Problem solving with computers in a collaborative learning environment: a preliminary study

Collaborative learning in one form or another has been common practice in schools over many years. However its use has been spasmodic and at times restricted to particular levels (e.g. middle and upper primary) or subjects (e.g. social studies, science prac). In previous investigations researchers have concentrated on the product of collaborative learning and the actions of the group as an entity. Current research into collaborative learning is concerned with interactions between members of the group and how these interactions influence learning and any material that is produced. Both teachers and researchers are now aware of the importance of the social context in which learning occurs, and there is considerable research into understanding more fully the relationship between learners' social interactions and the learning process.

This paper contains preliminary comments on a study into one aspect of collaborative problem solving by grade 4 primary students using computers as an investigative and recording medium. Working in small groups the students were given a task to solve using designated pieces of computer software and non-computer related resources. As reported in previous studies, there were both agreements and disagreements among the students as they attempted to complete the given task. The role of disagreements during the process of collaborative learning will be the focus of this paper, both in relation to this study and to collaborative learning in general.

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Introduction
It is not unusual for children to be in groups when they work and play with computers. It is also common for primary teachers to use small group activities in many different subject areas. However it is not the norm in Australian primary classrooms for students working in groups to have access to their own computer throughout the whole school day, and for that computer to be supplied with a comprehensive range of software, compact disks, as well as having access to the Internet.

Background to project
On October 9th this year the Victorian Directorate of School Education (DSE) launched the “Classrooms of the future” project. Under the project, every school in Victoria will have access to the Internet within months. ... Every teacher in government schools will be trained to use the Internet to ensure benefits for students are maximised. ... Another highlight of the project is the creation of seven navigator schools as model Classrooms of the Future. The schools (four primary and three secondary) will trial and develop new teaching methods in using state-of-the-art interactive technology to improve learning opportunities for students. [3]

For the first three school terms of 1995 Grade 4R at one of these primary schools had operated like any other primary class. However

during the vacation between terms 3 and 4 their classroom was changed with the delivery and installation of a dozen desktop computers, printers, digital and video cameras, a scanner, sets of computer controlled Lego, and many different types of computer software and compact disks.

School term 4 commenced on Monday October 9. Most of the children in Grade 4R saw all this hardware and software for the first time on this day. During the second week of the term break the class teacher and about six of the children attended a week long in-service, conducted by the Sunrise Research Laboratory from RMIT, which concentrated on assisting participants become confident users of MicroWorlds, Netscape together with a simple HTML editor, and Lego Control-lab.

Grade 4R consists of 26 children aged around ten years together with teacher Mrs R. It operates in a semi-open room connected to two other classrooms associated with the “Navigator classrooms” project, but only one of which has undergone a similar technological metamorphosis. All the classes were accustomed to breaking into small groups to work collaboratively on research projects in a range of subject areas.

Collaborative learning
Throughout this paper two major assumptions have been made. They are made basically on two grounds. First that this is an exploratory and preliminary paper, and second that there is neither the time nor space to flesh out the appropriate arguments at an acceptable level of detail. However it is recognised that this will have to be addressed in any subsequent publications.

The first of these assumptions is that there is now widespread recognition and acceptance, among teachers and researchers, that learners actively construct knowledge for themselves, as opposed being passive recipients of knowledge. This is part of the constructivist theory of how knowledge is acquired.
The second assumption made is that learning is a fundamental consequence of conversations between people. There are two major aspects of this assumption. Conservation implies that learning communication does not have the traditional education meaning of being basically a one-way transmission from a teacher to the taught. Conversations are taken to be the means by which learners collaboratively construct shared beliefs and understandings. In turn, the use of conversation as a vehicle for learning implies that there is a social context and social processes that are indisputably part of the learning process.

As collaborative learning has engaged more researchers over the past decade, so the criteria for defining collaborative learning have been refined. The research literature also contains many variations on the use of "collaboration". For some the collaboration is between institutions such as schools and universities, and for others between an individual learner and a piece of computer software. Terminology and labelling associated with collaborative learning have become very disparate, and include "situated learning", "group work", "cooperative learning", "peer collaboration", "collective learning", and "communities of practice". Researchers now accept that much of conventional classroom group work is imposed on students by teachers, and is not a true example of collaborative learning. For the remainder of this paper working with others toward a common goal [1] will be taken as a working definition of collaborative learning.

Several researchers have investigated conceptual changes that occur during collaborative group work. Roschelle [9] has shown that in a collaborative learning situation it is possible for two or more people to coordinate their development of concepts so that eventually there is a common, shared understanding.

Others have focused on the discourse or dialogue that accompanies and is an integral part of collaborative learning. Kanselar and Erkens [6] make the point that currently teachers and researchers do not have specific knowledge about the way students communicate and thereby coordinate their information processing while collaborating. They also report on difficulties that arise when problem solving activities are recorded electronically for later analysis. Many of these difficulties are the consequence of communication in natural languages being implicit, without all points and issues necessarily being advanced in spoken form.

Barfurth [1] made an extensive study of the process and role of disagreements in collaborative problem solving. Although the study did not involve computers explicitly, the analytic framework Barfurth developed for studying resolution of disagreements in collaborative learning groups will be used as the basis for the present study.
Computers in a collaborative learning environment
Because of a shortage of computers in schools, often only one or two
computers to be shared between 25 children, many primary schools have
been forced into introducing group work for computer related
activities. Although many of the primary teachers in this situation
might not be aware of it, there is a body of research-based evidence
that children working in groups are more productive than children
working alone [4,7].

Several studies have investigated the importance of conflict with
collaborative learning groups. Researchers appear uncertain about how
participants perceive such disagreements, how they are resolved, and
how this process can lead to cognitive change [1,5,8]. All agree that
further understanding of these issues can only come from deeper
investigations into the social interaction of collaborative learning,
and in particular the dialogue process.

Clements and Nastasi [2] also studied conflicts, but in two different
computer-based environments. Their findings suggest that Logo might
facilitate both the development of higher-order thinking and the
resolution of conflicts within the group.

Method
A continuing process of observation, video taping, and analysis has
begun. The aim is to investigate grade 4 children working
collaboratively on a set task in a technologically rich learning
environment.

During October and November grade 4R has been observed by the author
each Thursday morning. The time table usually includes times when no
children use computers (religious instruction), times when one third of
the children worked individually at a computer (Mavis Beacon), and
other times when the whole class, working in groups of three, has the
opportunity to use a computer if it is appropriate for the task they
are working on.

The researcher takes the role as a participant observer, working with
the class teacher and assisting the students when it is appropriate.
He also manages the video camera, although the children know how to set
up and operate the camera and have been of great assistance. If there
is a formal start to a lesson the teacher and the whole class are video
taped. As soon as group work wins the camera focuses on a particular
group that is being recorded while they work together, both on and off
the computer.

Over the non-teaching period from December to February it is planned
that all video tapes will be reviewed, and decisions made about which
sections will be transcribed. The computer software CVideo will be used for transcribing dialogue from the tapes and for selecting and linking visual events with the transcription. The qualitative data analysis program NUDIST will be used to analyse the transcriptions and researcher's field notes.

A framework for analysing disagreements
As noted previously, other researchers have investigated cognitive conflicts among small groups working with computers [1,2,5,8]. They have each developed their own analytic framework. Most agree that there are important differences between socially-based disagreements and cognitively-based disagreements. Barfurth [1] notes that acceptance of these differences is based on recent research into peer interaction that commences with, and then builds on, the theories of Piaget and Vygotsky. She proposed the notion of a social move and a cognitive move to operationalise the different perspectives.

Social moves are concerned with processes across a group, and consider interactions between participants in the chronological order sequence they occur. It is assumed that whenever a social interaction occurs, a parallel cognitive process is taking place within an individual, and such cognitive moves can be identified and analysed. Both social and cognitive moves can be subdivided into a number of components.

Summary
This research has only just begun. It will probably continue throughout next year as more computers come into the school and all grades become involved. Because the school has not decided whether to keep grade 4R together in 1996, it is not possible to state which grades or levels will be part of the research project. Whatever happens there is still an enormous amount still to learn about students learning in collaborative groups and having immediate access to computers.

References


3 DSE 1995 Classrooms of the future ... today. Press release from the Directorate of School Education carried in many Melbourne local and community newspapers, for example Diamond Valley News, October 25th 1995, pp.


