Computer supported collaborative writing in an early learning classroom

A. Lingnau, H.U. Hoppe & G. Mannhaupt
Gerhard Mercator University, Duisburg, and the University of Erfurt, Germany

Abstract This paper describes a collaborative experiment in an early learners’ classroom, equipped with special software and hardware to support the acquisition of initial reading and writing skills. This ‘Computer-integrated Classroom’ originated from the EU project NIMIS. Here, a new method to teach ‘reading through writing’ is supported by a specific software tool (T³) in the general framework of the classroom environment. Particularly, a collaborative writing task facilitated by a shared workspace system has been evaluated with a group of first graders using the T³ application. The speciality of this experiment lies in the study of domain-specific collaboration in a rich real world learning setting.

Keywords: Collaboration; Empirical; Literacy; Primary; Synchronous; Writing

Introduction

A common scenario in CSCL is synchronous cooperation/collaboration through shared workspaces (e.g. Baker & Lund, 1996; Plötzner et al., 1996). Yet, most of the empirical studies using innovative CSCL-specific tools (beyond windows sharing as part of videoconferencing sessions, etc.) were usually based on selective experiments, often in the laboratory (recently, e.g. Fischer & Mandl, 2001). In previous work, the present authors have found that co-constructive activities in shared workspaces require a special introduction and that it is appropriate to provide specific training material (cf. Hoppe et al., 2000a). Thus the ‘ecological validity’ of previous educational investigations of shared workspaces is open to debate. This paper describes a study with shared workspace interaction in a real, though quite innovative, classroom setting for young children. The aim is to demonstrate that the quality of learning is indeed improved by the introduction of specific interactive media into this group learning scenario. The tools themselves are either used by ad hoc pair groups in one place or in a more controlled way by two students in separate work places.

A computer-integrated classroom for early learning

The new perspective underlying the idea of Computer-integrated Classrooms (CiC) is to step back from computers as general purpose machines with standard input and
output facilities. Integrative approaches with new interfaces and devices are recently receiving a lot of attention, e.g. under the heading of ‘The Invisible Computer’ (Norman, 1998), ‘Tangible Bits’ (Ishii & Ullmer, 1997) or ‘Roomware’ (Streitz et al., 1998). This approach lets the traditional computer recede more into the background and requires new specialised devices and interfaces driven by appropriate software architectures. A first version of a CiC was described in Hoppe et al. (1997). This vision was implemented as a laboratory prototype which has now made its way to real classrooms.

In the framework of the European NIMIS project (‘Networked Interactive Media In Schools’, cf. Hoppe et al. 2000b), the general concept of a CiC for young children (5–8 – year-old) has been developed. To be successful in terms of usability and acceptance with the envisaged users and particularly with the responsible teachers, it was important set up the learning environments in such a way as to take the existing social interactions and specific needs into account. During the project’s lifetime, three CiC instances have been designed and installed across Europe as roomware environments (i.e. including aspects of furniture, hardware and software) to support early learning. The classroom in Duisburg (Germany) was designed from scratch and installed in an originally empty room, whereas the other two in Portugal and UK where integrated with existing environments. Figure 1 gives an impression of an embedded classroom installation with integrated hardware components and a big interactive screen.

To make sure that new media technology really supports learning without redefining well-suited pedagogical procedures, existing interactions and curricular activities were studied in the classrooms of three primary schools associated to NIMIS. The CiC that exists now in the German primary school has been set-up in close cooperation with teachers and test groups of young children. Furthermore the teachers and children were involved in the design process of the software. By following a rapid prototyping approach, it was possible to get immediate feedback from the teachers as well as from the pupils. Periodical meetings with the teachers discussed the experiences and new requirements that had arisen from the daily use of the CiC.
Method

Participants
The ‘Gemeinschaftsgrundschule Kirchstraße’ is the German school involved in the NIMIS project. The primary school is located in the city of Duisburg and provides education for nearly 400 pupils. The school staff consists of approximately 20 teachers, who are mainly aged 30–50 of which the majority are female. Twenty-seven children and three teachers took part in the project. All classes and grades are of mixed ability, in particular this school has many (approx. 34%) children whose native language is not German.

In general, the children are taught in individual work phases in which the teacher organises the learning environment, but the structuring of activities (i.e. what has to be done when) originates from the children themselves. The teachers act, most of the time, as moderators and they decide what the line of work will be for the school day.

The class involved in the experiment in Duisburg consisted of 27 six and seven year old children, with a high percentage of pupils with mother tongues other than German, a true reflection of the local population. It was the first year in school for the children. Within the NIMIS project, the CiC was used every day for at least one hour with half of the first graders group.

Software environment
To provide networked interactive working and collaboration, the NIMIS Desktop is a multifunctional tool for pupils and teachers (Figure 2). It gives access to the main functions without the need for technical instruction or deeper knowledge about computers. Children can easily pass data to others, share data with others, move, print, send or delete their data.

\[ T^3: \text{a collaborative writing tool} \]

The main focus of the NIMIS project was to provide different means for a wide range of experiences with literacy. Among the NIMIS applications, T3 is the one that concentrates on the very first step in acquiring literacy related skills, namely learning to read and write (Figure 3).

T3 extends a method of teaching literacy called ‘Lesen durch Schreiben’ (Reading through Writing) (Reichen, 1991). This method is used in Switzerland and is becoming more and more popular in German primary schools. The most important

© 2003 Blackwell Publishing Ltd, Journal of Computer Assisted Learning, 19, 186-194
benefit of this method is that children acquire reading and writing skills at their own pace and can freely apply their pre-existing knowledge. Each child can immediately start writing words or even small sentences independent of their stage of cognitive development. Reading emerges spontaneously from this synthetic writing experience. It may happen after a week or after five months and it is not specifically triggered by the teacher.

The crucial feature of T³ is, to provide almost immediate auditory feedback of the children’s written work. Children start writing the words before they have the ability of reading what they have produced. Initially, it is quite frequent that a child cannot read what he or she has written a few minutes ago. Although not emphasised in the original method, this important feedback cycle starts in the noncomputerised classroom practice with the exact pronunciation of the written phonemes by the teacher and was implemented in T³ (Tewissen et al., 2000a).

Collaborative work in the class of first graders takes place in asynchronous and synchronous mode. Asynchronous collaboration takes place by children creating simple written dialogues and sending each other text parts (i.e. small questions and answers written with T³) via the NIMIS desktop’s email function. For synchronous collaboration of two or more children, shared workspaces were used. In the case of the T³ application, the writing area (Figure 3, left workspace) is synchronised by means of a software library for coupled objects (‘Match-Maker’, see Tewissen et al., 2000b). The users cooperate in shared workspaces based on a replicated software architecture. A replicated software architecture is characterised by synchronising separate fully functional application programs and not by multiplying the display of one master application (as in ‘windows sharing’ approaches). This allows for supporting workspace sharing in a flexible and robust way in terms of view independence and recovery.

**Procedure**

When working in the NIMIS environment the pupils were divided into two groups of 13 and 14 for the reading and writing lessons. One group then worked within the NIMIS classroom environment while the other was taught following the same ‘reading through writing’ method in an ordinary classroom environment without technical assistance. The next day, the two groups switched classrooms for this literacy hour. All in all, each group had two to three lessons per week in the NIMIS classroom environment. Each lesson took 45 minutes.
In both classroom environments children worked individually or in pairs solving problems that most of the time had to do with literacy. In the NIMIS environment six interactive Wacom tablets served as ‘interactive workplaces’. The pupils could work in pairs or, if they preferred, in turns since non-computerised workplaces had also been introduced. The tasks from which the pupils could choose changed about once every 6–8 weeks and usually referred to a main theme such as Autumn, Winter or Christmas.

The children’s cognitive prerequisites were assessed at the beginning of the year using the Bielefeld-Screening test (Jansen et al., 1999). The Bielefeld-Screening assesses the cognitive prerequisites considered relevant for literacy (e.g. phonological awareness, short-term memory span, speed of memory recall, visual discrimination). These tests indicated that in the beginning of the school term seven out of 24 children who took part in the evaluation were at risk of developing literacy problems. This percentage of 30% is considerably higher than in ordinary groups of first graders (expected average 17%) and can be explained by the fact that the percentage of children with German as second language was higher than in ordinary schools and also by the high number of children from broken homes in the sample.

A study was conducted to investigate whether first graders were able to make use of synchronous collaboration through the shared workspaces available in the T3 application. Although the basic task of acquiring reading and writing skills is an individual one, the T3 application also provides a mode for collaborative work in a shared workspace. This experimental study of collaboration with T3 was embedded in the everyday classroom environment. This avoided well known problems in collaborative learning where learners are familiar with the learning content but not with technical tools and computer-mediated collaboration (e.g. Fischer et al., 1999).

From a set of different collaboration modes (i.e. distribution of material, roles and goals), a mode was chosen in which the participants were allowed to use different material but had the same goal and role. This mode was similar to the ‘jigsaw’ method of cooperative learning developed by Aronson et al. (1978).

The task for each of the 12 pairs of children was to write together five words presented on a working sheet within 10 minutes. In order to encourage the children to cooperate, the phoneme tables were split up. One of the partners had to work with the vowels, while the other could only make use of the consonants. Therefore, to complete a word, both partners had to work together. As the children were familiar with the application they got a very short introduction by the teacher about the
collaborative task. The two writing boards were linked to each other on opposite tables so that each of the children could see the actions of the partner (Figure 4).

**Observational analysis**

For the observation procedure two stages have been used. In a first step the observer took notes while observing the interaction of the children. In the second step the observer was asked to encode certain predefined events during the observation using a predetermined coding sheet. The coding sheet contained a number of categories, each of which reflected, how the partners interacted.

To standardise the observation, an extensive 20 hour observer training was conducted. Based on videotaped sessions from the classroom, the observer was instructed in using the coding sheets. Potential ambiguities were resolved. Since only one observer could be used, it was not possible to calculate statistically measures of reliability. Nevertheless, by the end of the 20 hour training, the correspondence of the observations between the observer and the instructor exceeded 0.8.

The observation procedure followed the event-sampling paradigm, i.e. observers were requested to count the occurrence of predefined events, while neglecting undefined events. From extensive preliminary studies in the class a classification of events of interest was derived reflecting the degree of interaction between partners. The observation categories, which were explicitly defined to rely heavily on observable and overt behaviour to minimise interpretative freedom, are subdivided in four major parts (Table 1).

**Results**

After the observations of the 12 pairs, the frequencies of each of the 14 categories were calculated. Table 1 shows the mean frequencies of the 4 main categories. The category with the highest frequency was individual work (category 1.1). Since the children had to move letters individually on their own desktop, these actions were coded in this category. Among the interaction categories, coordination actions scored the highest, reflecting the children’s need to mutually decide on the next steps to take (e.g. which words or letters to write next, deciding on whether or not to use the computer’s auditory feedback device). Comparing the frequencies of category 2.1 (asking for/receiving help) and category 2.4 (giving/executing suggestions) reveals the pupils’ tendency to give orders/advice rather quickly instead of giving the other child time to find a solution on his or her own. Also, within a pair both partners at times did not asked each other for help.

An interesting issue is also the low number of affirmations given to the partner (2.5). This was observed throughout all attainment-levels. As can be seen in the two categories labelled ‘teachers involvement’ (3.1, 3.2), teachers were rarely asked for assistance or guidance.

It is evident that collaborative activities prevail over non-collaborative activities. Further, it should be noted that the number of non-task oriented actions remains rather low in all different groups. It is also quite interesting that the children mostly refrained from seeking the teacher’s help.

Most pairs came up with phonetically correctly spelt words. Some of the high-attaining children were even able to develop syntactical rules for their spelling. For the low-attaining children, there are indications that the partners came up with higher
quality solutions than each of them would have produced alone. These indications are based on observation which were later corroborated by the analysis of concrete writing results in the different conditions. The comparison makes use of task-specific quality measures such as number of correctly spelt graphemes, number of orthographic elements, etc.

As for the overall reading and writing skills, there are clear indications of below average prerequisites based on the standardised ‘Bielefeld-Screening’. Yet, the overall development of the students in the first grade turned out quite positive in terms of an also standardised spelling test (‘Hamburger Schreibprobe 1+’; cf. May, 1998). Table 2 shows the development in three stages, starting with the Bielefeld prerequisite test and continuing with the Hamburg spelling test after months 6 and 11. As an overall observation, the results are much better than to be expected based on the prerequisites test. Of course, this overall result has to be attributed to the NIMIS condition as a whole and not only to the specific shared workspace interaction focused on in this paper.

Discussion

Observations during previous experiments show that it is reasonable to present warming up material to the learners before starting with the actual task (Gaßner & Hoppe 2000). This does not prove that it is a necessity but this it taken as a hypotheses. In this case the children worked with the computers solving different tasks every second school day. They were experienced with the non collaborative usage of the environment.

The overall impression of how the children managed the experiment was very positive. The children became familiar in using the collaborative working scenario quickly. During the first 1 or 2 minutes of the 10 minute observation interval, the partners usually needed to adapt to the new mode of use. Most of the mutual tutoring

© 2003 Blackwell Publishing Ltd, Journal of Computer Assisted Learning, 19, 186-194
occurred in this phase. Children were explaining to each other what this software scenario was for and how they could use it. After one or two letters were moved to the working section of the desktop, the ‘warming up’ period was usually over and the children started to work on the words they would have to write.

Typically one partner started by simply moving a letter to the working window of the screen and then waited for the partner to continue. When the partner was unsure how to continue, the children usually engaged in a collaborative dialogue: The weaker partner sometimes asked the stronger for assistance. More often, the higher-attaining pupil gave advice without request, which was usually accepted by the partner. Occasionally there was dissent, whether a word was spelt correctly or not. The children tried to solve this by reading the word aloud to check the phonetics, asking the computer to read it for them or simply by ‘consent over dissent’. Disagreement was seldom settled in a destructive or dominating way. After the time was over, most of the pairs were willing to spend some more time on the refinement of the words in the task.

The findings show new opportunities and necessary conditions to organise computer-mediated learning from the beginning of school onward. The children were able to productively collaborate on a task. The weaker pupils benefited from this learning situation as much as the stronger students. Computer mediated collaborative learning situations are often novel and difficult activities. This difficulty is often the explanation for the problems observed in managing these multiple demands: The learners have to solve a double task. They have to solve the content task while becoming familiar with the new collaboration medium. In this study there was no evidence of a double task. The children even made use of the social learning setting to support their work on the content task. Also, it should be mentioned that, for these young children, to stay on a coherent collaborative task for 10 minutes (and more) is a non-evident result as such.

As a hypotheses it is assumed that there are a number of possible reasons why T³ was effective. First, the learners were familiar with the content of the task. They were not confronted with an unknown or unusual task. Second, the learners knew the computer application tools implemented in T³. They did not have to get to grips with a new means of working. Thirdly, the structure and demands of the task were appropriate to the social and cognitive developmental state of the learners. Especially, for the young learners taking part in the NIMIS classroom, the task consisted of one objective that could be achieved together, but with distributed means in a jigsaw arrangement. This arrangement was an effective way to organise social learning for the participants.

Acknowledgements

Parts of this work was undertaken in the Esprit project No. 29301, ‘NIMIS’. We thank our NIMIS partners for the good and constructive cooperation, and especially the pupils and teachers of the associated schools for their intensive participation and important contributions.

References


© 2003 Blackwell Publishing Ltd, Journal of Computer Assisted Learning, 19, 186-194