CinemaSense Portal and Neural Network Analysis Method for Supporting Students of Linguistic Minorities in Distance Learning

Abstract

In this article, we present possibilities of supporting Deaf [1] students in distance education through information networks by using Self-Organizing Maps [2]. The use of the Self-Organizing Map (SOM) is approached on the basis of current theories of learning. The cognitive models of learning have often been based on a plain computer metaphor in which learning is viewed as memorizing. Moreover, the phrase computer-aided learning has earlier referred to systems that helped the users in memorizing "facts". We focus on the constructivist point of view taking into consideration human collaboration and problem-based learning. After the theoretical discussion we present how the Self-Organizing Map could be used in a computer supported collaborative learning (CSCL) environment. Hypermedia-based distance education through the information network (like the Internet) provides a significant opportunity to enhance the learning of Deaf students in universities.

Keywords: Cognitive models, Collaboration, Constructive learning, CSCL, Deaf studies, Distance learning, Film studies, Self-Organizing Map, Sign Language, SOM, Memory models.

1 Introduction

We introduce a method for analyzing significant learning patterns among university level Deaf students. Our intention is to make such information more accessible for tutors, curriculum developers and web designers, as well as for students themselves. A general-purpose evaluation tool of a tutor to visualize and manage data of distance learning studies using the Self-Organizing Map (SOM) will be presented in this paper.

This study does not see deafness as a medical deficiency; instead, Sign Language is seen as an interesting cultural, communicational and visual phenomenon [3]. There are about five thousand Deaf people living in Finland and in 2003 only one percent of them were registered as university students. Universities do not provide education in Sign Lanuage (hence Deaf students should be at least bilingual) and "on location" instruction based on lectures and seminars requires using Sign Language interpreters (only a few of the Deaf students prefer writing as the primary interpreting medium). Yet Deaf undergraduates should perform on par with their hearing peers in academic studies and effective collaboration with all persons involved would contribute to graduation. The practical objective of the research was to show the suitability of hypermedia (e.g. WWW service like CinemaSense) and CSCL in the distance learning of Deaf students. Hence our research contributes to the methodology and tools for the inclusion and flexible learning of cultural minorities.

2 Constructivism, problem solving and collaborative learning

In current cognitive learning theory, three core conceptions may be identified [4]. The first concept, constructivism, is the idea that knowledge and cognitive strategies are constructed by the learner, and that learning involves qualitative restructuring and modification of schemata, rather than just the accumulation of new information in memory. The second concept, active epistemology, is closely related

1 "Deaf" with capital "D" refers to "a person born deaf and having learned Sign Language as his or her first language, and who is actively using it". Hence, the concept "Sign Language using Deaf student" is equivalent to "Deaf student" in this paper.
2 Kohonen 2001.
3 Padden & Humphries 1988; Poizner, Klima & Bellugi 1987; Sacks 1989; Lane 1984; Fiske 1990.
4 Lonka, Joram & Bryson 1996.

to constructivism, but refers specifically to beliefs about the learner's role in the learning process. Mental representation is the third core concept. In cognitive learning theory, performance on problem-solving tasks and students' explanations of such tasks are most often accounted for by the nature of their mental representations along with their prior knowledge. Moreover, representations are highly situational [5] and knowledge is socially shared and constructed [6].

3. Action research and co-design project with Deaf students

The action research started in the fall of 1999, overlapping with the production of CinemaSense portal [7], and was made in collaboration with the Class Teacher Education Program of Finnish Sign Language Users in the University of Jyväskylä, where the necessary infrastructure (information technology, Deaf studies, interpreter services, and an authentic Deaf student community) has been established in the 1990's [8].

The distance learning was realized so that the Jyväskylä students took the basic two credits course on cinematic expression as non-registered students in the Department of Film and Television at the University of Art and Design Helsinki. Interactive distance learning and collaboration was mostly done through the FLE3 – Learning Environment developed in the Media Lab of the University of Art and Design Helsinki [9]. A Computer Supported Collaborative Learning (CSCL) tool such as FLE3, a web-based groupware for CSCL, supports collaborative building of knowledge, progressive inquiry and guided inquiry learning. With the SOM, the use of the CSCL tools could potentially be made even more effective (Figure 1).

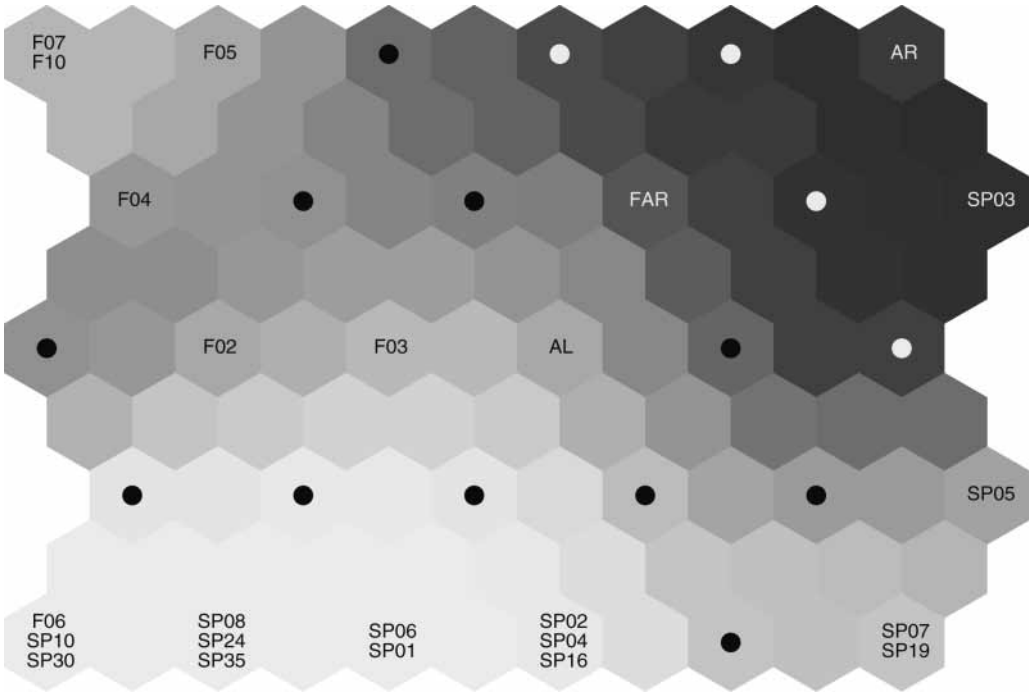

Figure 1. A map of FLE3 and e-mail communication during the action research based on strategies of collaboration.
F=FLE3 message, SP=e-mail, 01–10=students of Jyväskylä; 16–35=students of Helsinki; AR=Tutor, AL=tutor of editing workshop.
Note student SP03 near the tutor and a mixed cluster of Helsinki and Jyväskylä students at the bottom of the map.
The same student (F03) collaborates more in the FLE3 environment.

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5 Brown, Collins & Duguid 1989.
6 Honkela, Leinonen, Lonka & Raike 2000.
7 Laitinen, Raike & Viikari 2003.
8 Padden & Humphries 1988; Glaser & Strauss 1971.
9 Leinonen et al. 2003.

The CinemaSense course in the FLE3 had a primary goal to support students to produce a documentary film of one to ten minutes during the research project. The documentary film was supposed to tell about the first school day of the Deaf pupils. Different topics and concepts about cinema were drawn into the discussion. Deaf students noticed during the research that it was a great benefit to the documentary film project if the discussion in the FLE "Knowledge Building" was dynamic and progressive.

4 Self-organizing map as an analysis tool

As a result, we had information in the data corpus of the Deaf students' emails, learning environment discussion messages and concept maps drawn by each student during film study workshops. Beside the corpus, all aspects of the inquiry learning process, i.e. setting up research problems, constructing one's own working theories, searching for new scientific information, can be shared with fellow students by using CSCL shared database. The information-objects, e.g. in the form of notes, can be produced as a dialogue so that each note is commenting and linked to one another. The metadata of each note contains information indicating issues like who is the author, what is the category of inquiry defined by the author, and on which note it is referring to. Different self-organizing maps (SOM) can be generated based on this metadata and the written information in the subject and body of the notes.

The SOM [10] is a widely used artificial neural network model. Finding structures in vast multidimensional data sets like students' e-mail messages is difficult and time-consuming. Kohonen's SOM can be used to aid the exploration: the structures in the data sets are illustrated on map displays where similar items lie close to each other. The SOM learning process is unsupervised: no a priori classifications for the input examples are needed. The learning process is based on similarity comparisons in a continuous space. The result is a system that associates similar inputs close to each other in the two-dimensional grid called the map. The input may be highly complex multi-dimensional numerical data. Recently, the SOM has also been used for the analysis and visualization of symbolic and text data [11].

The self-organizing map can also be considered as a memory model [12]. It is dynamic, associative and consists of elements that can also be called adaptive prototypes. Inputs are not stored as such but comparison is made between the input and the collection of prototypes. The closest prototype of the input is adapted towards the input. The same operation is also conducted for the neighboring prototypes, which gives rise to the topographical order on the map. The SOM could also be used to present study material in a natural way. The approach is particularly well suited for web-based CSCL and distance education, where it can be applied in conjunction with the WEBSOM methodology [13] for analyzing free-format documents, such as concept maps (or mind maps), film scripts, story boards and shot lists.

The teacher or supervisor may create a context by presenting the SOM of the area under consideration. The SOM of the context may present a wider view to the study subject by presenting related subjects and concepts close to the main area interest (Figure 2). The SOMs may indicate which direction students should continue so as to span the whole area under investigation. The students and the tutors may also compare the SOM generated by the experts and the SOMs constructed by the students during the inquiry learning process.

5 CinemaSense 1.0 – web-based study material for distance learning

CinemaSense 1.0 is a web-based study material for film production [14]. The objective of the portal is to help the students to construct knowledge and structural understanding of cinematic expression.

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10 Kohonen 2001.
11 Honkela, Pulkki & Kohonen 1995; Ritter & Kohonen 1989.
12 Honkela, Leinonen, Lonka & Raike 2000.
13 Honkela, Kaski, Lagus & Kohonen 1996; Kaski, Honkela, Lagus & Kohonen 1998; Lagus, Honkela, Kaski & Kohonen 1999.
14 Laitinen, Raike & Viikari 2003.

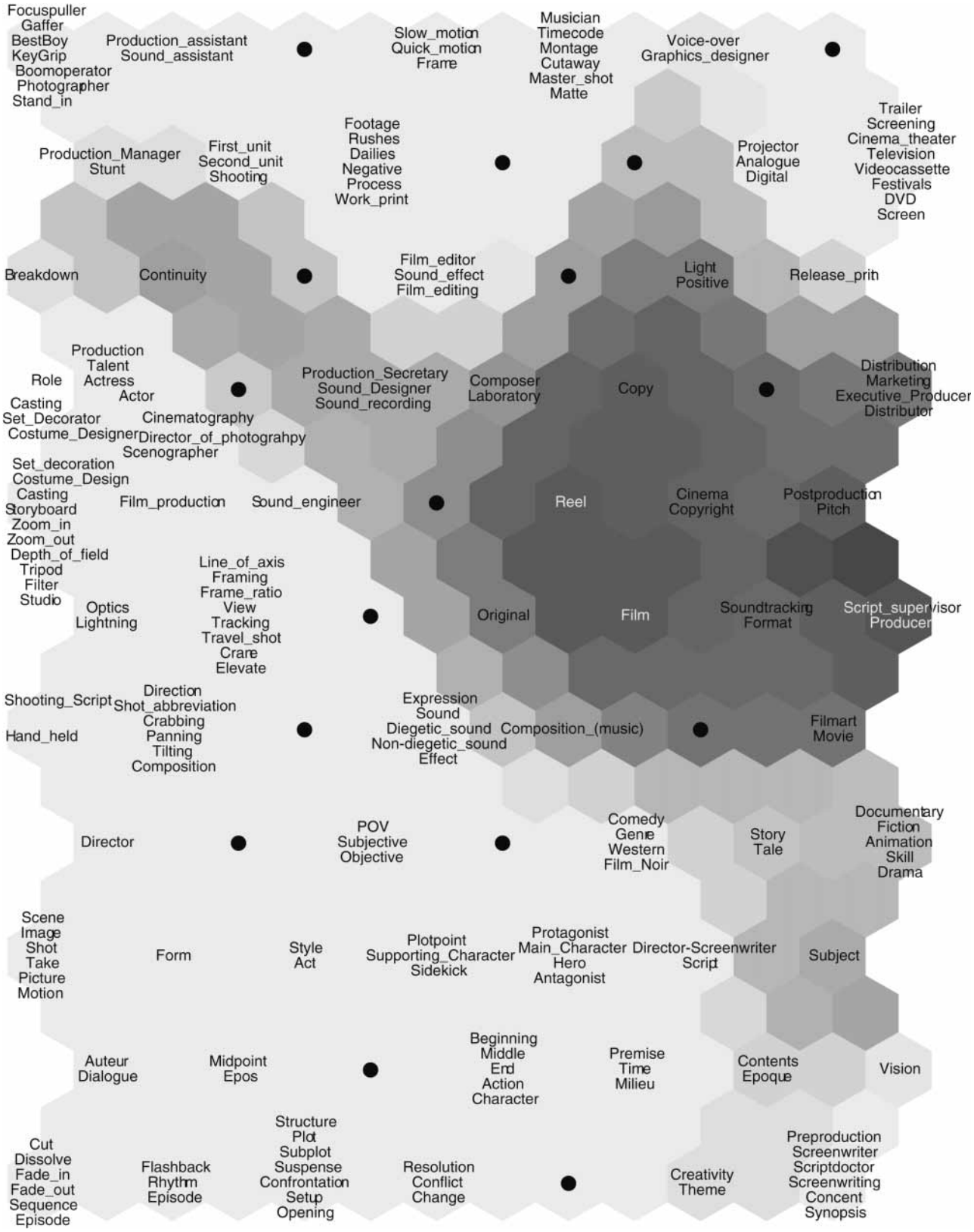

Figure 2. A SOM of cinema concepts based on concept maps of the students.

The product has been developed in parallel with the action research and the students' concept maps and comments were utilized. (For the extensive materials also the SOM was used.)

6 Discussion

The objective of the action research was to improve the Sign Language using Deaf students' understanding of distance learning and to produce adequate tools for effective studies.

First, one can ask how the Deaf students learned the conceptual thinking of the film art and how they created the links between the concepts of cinematic expression. The results suggest that intensive use of hypermedia were relevant tool in learning of the film art, augmenting the theoretical thinking. However, the on location instruction must also be taken into account, as well as the interaction and collaboration between the teachers, tutors, interpreters, and students.

Second it was found, that during the study period a group of Deaf students turned into a Deaf film production team. Novice filmmakers worked virtually in FLE3, and searched for knowledge and material from the web. During the independent periods students collaborated actively especially if they had technical problems. However, it was observed that distance learning required tutoring and "on-location" teaching as well, in one form or another.

Finally, the study revealed that SOM, co-design and action research are effective methods in a design process which contribute to tutoring.

7 Conclusions

It is an auspicious and interesting possibility to provide basic theoretical and practical film studies through an interactive user interface and CSCL with the assistance of a tutor. We suggest that professional designers of the educational products and Deaf students in higher education should collaborate more closely to improve effective learning tools for distance education. We claim that the SOM is a relevant tool in distant learning of film art, augmenting the theoretical thinking of the students and effective tutoring of the group when used with personal concept mapping and intensive use of other web-based learning tools. Future research with practical experiments will show how effective the use of the SOMs will be from the point of view of student learning. They provide promising possibilities for visualizing and making conceptual changes overt. What has already been shown is that the SOM constitutes a useful framework for modeling central concepts of constructive learning.

The final and full report of our action research will be published at the end of the year 2003.

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