, M., & Costa, X. (2009). Exploring the potential of language learning through video making [Electronic version]. *Proceedings of EDULEARN09 Conference*.

Meyer, D. K., & Turner, J. C. (2002). Discovering emotion in classroom motivation research. *Educational Psychologist*, *37*(2), 107-114.

Nevgi, A., & Löfström, E. (2005). The quality of online learning—Teachers' and students' evaluations of meaningful learning experiences in online and blended courses [Electronic version]. In S. Kiefer, J. Michalak, A. Sabanci, & K. Winter (Eds.), *Analysis of educational policies in a comparative educational perspective* (pp. 96-104). Linz, Austria: Pädagogische Hochschule des Bundes in Öberösterreich.

Op't Eynde, P., De Corte, E., & Verschaffel, L. (2001). "What to learn from what we feel": The role of students' emotions in the mathematics classroom. In S. Volet & S. Järvelä (Eds.), *Motivation in learning contexts: Theoretical advances and methodological implications* (pp. 149-167). Amsterdam: Pergamon.

Pekrun, R. (2007). Emotions in students' scholastic development. In R. P. Perry & J. C. Smart (Eds.), *The scholarship of teaching and learning in higher education: an evidence-based perspective* (pp. 553-610). Dordrecht, the Netherlands: Springer.

Pekrun, R., Goetz, T., Tizt, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, *37*(2), 91-105.

Peppler, K. A., & Kafai, Y. B. (2007). From SuperGoo to Scratch: exploring creative digital media production in informal learning. *Learning, Media and Technology*, *32*(2), 149-166.

Poikela, E., & Poikela, S. (2006). Problem-based curriculum—Theory, development and design. In E. Poikela & A.R. Nummenmaa (Eds.), *Understanding problem-based learning* (pp. 71-90). Tampere, Finland: Tampere University Press.

Schutz, P. A., & DeCuir, J. T. (2002). Inquiry on emotions in education. *Educational Psychologist*, *37*(2), 125-134.

Schwartz, D.L., & Hartman, K. (2007). It is not television anymore: Designing digital video for learning and assessment. In R. Goldman, R. D. Pea, B. Barron, & S. Derry (Eds.), *Video research in the learning sciences* (pp. 335-348). Mahwah, NJ: Erlbaum.

Shewbridge, W., & Berge, Z. L. (2004). The role of theory and technology in learning video production: The challenge of change. *International Journal on E-Learning*. *Corporate, Government, Healthcare, & Higher Education, 3*(1), 31-39.

Soini, H. (1999). *Education students' experiences of learning and their conceptions about learning disabilities. Towards a comprehensive theory of learning*. Acta Universitatis Ouluensis E Scientiae Socialum 40. Oulu, Finland: Oulu University Press.

Strobel, J. (2006). Participatory design strategies for eLearning: A design-based research approach in the field of educational technology. In J. Multisilta & H. Haaparanta (Eds.), *Proceedings of the Workshop on Human Centered Technology HCT06* (pp. 187-195). Tampere University of Technology, Pori. Publication 6.

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective: A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *The Interdisciplinary Journal of Problem-based Learning*, *3*(1), 44-58.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research & Development*, *53*(4), 5-23.

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