Concept maps in
the design of accessible CinemaSense service

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Abstract
The purpose of the study was to produce accessible web-based study material concerning
cinematic expression, entitled, CinemaSense (http://elokuvantaju.uiiah.fi), suited to those of
diverse backgrounds. The design of the web service in question took place in collaboration
with two groups of students in two universities. The first ‘Novice Group’ consisted of seven,
Deaf, teacher-training students who use Finnish Sign Language as their first language; they
were education majors in a 5 year M.A. program, preparing them for the primary-level
classroom. They were engaged in a two-year web-based study concerning cinematic
expression, culminating in making their own documentary. The second ‘Expert Group’
consisted of five Finnish-speaking students majoring in film who followed their own art
school-based curriculum. The participants were asked to draw concept maps concerning
cinematic expression several times during the design experiment. The conceptions and
structures of the participants’ concept maps significantly affected the design of
CinemaSense’s map-like user interface and assisted in validating design decisions across three
iterative cycles. Multi-level evidence gathered at the end of the experiment indicated that the
participants in the ‘Novice Group’ adopted a novice filmmaker’s perspective on films rather
than film viewer’s perspective. Implications of creating more accessible learning
environments are discussed.

Keywords: accessibility, art education, Computer Supported Collaborative Learning, design
research, film studies, inclusion, multi-modality, usability, web-based learning material.
Introduction

In the present design study the objective was to develop the CinemaSense (http://elokuvantaju.uiah.fi) web service to provide basic information on film art. Technology-enhanced learning environments provide tools and practices that facilitate inclusive processes of collaborative learning across educational contexts serving diverse populations, in terms of backgrounds and abilities. The purpose of the qualitative study was to develop a tool and practice of Computer Supported Collaborative Learning (CSCL; Wasson, Ludvigsen, & Hoppe 2003; Lehtinen, Hakkarainen, Lipponen, Rahikainen, & Muukkonen 1999) for learning cinematic expression, which were more accessible and flexible in nature. The study is a part of efforts to develop inclusive higher education, according to the principles of Design For All (DfA) or inclusive design (Keates & Clarkson 2003), because all students should have equal rights to complete their academic degrees regardless of the minorities to which they belong. We refer to cultural, ethnic, national, and differently abled groupings, among others; those representing various types of diversity, in relation to the majority. Recently the needs and requirements of inclusive education have been theoretically examined (Adams & Brown 2006; Castells 1999: 355–380; Riddell, Tinklin & Wilson 2005; Seale 2006) and technology needed for its practical implementation is available (Miesenberger & al. 2004, 2006, 2008).

The study is positioned in the areas of film (art), media, film research, as well as the field of pedagogy and applied cognitive science. It relies on the assumption that learning is a collaborative rather than a merely individual and mental process. Collaboration and community building are especially important in the case of minority students, who may be more isolated and often have to cope with requirements and a context designed according to the majority’s needs. One of the challenges was to examine how academic art studies can be made more accessible. We wanted to investigate what methods and services are needed to make basic studies concerning film art accessible to all students.

The pedagogical objective of the investigation was to promote transformations of prevailing educational practices that facilitate the development of skills and competencies relating to the deliberate creation of knowledge from one’s entrance into higher education (Hakkarainen, Palonen, Paavola, & Lehtinen 2004). Despite the fact that our ideas of learning and knowledge have drastically changed, university education in many European countries has remained the same for centuries. A number of investigators have argued that students of higher education take too many years within exclusively acquisition-oriented and teacher-
centred studies, without pursuing their own personal responsibility for knowledge advancement (e.g., Mandl, Grüber, & Renkl 1996). Successful achievement in traditional higher education studies often fails, by itself, to provide students with competencies to solve the complex and ill-defined problems of professional life. In response to these challenges, Boud and Feletti (1991) proposed that problem based learning (PBL) is a productive practice for creating a substantive program intended to produce professionally relevant skills and competencies. Instead of direct assimilation of the information, students should construct knowledge through solving problems in communities of practice (Lave & Wegner 1991). Many skills and competencies that are difficult to learn through verbal instruction or by reading books become accessible when the learners are engaged in an intensive process of doing, and collectively reflect on the evolving epistemic competencies. While distance education may sometimes be the only viable way of offering access to academic learning opportunities, the authors would like to emphasize the importance to integrating virtual learning with meetings of physically present communities. Such blended learning environments provide, in many cases, valuable support for accessible and meaningful, in-depth learning. Participation in genuine film production that imitates professional practice is intended to guide participants in problem-driven learning in which each student may assume an expert-like role and engage in solving corresponding problems in practice (Hakkarainen et al. 2004; Bereiter & Scardamalia 2003).

This user-centred study involved the parallel pursuits of developing a web service and analysing the conceptualisation of cinematic expression with the help of two Finnish student groups. The main participant group (the ‘Novice Group’) consisted of seven, Deaf, teacher-training (primary-level) students pursuing a 5 year program in education, leading to a master’s degree, who use Finnish Sign Language (FinSL) as their primary language, and written Finnish as their secondary language. From here onward, ‘a Finnish Sign Language user’ will be referred to as 'Deaf' with capital D (i.e., Deaf student). There were initially 10 students in the Novice Group, but one decided to change to a different major, another interrupted studies because of salaried work, and the third one moved temporarily to another university. The second group (the ‘Expert Group’) consisted of five hearing students of film art who use spoken Finnish. The national languages of Finland are Finnish and Swedish, but FinSL, Sámi and Romani are the other languages recognized by the Constitution Act of Finland. Therefore, FinSL and written Finnish are used within bilingual educational settings with Deaf students in higher education. When sign language (SL) and spoken language (SpL) are in contact, the two
distinct modalities may pose challenges, because SpL is communicated through the auditory-vocal modality, and SL is communicated through the visual-spatial modality. However, SL-SpL and SpL-SpL bilingualism are similar in education (Marschark & Hauser 2008).

The most important outcome of the project was an independent design artefact in its own right: the *CinemaSense* 1.0 ([http://elokuvantaju.uiah.fi](http://elokuvantaju.uiah.fi); Raike, Laitinen & Viikari 2001). The entire study involved several inter-dependent components, including a) developing the *CinemaSense* service, b) facilitating inclusive education, and c) developing technology-enhanced collaborative knowledge practices. Using the concept maps developed by the two student groups, the evolution of cinematic knowing was examined. This was used in the development of the map-like user interface of *CinemaSense* across three iterative design cycles supporting the production of alpha, beta and final 1.0 version. The aim of the iterative and incremental *CinemaSense* production (initial draft release alpha, followed by beta and the first finished release 1.0) and associated three design experiments (DE1–3) was to make collaborative learning of filmmaking accessible to minorities, such as, in the present investigation, Deaf students. Figure 1 describes the relationships between the elements of the study and associated literature studies, analyses, and reporting.

Figure 1. The design research project and the production of *CinemaSense* 1.0 took place in several stages from pre-production to distribution that was embedded in three cycles of design experiments (DE).
CinemaSense is designed to support both virtual distance learning and on location instruction offering an access to various film-related web services and data files; it was intended to help in understanding film as an art form and product of cultural activity. Research and development of the CinemaSense 1.0 constituted the context and background of the study, but details of the design process are reported elsewhere (Honkela, Leinonen, Lonka & Raike 2000; Raike 2005, 2006). Briefly, CinemaSense aims to support basic-level university studies of those who belong to linguistic minorities (even in different educational institutions) and are active in the domain of film art. It offers an opportunity for accessible studying between various groups, e.g. high school students, Deaf or exchange students or students, who are not able to take part in on-location instruction for a strong reason. CinemaSense provides explanations of cinematic concepts in Finnish, English, Spanish and Japanese. In addition, FinSL signs are provided for the concepts explained in Finnish, and Colombian Sign Language signs are provided for the concepts explained in Spanish. The map-like interface is organized according to a flowchart. A film production from an idea or a “concept”, into a distributed film, is visualised as follows: an idea emerges within cinematography (white area) and advances from the upper-left corner through three production stages to the distribution of a final release print of a film in the lower-right corner (Fig. 2).

**Figure 2.** Study material map of CinemaSense’s interface (http://elokuvantaju.uiah.fi/english/english.jsp)
The *CinemaSense* is open for all, providing basic information on film production to a person before he or she embarks on corresponding academic studies or pursues individual productions. *CinemaSense* also represents educational entertainment (edutainment) that provides general users interested in films with rich cultural knowledge of the topic, regardless of whether they have formal educational aims. *CinemaSense* is meant to help a student to a) internalise the basic concepts of film production, b) understand the production workflow, c) understand the group work quality of cinematography, d) prepare for the entrance examinations of film schools, and e) get through basic film studies before the practical work. However, the service functions best as a study support for a decentralised learning group when a tutor supports and encourages the collaborative work of the students. A recommended way to study with *CinemaSense* is to launch a group through one's own educational institution and agree on the study credits. The access to the group work tool (FLE) must be done through a school, using user identifiers.

**Future Learning Environment FLE** (http://fle3.uiah.fi/) was utilised in the study. FLE was developed in collaboration between the Media Lab, University of Art and Design Helsinki (TaiK) and the Centre for Research on Networked Learning and Knowledge Building, Department of Psychology, University of Helsinki (Lahti, Seitamaa-Hakkarainen, & Hakkarainen 2004; Muukkonen, Lakkala & Hakkarainen 2005). The second author is the scientific leader of the latter research unit and took an active part in the pedagogical design of FLE. This open-source groupware system is used in more than 50 countries. It allows the participants to engage in discussions organized according to their own research questions and working theories. Many earlier investigations have indicated that FLE can productively be used for facilitating collaborative-inquiry learning at university level. Moreover, the system has been used to mediate students’ collaborative design processes by sharing visual digital artefacts with a special jamming tool (Seitamaa-Hakkarainen, Raami, Muukkonen, & Hakkarainen 2001; Seitamaa-Hakkarainen, Lahti, & Hakkarainen 2005). FLE is an intrinsic part of *CinemaSense*, and the studying should be done in FLE according to ways agreed upon within the group, as directed by the tutor. In the present case, FLE continuously supported the Novice Group in between their face-to-face meetings; as well, it allowed participants to organize discussions around topics related to film. It appears that, when used in conjunction with collaborative learning environments, web-based study materials, such as *CinemaSense*, can be productively utilised to support the participants’ own knowledge-seeking inquiry; this
is a process driven by their own questions and wonderings, instead of merely their effort to assimilate already existing information (Hakkarainen, & al. 2004).

**Research aims**

The design experiment focused on developing a *CinemaSense* web service to support basic studies of film art. The research problem was to produce an accessible web service on cinematic expression and study how it supports both collaborative web-based learning and the individual development of knowledge in the film domain. The study was based on the assumption that multi-modal web-based study material and easily comprehended map-like interfaces elicit the development of cinematic knowledge. The research and design process of CinemaSense is reported in other articles (Raike 2005, 2006; Raike & Honkela 2003; Honkela, Leinonen, Lonka & Raike 2000). The present investigation focuses on examining the role the web-based study course had on the iterative development of *CinemaSense* within a user-centred design context.

Our first aim was to examine how inclusive higher education involving film studies can be implemented, in practice, acknowledging the needs of diverse students. Specifically, we wished to study how the *CinemaSense* service should be designed so that it would support accessibility of film studies in general, and the construction of cinematic knowledge of the Deaf students. The usability and accessibility of the service were observed during web-based courses in cinematic expression, with the help of concept-map analyses and web-based communication.

Our second aim was to examine how the participants’ personal cinema sense was conceptualised through networked learning, as evaluated by concept maps. We wanted to analyse the Deaf students’ deepening knowledge and conceptualisation related to the subject of cinematic expression, as well as their collaboration during the web-based course. Further we examined the kinds of concepts used in structuring cinematic knowing so as to assist the participants in adopting a filmmaker’s rather than a mere film viewer’s perspective. The results supported the iterative production of the map-like interface of *CinemaSense*.

Our third aim was to analyse how the imitation of a professional production of a documentary film in virtual learning facilitates the development of *CinemaSense*. Specifically, how does the overall film production from an idea to finished product become structured through web-based learning in the three stages of film production, i.e., pre-production, production, and post-production? It was assumed that, because the participants were challenged to produce
their own documentary films, they would appropriate knowledge practices characteristic of professional filmmakers, and adopt associated professional roles; this would encourage participants to take a filmmaker’s rather than a film viewer’s perspective on cinematic expression.

Method

The investigation was intended to design and produce the accessible and multilingual *CinemaSense* portal in Finnish, English, Spanish and Japanese with Finnish and Colombian Sign Language signs for film production. The alpha and beta versions of *CinemaSense* were tested in three design experiment cycles (DE1–3) and were developed into an accessible and multi-cultural, art domain, web-based study format of the *CinemaSense* 1.0 in collaboration with two groups of students. User-centred and participatory design methods were utilised in close interaction with the user community. The following sections describe the participants, data sources, and analytic methods involved in the study.

Participants

Two groups of participants, who are respectively termed the ‘Novice Group’ and the ‘Expert Group’, were asked to take part in the present study. Due to the exploratory nature of the investigation, the terms ‘novice’ and ‘expert’ should be interpreted as mere descriptive characterizations of the groups. The first group was called the Novice Group because they did not have professional knowledge of film art. The group consisted of 7 students from the Classroom Teacher Training Programme for Finnish Sign Language (FinSL) Users of Jyväskylä University, Finland. A student is considered a FinSL user when his or her primary language is FinSL and secondary language is Finnish. Six of the seven participants considered themselves as FinSL users; the seventh participant was also confident with FinSL. The participants were majoring in education and aiming to become primary school teachers at the primary-level of education, after getting their Master’s degree based on five-year study. The study program was designed to give a specialisation for teaching Deaf children using Sign Language. The present study took place across a two-year period during which they were pursuing their second and third years of study.

The Novice Group took an active part in designing and shaping their web-based studies at several stages. Their participation in the first stage was voluntary, and they did not receive any formal credit points. By taking part in the two later stages of web-based study, the
participants completed two credit units (approximately of 80 hours of work) of studies at the Department of Film and Television; these studies constituted a part of the “freely chosen minor studies” of their degree program. The group was interested in films and associated cultural phenomena. Moreover, awareness and prior understanding of FinSL, challenges related to bilingualism, and deafness were at a relatively high level within the group. Whereas the participants had diverse personal characteristics, FinSL provided the smallest common denominator of the group that bound it together as a distinct student community with Deaf identity (Ladd 2003).

The second group that provided data for assessing the first group’s learning was called the Expert Group. This group consisted of five full-time Finnish MA students of film art from the University of Art and Design Helsinki (TaiK). These students aimed to become professional filmmakers either as directors, film editors, cinematographers, or producers. After either a three- or five-year study program, they aimed to become Candidates or Masters of Fine Arts. Consequently, this group constituted an expert-like knowledge-practice group regarding film issues; they were, in a concrete way, intellectually socialized towards acquiring a filmmaker’s perspective on film art. Analyses of the ways the participants in this group conceptualised films provided the basis for assessing the Novice Group’s evolving knowledge and expertise of films.

The groups were similar to each other in terms of age (M=28, SD=26) and number of languages mastered. However, the goals and motivations of the groups were different in many ways; the Novice Group studied in order to become primary school teachers, and the Expert Group to become professional filmmakers. The investigators were not primarily interested in examining how the Deaf students’ learning differed from that of Finnish speaking students, but to explore how to co-design a web-based service product that would support both groups’ collaborative virtual film studies.

The method of participatory design research

‘Design’ refers to planning, giving form to, and developing a product or a service. It involves designing an artefact, but also exploring, testing, and cultivating social systems and practices related to the use of the artefacts. The research project has the character of a design experiment (Collins, Joseph, & Bielaczyc 2004) involving intensive interaction between a) systematic advancement of design ideas, b) implementation of the ideas in the design of
technology tools and services, c) exploring the ideas, tools, and methods in pedagogic practice, and d) further developing both ideas and their technological implementation.

An essential aspect of such processes is their iterative nature. In developing a CinemaSense type of web service, one cannot advance straightforwardly from idea to implementation; a more complex process is needed in which ideas and visions co-evolve with experiences and practices of the user communities involved, in the spirit of user-centred and participatory design (Greenbaum & Kyng 1991; Engeström & Middleton 1996). Involvement of user communities is especially important when web services and products are developed for purposes of inclusive education (Keates & Clarkson 2003; Papanek 1983). In the present case, the first author visualised an accessible and flexible cinematic-related learning that was verbally described to the visual designer and the software developer for the initial alpha version (Raike 2005). He was pursuing a vision of how the learning environment would stimulate heterogeneously oriented students while they are planning a joint film productions, a process in which challenging problems elicit collaborative work. On the basis of such vague and initially unorganized visions and practical experimentations, the first alpha version of CinemaSense was implemented (Fig. 1).

**Concept maps as research instruments**

Concept maps were used in the study to examine the expansion, interlinking, and development of the participants’ cinematic knowing. The use of concept maps as a research instrument was consistent with the iterative aim of the experiment to develop the study material map of CinemaSense. The concept maps of the participants provided information during the design of the web service and assisted in managing the accumulating research data.

The concept map is an open description of concepts and associated propositions. A proposition is a meaningful whole that interlinks at least two concepts and represents their mutual relations; it thus states a fact (Anderson 1995). Within a concept map there may be several propositions. In a simple concept map there are only two concepts that constitute a proposition through one or several labelled links (Novak & Gowin 1984). Concept maps allow investigators to examine the validity of propositions and analyse missing links between concepts (Novak & Gowin 1984). For instance, a claim ”Bad guys wear black hats” was relatively valid in the westerns of 1950s, but hardly in movies produced after 1970s. The links represent paths between nodes of the map and integrate the meanings of concepts to propositions regarding their relations (Kremer 1998).
In principle, a concept map is a hierarchical representation so that the superordinate concept or hypernym is in the upper middle part of the map and the subordinate concepts or hyponyms are represented below (Kangasniemi 1997: 57). At the bottom of the map are represented examples and instances of concepts, such as proper names. In the present case, the first author decided that the construction of concept maps should be relatively flexible so the top-down hierarchy was not necessarily followed. Hyponymy was involved in putting the superordinate concept – ‘film’ – in the middle, and the subordinate concepts grew in different directions like small pools of water. Such a mind-map type solution was used in all concept maps, but the participants were advised against using drawn images. Concept maps assist participants to focus on core ideas relevant in each task. There is not just one way of working with concept maps and it is never the final representation of issues being investigated; rather it is a flexible tool for learning and designing. For investigators, concept maps provide a synthesis relating to what the participants have learned and what kind of conceptual relations are addressed. It is possible to follow, for instance, changing, adding, clustering, and disappearing of concepts and the transformation of their relations.

The two groups were taught how to make concept maps during the first session. The first author relied on procedures developed by Novak and Gowin (1984); the participants were not, however, shown a model map. Working with concept maps appeared to be relatively easy and natural to both groups, perhaps because Mind Map® term was already familiar to them (Buzan & Buzan 1993). When provided with instruction concerning film-related concept maps, the participants were asked to draw a concept map about the topic ‘film’, according to their own understanding of the subject. Both groups were instructed the same way. The instructions were as follows: “Draw a concept map concerning the topic ‘film’ as you understand it. Include in the concept map those concepts that you consider important regarding films (movies). Draw the map in a way that allows you to use it to explain the issue question to another person.” Participants were asked to include in the concept map those concepts that they consider important regarding films. In addition, it was pointed out that the concept map could be used to explain the issues to other people, and, thereby, could have a communicative function. It was also clarified that concept maps diverge, in this regard, from Mind Map®s. The participants were given a separate paper for sketching the concept map. This was utilised by some of them. It was also suggested that they locate the starting superordinate concept either in the middle or upper middle part of the paper, the latter location being recommended by Novak and Gowin (1984).
The Novice Group (n = 7) took part in 7 face-to-face meetings, participated in working within the FLE environment, and engaged in email communication as well. During the sessions they created 5 concept maps concerning ‘film’ or ‘movie’, one concept map concerning the concepts of ‘film expression’ and ‘Sign Language’, one concerning ‘virtual learning’, one about ‘teaching’, and one concerning ‘communication’. The meetings took place every two to three months during academic semesters (with four month breaks during summers) and extended across two years. Each participant drew one to three concept maps in each meeting with one exception; the concept map regarding the student-selected topic of distance education was constructed in pairs. In five sessions participants created concept maps related exclusively to films, coded as CM1 (concept maps created in the first session) to CM5 (concept map created in the fifth session). All concept maps were created on standard (ISO 216) white A3 paper sheet in landscape position using black and super-fine felt-tip pens. The participants worked in a silent room isolated from outsiders in the presence of the first author. Identification information was marked at the upper right corner of the sheets, i.e., name of the participant and the date of session. In reporting the results, the corresponding codes (the number of participant, identification number of concept map and so on) will be used. Participants were asked to produce an additional flowchart (i.e., in CM2 session) concerning the “chronological representation of different stages of film production”. This assisted in describing the production process both temporally and technically.

The original concept maps were in Finnish; in order to share the research data with an international audience, each of the concept maps reported in this article was reconstructed by using CmapTools software (http://cmap.ihmc.us) in a way that has conserved concepts, links between them and the overall spatial layout of the map. For technical reasons, a certain level of simplification has deemed acceptable (Fig. 3).

The Expert Group, in the first meeting, drew concept maps concerning the topic ‘Film’ and ‘Internet’ and in the second meeting maps concerning ‘Film’ and their own major subject (film editing, direction, cinematography or production). The concept maps created by the Expert Group provided information concerning how the basic concepts of film production are comprehended in an intensive conventional (i.e., non-virtual) educational program of film art. The material depicted how the participants understood concepts and their links concerning films after two-year intensive studies at TaiK.

The concept maps created by the participants at different stages of the design experiment were analysed in order to obtain a detailed view of the nature and structure of the participants’
cinematic knowledge; this analysis provided heuristic support for the design of *CinemaSense*. At the first stage, concept maps created in a same session were examined in parallel and compared with one another. This provided a comprehensive picture of how the participants conceptualised and understood a film. At the next stage, the concepts used by the participants were identified and coded. The frequencies of use of various concepts as well as the occurrence of links between concepts were analysed. The frequencies of concepts used in all 95 concept maps were tabulated and relations between concepts calculated. Certain individual words and examples were abstracted and clustered to make higher-level concepts. Concepts were identified, given a numeric code, and listed in matrices.

Figure 3. CmapTool reconstruction of Participant 4’s first (CM1) concept map

The concept maps created by an individual participant were analysed chronologically across different sessions. By examining a participant’s chronologically ordered concept maps, it was possible to analyse the evolution of his or her way of conceptualising cinematic phenomena as well as to assess how the use of *CinemaSense* may have affected the usage and interlinking of concepts. The concepts used in each concept map were compared with concepts involved in *CinemaSense* using numeric codes.
Although the concept maps provided the most important data of the present study, they were not the only basis of analysing the participants’ cinematic learning processes. The Novice Group took part in web-based learning across all three cycles of the design experiment (DE1–3; Fig. 1). The members of the Novice Group worked between face-to-face sessions within FLE. Emails were used, in addition, to support communication with the tutor (the first author) and among the participants themselves. This provided important support during the first two DE1–2 cycles when FLE was unfamiliar to the participants as both a pedagogical and technical environment. All FLE and email messages sent and received from the participants of the Novice Group and sent to them by the production team were stored for qualitative content analysis. Together with learning logs produced by the participants, this material provided content-rich and contextual evidence of the participants’ evolving cinematic knowledge. The accumulating material supported and complemented analyses that relied on the concept-map evidence.

**Results**

**Conceptualising films by concept maps**

The advantages of concept maps were apparent in the first session; working with the maps was relatively easy and the fastest drawers produced adequate maps in just over fifteen minutes (Fig. 3). On the other hand, such activity may not suit to all students because two of the participants had problems starting to draw a map. It was not, however, possible to find out whether these difficulties were caused by the map-drawing task, the ill-structured nature of associated competencies, or a plain social caution.

The first concept maps involved a great many myths or hopes about the financial success (becoming rich) of filmmakers that do not represent Finnish reality. The participants’ concept maps involved terms, such as ‘awards’, ‘Oscars’ and ‘success’ that were interpreted to represent the superordinate concept ‘fame’. This interpretation was based on inter-linkages between the concepts; ‘Oscar’ is the best-known indicator of fame that assists one to obtain new projects and funding. While these phenomena are linked to film production, these are not essential concepts concerning basic cinematic knowing. Yet, this illustrates an essential aspect of concept-mapping activity in which concepts are defined in terms of their superordinate or subordinate concepts (Kangasniemi 1997). E.g. the meaning of the term ‘production’ can be explained by linking it with terms, such as ‘shooting’, ‘sound’, ‘actor’, and ‘direction’.
In all concept maps one can, in general, see improved organization and unification through the learning process. Even the first concept maps (CM1–CM2) were relatively exact, but concept maps (CM3–CM5) created in the later stages of participatory cinematic study involved learned structures and terminologies; this can be seen by comparing, for instance, Participant 4’s concept maps CM1 (Fig. 3) and CM5 (Fig. 4).

![Diagram](image_url)

**Figure 4. CmapTool reconstruction of Participant 4’s final (CM5) concept map**

The former map CM1 is strongly branching; the hypernym has 19 direct links to hyponyms; in addition the taxonomy is poor, and there are not clearly identifiable concept clusters (Fig. 3). In addition, the first concept map has 32 concepts. The branching factor at the root of the superordinate concept is large, but small at lower levels of the conceptual hierarchy. The proposition concerning different genres of films (‘different genres’) is good and provides a productive basis for subsequent study: such concepts appear to provide a way of linking the emerging film viewer’s film-related knowing with that of experts. In the case of Participant 4’s first concept map, there are only the concepts ‘FILM’ (movie), ‘SCENOGRAPHY’
(staging, production design), and ‘SOUND’, which are in common with the map-based user interface of *CinemaSense* (Fig. 2).

When one looks at the last concept map of Participant 4 (CM5; Fig. 4), it can be observed that the branching factor of the ‘film’ concept has reduced; the hypernym has only 11 links to hyponyms. Propositions have become more exact, the taxonomy is clearer, and there are more concept clusters. Cross-links have not been drawn but the map is in general easy to comprehend. Participant 4 uses also flowchart type process descriptions while representing advancement of subtasks in film production in CM5. Here one can clearly see evidence of the personal participation in the collaborative production of a documentary in which Participant 4 assumed a producer-type role. The two concept maps of Participant 4 represent the development of film-related and production-related knowing. The last concept map (CM5) of Participant 4, involved 66 concepts; this is about twice as many as in the first map (CM1). In addition, all concepts of map CM5 are related to some domain of film culture and film research, film production and distribution. Concepts that are shared with *CinemaSense*’s study material map or user interface are ‘FILM’, ‘PRE-PRODUCTION’, ‘PRODUCTION’, ‘POST-PRODUCTION’, ‘SHOOTING’, ‘SCRIPT’, ‘SCENOGRAPHY’ (Production design) and ‘DISTRIBUTION’ (Table 1).

A similar trend characterizes the concept maps of other participants in the Novice Group. Participant 2’s first CM1 concept map represented clearly the film viewers’ perspective. There were only a limited number of concepts, only some of which referred to film production. The participant 2’s final CM5 concept map is very rich and involves a sophisticated examination of various aspects of film production structured according to the hyponyms of *CinemaSense* (Table 2).

The Expert Group’s concept maps were from the very beginning structured according to film production rather than relying on a film viewer’s perspective. This is not, however, due to participation in the web-based course or research and development of *CinemaSense*, but to studies at the Department of Film and Television at TaiK, during which the students had created their own community of practice with associated professional conceptions supporting their academic studies. Participant 30 provided in his/her concept map, created after two years of film studies, a multi-faceted and clear description of film production (Fig. 5).

Participant 30 differentiated filmmaker’s and film viewer’s perspectives, which open their own chains of propositions. Such double meaning of artworks can also be seen in the other
concept maps of the Expert Group. On the other hand, participant 30 has structured film production according to production stages, i.e., pre-production, shooting, and post-production. Cross-links are, however, missing. Creation of several concept maps by the Expert Group during the present design experiment improved, in general, in readability. The number of concepts did not usually increase but comprehensiveness of expression and structuring of maps improved to some extent. Because there was no corresponding change in the qualitative nature of the maps from representing film viewers to filmmakers’ perspective, the resultant analysis focuses mainly on the Novice Group’s concept maps.

Table 1. Concepts in Participant 4’s first (CM1) and last (CM5) concept map (compare Figures 2 and 3).

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<thead>
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<th>Code</th>
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<th>CM5</th>
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<td>genre-2</td>
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<tr>
<td>90</td>
<td>director</td>
<td>155</td>
</tr>
<tr>
<td>99</td>
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<td>164</td>
</tr>
<tr>
<td>132</td>
<td>producer</td>
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</tr>
<tr>
<td>133</td>
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<td>139</td>
<td>SOUND</td>
<td>180</td>
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<tr>
<td>153</td>
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<td>182</td>
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<td>205</td>
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<tr>
<td>81</td>
<td>publicity</td>
<td>205</td>
</tr>
</tbody>
</table>

In the course of learning, conceptions used in both the Novice and Expert Group’s concept maps became more exact and elaborate. The concept-map based approach provided, in this regard, a productive and easy-to-use method of following advancement of learning. In what follows, we will examine concept frequencies that were calculated on the basis of the maps and allowed examination of the development of participants’ cinematic knowing as well as their conceptual advancement.
Enumerating words presented in the concept maps would not as such assist in understanding
their learning process without being contextualised by examining the situations in which the
concept maps were created. The first concept map (CM1) was drawn in a situation in which
the participant did not yet have a comprehensive picture of the purpose and nature of the
study (DE1; Fig. 1). Participants had not yet decided whether to produce a documentary film
or complete the present studies by writing an essay. The last concept map (CM5), in contrast,
was drawn after the web-based course and after completing production of a documentary (DE3; Fig. 1); at this point the members of the Novice Group had already adopted a more or less expert-like orientation toward film production. Nevertheless, concept frequencies assisted in understanding what kinds of conceptions could be utilised while pursuing basic studies of film art using a CinemaSense type web service.

Figure 5. CmapTool reconstruction of Participant 30’s (Expert Group) production-oriented concept map.

The maximum number of words referring to cinematic concepts used by the Novice Group was 66. At the lowest level one participant used only 19 concepts. The concept frequency arose monotonically from the first to the last concept map for almost all participants in the Novice Group. Relying only on concept maps, it is difficult to get an overview of the development of conceptions that represent the participants’ evolving cinematic knowing. Nevertheless, the increase in the number of concepts used in the third, fourth, and fifth concept map (CM3, CM4 and CM5) appeared to indicate emergence of more sophisticated understanding in the participants’ cinematic knowledge (Table 3).

In general, the Novice Group participants expressed their conceptions by relying of terminology that was relevant for collaborative cinematic studying while moving to the virtual
The data indicated that the participants learned commonplace cinematic expressions already during stage DE1 and DE2; they appeared to have basic skills and competencies needed for relatively clear and comprehensive expression of film-related knowing. Correspondingly, concept maps CM1–CM5 may be interpreted to describe both subjective knowledge structures and the development of competencies of collaborative communication, in which flowcharts assisted in structuring film knowledge.

### Table 3. A summary of frequencies of concepts used in the Novice Group’s concept maps (CM1–CM5).

<table>
<thead>
<tr>
<th>Participant</th>
<th>CM1</th>
<th>CM2</th>
<th>CM3</th>
<th>CM4</th>
<th>CM5</th>
<th>$\bar{X}$</th>
</tr>
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<tbody>
<tr>
<td>2</td>
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<td>54</td>
<td>36</td>
<td>46</td>
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<td>-</td>
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<td>5</td>
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<tr>
<td>$\bar{X}$</td>
<td>30</td>
<td>45</td>
<td>32</td>
<td>41</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

All concepts occurring in the concept maps were tabulated and their frequencies calculated (Fig. 6). The frequency of the ‘film’ concept (extreme right) was about 20% of all 205 concepts mentioned. It appears that the frequency distribution of concepts essential for studying film related issues forms a Pareto-distribution (i.e., power law distribution; Barabási 2002: 71).

The Pareto-distribution has a large number of nodes (terms) that have only a few links and only a small number of nodes (terms) with a large number of links. This corresponds to our everyday understanding of conceptual taxonomies and the importance of hyponyms. Some concepts simply cover a broader scope of meanings than others. Through using such concepts, more possibilities are opened up to move forward in conceptual structures. In the present data, such a concept was, of course, *film*, that opens up necessary terminology in a completely different way than, for instance, terms *cinéma vérité* or *release print*.

**From a film viewer’s toward a filmmaker’s perspective**
In the first DE cycle (DE1; Fig. 1), the participants took part in *CinemaSense* (alpha) course in FLE; the aim was to become familiar and learn to use of the system by viewing and discussing films (i.e., tasks of going to view a film, reporting the experience, and discussing about it). The aim of this introductory stage DE1 was to equalize technical skills and support their community building. Simultaneously, an idea emerged to challenge the participants of the Novice Group to pursue their own documentary project; FLE discussions in DE1 indicated that it would be considered relevant for the partners and well as fitting in with the aims of the *CinemaSense* design process.

![Distribution of concepts (f=205) across all concept maps (f=75)](image)

**Figure 6.** Frequencies of concepts used by the Novice Group constituted a pareto-distribution. The hypernyms of film production are at the right end section of the figure; at utmost right, the hypernym "FILM" (f= 41).

The second DE cycle (DE2; Fig. 1) aimed at preparing the documentary project by searching for information and using the beta (second) version of *CinemaSense*. In order to facilitate the development of cinematic knowing, they were asked to carry out, in pairs, a documentary film project. The aim was to obtain sufficient expertise to create a 5-minute documentary film on “How to describe school from the perspective of a deaf first grader?” relying on shared footage.
In the third DE cycle (DE3; Fig. 1), the participants of the Novice Group became external students of TaiK and engaged in activities associated with producing the documentary film. For acceptable completion of the course participants were required to 1) create a script for the documentary; 2) plan the shooting by constructing a storyboard or a shot list; 3) carry out the production (shooting) on location; and 4) engage in post-production tasks involving video editing on the basis of footage shot by the participants themselves. The editing took place in a special film-editing workshop in which a professional film editor guided the process. The planning of the workshop took place in FLE. At the end of the project, there was a final seminar in which the participants gave formal presentations, had opponents criticize them, and provided feedback.

Sharing of expertise, developing complementary competencies, and taking on diverging roles was intended to transform students’ diversity and emerging problems into resources for collaborative activities. Participants’ learning logs were completed by four of the seven participants in the Novice Group. These indicated that the students organised themselves into roles for making the documentary; Participants 4, 7 and 10 started as scriptwriters, 2 and 3 as cinematographers (cameramen), 6 as the narrator, and 5 as a production assistant. This did not, however, represent the final division of labour between the participants, but indicated that in order to carry out the complex task, they needed to become organised and managed the process by assuming diverging roles. The participants had taken part in a multimedia production course as a part of their teacher-education studies; this supported participation in the film-editing workshop.

 Appropriation of professional production terminology was an expected result of taking part in the corresponding cultural activities. The participants started, as the web-based course progressed, to use the same terms in relation to the same issues in the same way. The Novice Group’s concept maps and concepts became more coherent or unified; this improved the tutor’s (the first author) ability to evaluate collaborative learning concerning cinematic topics. Concept mapping supported the development of cinematic knowledge and assisted the members of the Novice Group in examining film production as a developing process and as a manageable project.

**Interaction between concept mapping and design of CinemaSense**

In collaborative communication, one needs visual representations that others understand. This is relevant to a variety of professional film production ephemera, such as technical drawings,
driving directions, production sheets, and storyboards. Concept maps and flowcharts are communicative tools intended to convey to the others how the author perceives and structures the issue in question. Such representations played a dual role in the investigations: a) they provided instruments for studying and facilitating the participants cinematic knowing and b) they structured the map-like interface of CinemaSense.

There were altogether 179 concepts in the CinemaSense’s study material maps. The study material involved in CinemaSense was divided into to 9 subsections, i.e., cinematography (film culture), pre-production, production, post-production, shot and shooting, screenplay (script), scenography (production design, staging), distribution and sound. The study material was initially structured in an alpha version according to the corresponding content of the study guide of the University of Art and Design Helsinki. This administrative structuring was further specified in the beta and 1.0 versions using concept maps created by participants of the Novice and Expert Group (Fig. 1). The results confirmed the adequacy of CinemaSense’s strategy of introducing nearly 200 film concepts using a map-like representation (Fig. 2).

The core concepts used in the study-material map of CinemaSense (Fig. 2) were, in general, represented in all maps created; these concepts are capitalized in Table 4. The most frequently mentioned were as follows: FILM (including ‘film culture’, 41 occurrences), SCREENPLAY (SCRIPT 33), PRODUCTION (25), SOUND (23), PRODUCTION (SHOOTING 22), SCENOGRAPHY (STAGING 21), PRE-PRODUCTION (19), SHOT (18), POST-PRODUCTION (16) and DISTRIBUTION (15). Apparently, the modern western culture teaches basics of audiovisual expression to all citizens, in some cases, rather thoroughly. As a consequence, different traditions and genres of cinematic expression were somewhat familiar to the participating higher-education students. Similarly, almost all knew something about media production. Concept maps and CinemaSense’s representational format appeared, in a sense, to be the chartings of the participant’s tacit cinematic knowledge: a basic level of CinemaSense is a part of all citizens’ tacit knowledge; we have grown up under the influence of cultural cinematic artefacts.

As mentioned above, the first concept maps (CM1) created by members of the Novice Group varied relatively strongly in relation to the last concept maps (CM5) that started to resemble the study material map of CinemaSense (http://CinemaSense.uiah.fi/english/study_material/study_material.jsp). The first concept maps were personal and resembled mind maps; the conceptions used in them varied significantly, and, in general, the taxonomy was limited and poor. In the course of studies, the maps began to transform from individual tools to
instruments of collaborative communication that provided a comprehensive picture of the
shared concepts used in participants’ own community of practice. Gradually, members of the
Novice Group appeared to learn to make concept maps for communicative purposes by taking
the expectations of the potential audience into consideration. For example, the ability to
understand the workflow is essential for producing a documentary film. Hence flowchart-like
representations organise a participant’s concept map temporally and in accordance with the
production stages (Fig. 2). This kind of overall comprehension of film production was an
important condition for making the Novice Group’s own documentary film project successful
during the web-based course. In any case, a flowchart is only one way of organizing concept
maps, involving tens of terms, in a way that highlights patterns that are relevant for learning.

Table 4. Occurrence of the hypernyms of CinemaSense’s study material map in concept maps of the
Novice Group

<table>
<thead>
<tr>
<th>Hypernym</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
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<tr>
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<td>1</td>
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<td>1</td>
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<tr>
<td>PRODUCTION</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SOUND</td>
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<td>1</td>
<td>1</td>
<td>1</td>
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During the design experiment, the study material map of CinemaSense was developed from
the material provided by the participants’ concept maps. In the present feedback loop of a
product and its users, we aimed at finding a map-like comprehensive representation for film
terminology needed in the introductory studies. It appeared that the Novice Group
appropriated structures and concepts that they experienced as meaningful. The occurrence of
CinemaSense’s subsections (film culture, script, pre-production, production, direction,
scenography, shooting, sound, post-production and distribution) in the concept maps took
place without separate instruction (Table 4). The iterative design loop was established when
the students picked up material needed in learning tasks from CinemaSense and,
simultaneously, adopted terminology that was consistently used in concept maps and
communication. The data concerning concept maps were collected in matrices while
designing the study material map of CinemaSense, and the meaningful concepts were
favoured in design. Some of the subordinate study material maps of CinemaSense were transformed and developed according to the concept maps created by the students.

Different motives of the groups can be seen in concept maps, but the differences in the concept maps between the Novice and Expert Group may be explained by individual variation, drawing skills, motivation, and the nature of academic study orientation. Yet the Novice Group’s concept maps appeared to become closer to one another and to the Expert Group’s concept maps both in structural and conceptual terms. In the case of both groups’ last concept maps, film production was emphasized.

Participants’ reflections of web-based film studies

The present study aimed at engaging the Novice Group in expert-like knowledge practices related to cinematic expression, both understanding films and how they are made. Toward that end, they were engaged in virtual discussion, both in email and FLE, concerning films, filmmaking, their evolving cinematic knowledge, and their experiences of web-based cinematic studies. Their virtual discussions addressed films that the participants had been asked to watch during the process. One said:

A Right to hear or right to not hear? […] Comments about the documentary “Sound and Fury” […] Of course my experience was pretty much the same as the rest of you, that is I was furious as I watched this documentary… After calming down I have to, even if I wouldn’t want to, admit that the makers of the documentary succeeded in what they were trying to do! I think that the point of the documentary was to make us angry and arouse our emotions – and that’s exactly what happened! A cochlear implant is a tough subject for deaf people as well as for those parents who decide to give the implant to their children. In a way there’s an invisible battlefield between ‘us’ and ‘them…’ Even though we often try and forget our own emotions and respect the decisions that parents make, still emotions can just surface… Some of you said that there was too much emotion in the documentary, and that the subject could have been dealt with in a more logical way… I doubt it I don’t want to believe that any of us could stay neutral about it, when it was about such an important matter […] if the documentary had been made in such a way, that is calmly and rationally, and then would we be left with anything after seeing the documentary? I doubt it […] But some of the subjects in the documentary could have been skipped, and a lot at that [was unnecessary] – e.g., the claim that a deaf person wouldn’t manage? And other such things. […] I also want to say that I completely agree with the rest of you that the documentary was made quite unethical[ly] (with the name-calling, taunts and so on…) […] They also reflected on various aspects of making films. Another said:

… When I think about the documentary “Silent Rhapsody”, I think about the small pieces and about the little ways in which the documentary was made effective. The video-clips would be very short but still contain a lot of information within a few
seconds. Equally effective was using different contrasts, such as switching between black and white or changing the playing speed of a scene, not even mentioning the camera angles used.

The filmmaker can easily direct the viewer with these modest techniques, and they make the viewer wonder, what exactly is the message of this documentary/movie? What does it try to convey to the viewer? Also, how much can you compare metaphor and reality? Nor is much required to express it, if you just open your eyes, if can be found very close by!

The participants acknowledged that they had learned a lot about making movies through the course of the experiment. One participant said:

[…] I learnt about making movies, among other things, that to make a movie it requires true commitment, which in my mind is the same as committing to a relationship. That is, you commit to it completely and give it all your heart. Commitment requires work and trust, and also giving a lot of yourself. I think that it’s difficult to commit in our group – it’s understandable considering that making a movie isn’t the main priority in our lives. Making the movie was left as a secondary priority, always thinking ‘ah, I can do that later’. If we had more time we would have been in it with everything we had – then our movie would have been something different then what we currently have. […] I’ve learnt a lot about making movies, thanks to this diverse study package we’ve approached the movie from many different directions – among other things making and reading movie reviews and articles as well as making our own movies. I’ve realized that movies are art as well as creativity! […]

The participants appreciated FLE as a learning environment. One student said:

I feel that Fle2 [i.e. FLE] was a good tool for studying movie comprehension. Fle2 was a learning environment that I used the first time I did e-learning […].

Yet, some participants would have wanted more structured and teacher-directed approach on studying film art. One stated:

Antti [Raike]’s research maybe complicated the success of the course a little in the sense that he couldn’t guide our studies too much, or it would have affected his research results. Nonetheless I would have hoped for a strong leader who would have constantly taken our studies forwards. Each student had a clear role in what they were doing, but the leader was missing. He could have showed us a new title in the steps to make a documentary, first the script, the ideas related to that, the problems and so on; after that [he could have] made contact with the people and filming locations and constantly kept a rapport on FLE about subjects related to these ideas and their problems. I learnt a lot, therefore, about group dynamics. Also I understood how flexible people in the movie business need to be; [with all] the equipment, following the development of technology and learning to use the equipment, people involved with the project and the effect of their thoughts on progression of the movie. […] There’s never too much time to make a movie. And making the movie requires more seamless co-operation with each member of the team…
Discussion

The results support a general framework of inclusion, for a shared “university for all”, which adapts to the needs of different and diverse students. The results of the investigation indicate that multi-linguistic (Finnish Sign Language and spoken Finnish), multi-cultural, and flexible virtual study of cinematic expression can be carried out using problem-centred and collaborative knowledge practices and CSCL tools. The *CinemaSense* web service was tested and developed into an accessible and multi-cultural, art domain, web-based study format with the help of two groups of participants, i.e., a Novice Group consisting of Deaf students majoring in education and an Expert Group consisting of hearing students majoring in film art. Figure 7 presents a schematic description of relations between different aspects of the design experiment. During the design experiment, the participants of the Novice Group watched and analysed films, wrote about their experiences, and represented their evolving cinematic knowledge by constructing map-like drawings. The study indicated that the concept maps of the Novice Group became more unified and their concepts became more professional while studying cinematic expression in the web-based course. The Expert Group was oriented toward professional filmmaking throughout the design experiment. By the end of the web-based course, the concept maps of the Novice Group had developed from film viewer maps to beginning filmmakers’ maps. Thereby, the subjective cinema sense of the participants relying on FinSL developed toward expert cinematic knowing.

The Novice Group undertook professional production, designed and developed the subject of a documentary film, organized the production and produced three documentary films. In independently functioning pairs, they edited from jointly shot material three documentaries as the final report of the course project. The Novice Group formed their own community of practice for the production of the documentary and through a collaborative process learned how to use relevant network services and cultivated their academic skills. The production-centred orientation is very beneficial for learning because human beings learn best by doing (Schank, 1999); people grow up to become an expert only through participation in an expert community (Lave & Wenger, 1991). In production-centred knowledge practices, the participants learn to understand a director’s, a producer’s, and a scriptwriter’s roles and the significance of their corresponding work performance in creating a film. Concepts related to the filmmaking and the use of corresponding terminology in writing provide a trajectory for deeper learning, and elicit the development of high-level competencies when integrated with practical training projects. The knowledge practices they appropriated appeared to help
develop participants’ knowledge and competencies toward those of experts; such
development proceeded as far as participants producing their own documentary film at the
end of the design experiment (DE3; Fig. 7).

<table>
<thead>
<tr>
<th>Project task</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
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<tr>
<td>Evaluation</td>
<td>R3</td>
<td>R5</td>
<td>R18</td>
</tr>
</tbody>
</table>

**Figure 7. Temporal and functional relations between different aspects of the design experiment.**

The accessible, multilingual *CinemaSense* 1.0 service and a web-study course concept for art
studies were produced through a design experiment extending over five years of research and
development. The design process took place at multiple levels from theoretically
understanding and conceptualising film art to designing a workable map-like user interface
for *CinemaSense*. The process involved three cycles of design experiments (DE1–3) in which
the ideas, tools, and practices were explored with the two user communities (Deaf teacher-
students and Finnish speaking full-time students of film art). The methodological limitation of
the project is that within such complex and heterogeneous network involving multiple
tensions, obstacles, boundary encounters, and conceptual explosions, it is hard to determine
explicit causal relations between different components and elements of the process. This
appears to be the general problem of such activity. The evidence presented indicates that a
great deal of personal and collective learning took place, suggesting that *CinemaSense* can
serve various communities studying film art across the world.
We propose that similar methods can be applied in the production of multi-modal web courses, interfaces, and services that, for their own part, promote inclusion as well as multi-cultural and flexible university study. An institution, such as Aalto University, which provides multilingual higher education, has to provide each student with opportunities to create new cultural meanings during the studies. These require collaborative learning environments supporting participants of diverse background. There is evidence that virtual learning which complements conventional instructional practices, provides valuable resources for learning basic knowledge in almost any field of knowledge; it provides students a safe way of gaining familiarity with the domain of interest. The journey toward expertise progresses through convenient apportioning of novel requirements. Equal, flexible, and accessible network communication is a good way of learning to know both majority and minority ways of living and corresponding expert practices by following one’s own rate of appropriating knowledge.

**Contributions made by specific authors.** The present study was designed and implemented independently by DA Raike and constituted a part of his dissertation (Doctor of Arts) that was accepted at the University of Art and Design Helsinki (TaiK) in 2005 (Raike 2005). Professor Hakkarainen functioned as the main supervisor of Raike providing theoretical and methodological guidance during in scientific analysis and reporting of the data collected. The manuscript was revised together through several editing cycles. MA Hal While assisted in improving both argumentation and quality of English language. The authors would like to thank the participants of Raike’s study, without whom the present investigation would not have been possible.

**References**


