British Journal of Educational Technology *Vol 33 No 2 2002* 189–200

Email use in elementary school: an analysis of exchange patterns and content

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Abstract

Email was embedded in a project in design and technology education in elementary school. During four lessons children worked in groups on building a flying object. These groups communicated through email with groups of children from another school. The analyses of the emails, as viewed from distributed cognition theory, focus on the exchange patterns and content. Two characteristic exchange patterns are stacking and compounding. In stacking emails are sent out quickly enough to afford a "just-in-time" exchange of information. In compounding the emails transcend lessons. An "old" section of the email reacts to the partner's email about a previous lesson. A "new" section deals with the current lesson.

Question-answer exchanges accounted for only about 15% of the communications. Connected discourse with explicit or implicit references to the partner's email was likewise scarce. Groups mainly connected to each other through adoption, leading to shared scenarios of "We tell you our story—You tell us yours". The conclusion discusses the impact of the task on the children's communication. Among others, a precise definition and teaming of the task is deemed necessary to favour embedded email use. Because the genre of email use in elementary school is yet to be defined the authors caution against imposing many constraints on what children write to each other.

Introduction

Mountaineers sometimes say that they climb mountains "because they are there". A similar statement appears to be true for computers in school. Teachers sometimes use computers in school because they are there. Just as in mountaineering, success in school does not come easily; there are many obstacles to overcome. Interestingly, most of these obstacles have little to do with the technology itself. Salomon (1995), among others, indicates that the success or failure of using computers in school largely

Published by Blackwell Publishers Ltd, 108 Cowley Road, Oxford, OX4 1JF, UK and 350 Main Street, Malden, MA 02148, USA.

depends on the orchestration of the various actors and factors in the whole learning environment.

We report here about a project on email use by children from the upper grades of elementary school. The project employed email as a tool to communicate about the lesson topic rather than as an issue in itself; email was used as a means rather than an end. The main reason for employing email as a tool in a real problem solving task directly relates to our conviction that such an approach improves domain-related learning and also affords better personalisations of the tool by the children. This conviction is in line with constructivist approaches to education.

The larger part of the preparations for the project involved creating a series of four lessons and lesson materials in which email use formed an integrated, domain-related activity of the children. Developed in close collaboration with teachers, the lessons evolved around the problem of creating a flying object. Each lesson contained a prescribed email moment. A teacher manual that supported the participants, detailed each lesson and suggested topics for the email exchanges.

A critical element in the lesson plans involved teamwork because collaborative learning was deemed to be especially relevant for the relatively complex problem that the children were asked to solve (see Cohen, 1994; Dysthe, 1996; Mercer Wegerif and Dawson, 1999). The children were teamed up in small groups. During the various phases of problem solving these teams were to communicate about the project as a group, as part of the whole classroom, and as a conversational partner of a group of children from another school who worked on the same project. To facilitate the latter aspect, the teacher manual contained information about setting up an email project with another school.

The results from the project were examined with two notions from distributed cognition theory in mind, namely the idea that information and cognition is distributed and that learning objectives are (partly) defined by the learner (eg, Cole and Engeström, 1993; Dysthe, 1996; Mason, 1998; Pea, 1993).

The use of email entails a distribution of information and cognition in which *time* and *space* play a prominent role. Email affords an a-synchronous communication, meaning that there is always a time-lag between sending a message and receiving a reaction. This time-lag inevitably affects the uses of the tool. On the positive side it may stimulate reflection as children have more time to think through their responses. On the negative side it may reduce the chances of realising a truly connective discourse (versus "knowledge telling", see Scardamalia and Bereiter, 1993) and getting a timely response to pressing questions.

Email use also affords communicating groups to bridge their distribution in space. In schools the factors that affect the success of such an enterprise include: (a) the proper (eg, synchronous) scheduling of the lessons and their email moments in the teamed-up

classrooms, (b) creating a common ground for communication (eg, by groups introducing themselves), and (c) the choice of an appropriate means of responding to an email (eg, by annotating, repeating or paraphrasing a portion of the received email). Some of these issues are discussed when we present the results from analysing the content of the children's emails. In addition, we detail the exchange patterns that emerged. These patterns illustrate how the emails actually were distributed during the project.

Email is a lean medium. It is not much more than white space on a computer screen on which a message can be written. Apart from dictating a predominantly verbal form of communication, email does not impose much structure on what gets communicated. In other words, email gives children a great deal of freedom to *personalise* their communications. But there is no total freedom. The task is an important structuring factor and children are expected to communicate mainly about their design task. In addition, the teacher manual contained some suggestions for structuring the emails. Even so, it is the groups who determine how and what they communicate by and large. In other words, the objectives for the use of email are defined by the children and the results thereof are illustrated with the findings of the analyses of the content of their communications.

Method

Participants

Sixteen elementary schools in the Netherlands participated in the project and data were gathered from 301 children with a mean age of 11 years. The children formed 87 groups that sent out a total of 214 emails. In preparing for the project, special attention was given to three top-5 obstacles to computer use in Dutch schools, namely: (a) lack of sufficient (and fast) computers, (b) insufficient knowledge and training support, and (c) lack of lesson materials containing an integrated computer component (Ten Brummelhuis and Drent, 2000). The obstacle of computer access was handled by asking the participating schools to guarantee easy pupil access to the computer(s). The problem of technical know-how was circumvented by accepting only schools in which the participating teacher was a skilled email user and by offering technical support upon request. The introduction already described how we handled the third obstacle.

Coding and scoring

An important aspect of distributed nature of email use transpires in the *exchange patterns* that emerge. These patterns are operationally defined as a mixture of the score for the exchange rate and participation rate for a group. The exchange rate measures the mean frequency of emails sent out by a group in a particular lesson. A rate of more than one email is considered to be reasonably fast paced. The participation rate measures the continuity of the exchanges over the lesson series. A score of 75% indicates that a group has emailed its partner three out of the four lessons. Such a score also reflects a high level of participation.

Combining the low and high scores for exchange rate and participation rate yields four distinct exchange patterns. Figure 1 presents the criteria for these scores. Each distinct

pattern is also given an appropriate name. For example, the exchange pattern of a group is characterized as incidental when the group sends out no more than one email in a particular lesson and has emailed only during one or two of the four lessons. Chance alone favours the presence of the incidental and structural exchange pattern because of the interdependence of the exchange rate and participation rate.

		Participation rate	
		Low (25%–50%)	High (75%–100%)
Exchange rate	Low (0–1)	*incidental*	*compounding*
	High (>1)	*stacking*	*structural*

Figure 1: The exchange patterns that emerge from combining the scores for continuity in sending out e-mails in the four lessons (participation rate) with the scores for frequency of emails sent within lessons (exchange rate)

Coding of the *content* of emails followed a two-step procedure with segmentation preceding categorization. In segmentation, each email is divided into meaningful units such as a principle sentence or a (subordinate) clause. Adding all the segments in an email gives an impression of the mean *volume* of an email.

In categorization, each segment is classified on four dimensions: (1) linguistic expression, (2) content, (3) motivation and (4) connectivity. These dimensions and their subcategories were derived bottom-up as well as from theory. With regard to the later, only a few useful ideas could be abstracted from studies on email exchanges (eg, Atkinson-Christie, 1997; Duin and Archee, 1996; McKeon, 1999; Williams and Meredith, 1996). Our main source of inspiration was the work of Mercer (1996) on analysing face to face communications between children. A codebook was created to support the categorization by independent observers. Inter-observer agreements yielded a satisfactory score of 0.66 (Cohen kappa) and higher for these codes.

Figure 2 illustrates the coding of two segments from an email. Note that the Content dimension is the only dimension in which the main categories are **not** mutually exclusive. Only here some segments can belong to two categories instead of just one. For example, the segment "We have a tip for you concerning the design of your aircraft" scores into the category Communication and in Domain Talk.

In scoring, the mean results for all groups were first calculated for individual lessons. These scores were later combined to create an overall picture of the content of the emails sent during the whole project. The tables that are presented in the next section now portray the "average" email for the average lesson.

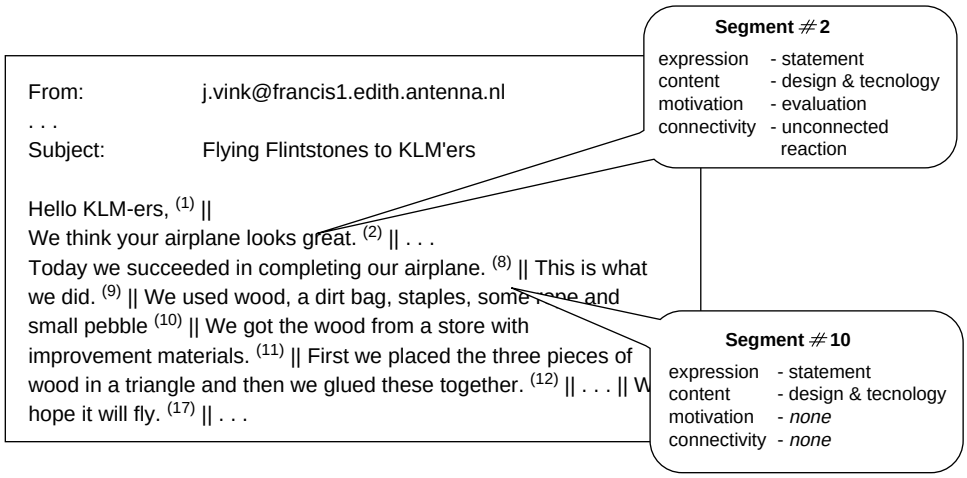

Figure 2: An illustration of a segmented and categorized email

Results and Discussion

Exchange patterns

The *incidental pattern* dominated. On a total of 87 recorded email groups, 56 groups (64.4%) had more or less haphazard exchanges. The exchanges of yet another 17 groups followed a *structural pattern.* In this pattern the emails are relatively plentiful. An impressive 94% of these groups came from schools in which the children already regularly used email before participating in the project.

The exchanges of 11 groups (12.6%) fitted perfectly within a *compound pattern*. In this pattern each email ideally consists of an "old" section, in which the group reacts to a previous email, and a "new" section that provides the stimulus for its email partner (see Figure 3).

In a *stacking pattern* groups interact more than once between lessons. Information is now given and received "just-in-time" because the children react quickly to the issues brought up by the email partner. The exchanges of 3 groups (3.4%) fitted this pattern (see Figure 4).

There was a statistically significant correlation between participation rate and exchange rate on the one hand, and email volume on the other (respectively $\tau = 0.40$, $p < 0.001$, and $\tau = 0.69$, $p < 0.001$). Partial correlations with the effect of participation rate filtered out still showed a positive and statistically significant relationship between exchange rate and volume ($\tau_{xy.z} = 0.56$, $p < 0.001$). In other words, groups who send out more emails also tend to make these emails longer. Perhaps this signals that email functionality carries its own rewards. The reasoning could be like this: longer emails → are likely to carry more substance → which make the interaction more valuable → which helps keep up participation.

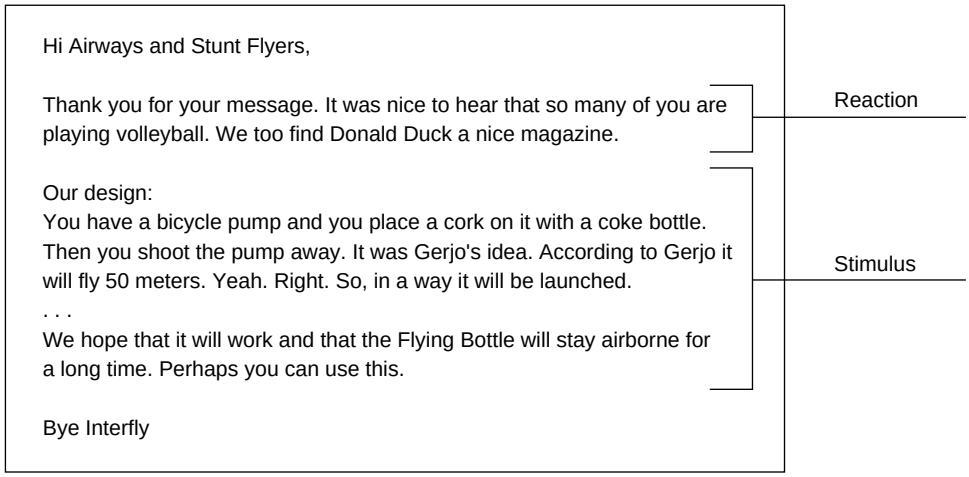

Figure 3: In compounding, an email ideally consists of two parts. One part deals with the last e-mail from the partner group. In this Reaction the group reacts to issues from an earlier lesson. The second part is what the group would like to tell about their current situation. This Stimulus presents topics from the current lesson

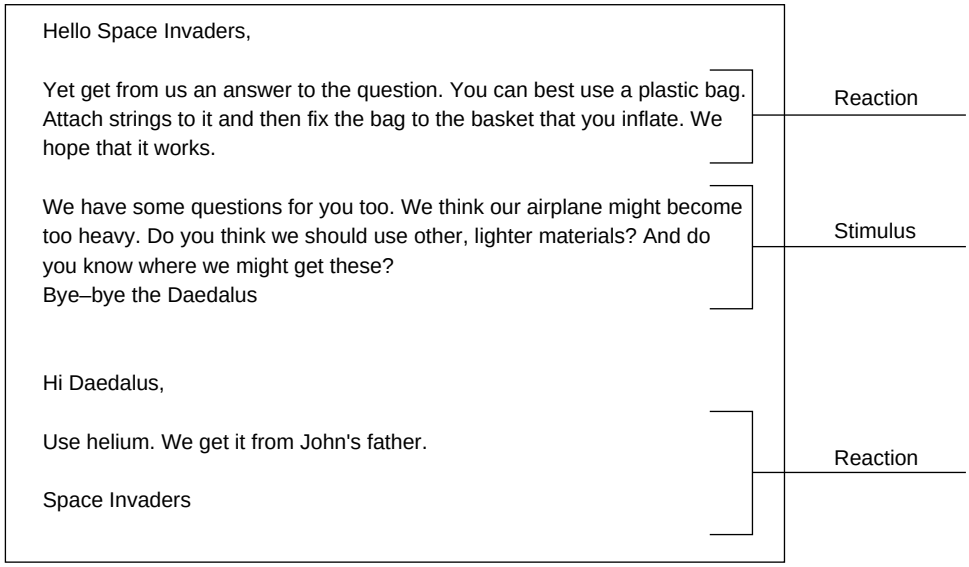

*Figure 4: In stacking, emails are exchanged swiftly enough for groups to share views on current issues (*ie, *the same lesson)*

The content of the emails

Dimension 1. Linguistic expression. The analyses in this dimension concentrated on three basic types of linguistic means: Statements, Questions and Responses. Statements are

operationally defined as expressions that, unlike Questions, do not explicitly invite a reaction and that are also not clearly a reaction to a Question or a Statement from the partner. Reactions to a Question or Statement are classified as Responses.

Table 1 shows that the emails consisted mainly of Statements. Almost 9 of the 11 segments in the average email are Statements. The presence of Questions and Responses is about balanced and seems to suggest that groups discuss their partner's question(s) in their response. A detailed inspection of the data shows otherwise, however. Only 59% of the Questions led to a Response. The remainder of the Responses were reactions to a Statement.

Table 1: The mean appearance of a linguistic expression in an email

	Mean	*Standard deviation*
Statements	8.85	5.80
Questions	0.98	1.20
Responses	1.06	2.08

In speculating about the meaning of this finding some intriguing ideas can be advanced: (1) the reaction-inviting nature of questions (the "illocuting force") is not as strong as people sometimes expect, (2) just as in face to face communications, it is not always necessary to ask a question to evoke a reaction, (3) it may not be wise to constrain the use of email to an exchange of questions and answers. The latter idea addresses the rather widespread conception among lay people that email is optimally suited for a swift exchange of questions and answers. The data indicate that this would have cut-off 85% of the communications if teachers would have allowed only for this type of exchange, all other things being equal. Perhaps more importantly, it would have deprived the groups from engaging in valuable social talk. Such talk about personally relevant issues helps build a relationship with the partner and contributes to creating a common ground (see Anderson and Guerrero, 1998; Baker, Hansen, Joiner and Traum, 1999).

Dimension 2. Topic. The topic dimension includes the categories of Communication, Social Talk and Domain Talk. Communication covers all segments in which the children say something about the process of communication. For example, a group may ask whether the other group has the ability to provide an answer to their question ("Do you know it?"), or it may express a desire to receive an answer ("We hope that you write back soon"). The category also contains expressions of an introductory nature such as "We have a question".

Social Talk includes "chatter" about pop music, sports and the like. Within this category we also classified expressions about the children's preferences, knowledge and skills for school work (eg, "I am good with computers").

Domain Talk covers all expressions about the domain of design and technology. If email is to serve its role as an important means for reflection, articulation and evaluation about the task at hand, the main body of an email should probably fall within this category. The subcategories here are: context, goal or objective, result or evaluation, materials and tools, planning and design principles.

Table 2 indicates that Social talk and Domain Talk are found in about even proportions in the average email. Compared to the total mean of 11 segments per email, each comes close to a 50%-score. Detailed examinations of the data revealed that the finding for Social Talk is inflated by a dominating presence in the first lesson. In this first email groups introduced themselves, as one would expect. Because groups added very little other information, 74% of the segments in the first email moment consisted of Social Talk.

Table 2: The mean appearance of a topical expression in an email

	Mean	*Standard deviation*
Communication	3.43	2.54
Social Talk	5.44	4.40
Domain Talk	5.58	1.61

From lesson two onwards there was much less Social Talk; the proportion of Social Talk for lesson 2, 3 and 4 was respectively 37%, 36% and 42%. The proportion of Domain Talk increased rapidly after the first lesson and then remained stable and fairly high. For lesson 1, 2, 3 and 4 the scores were 20%, 65%, 82% and 58%. In short, these findings reveal that there is a good deal of social talk but that this talk does *not* dominate the children's emails. In most emails the children are writing about task related matters.

Almost a third of the expressions deal with Communication. This seems to be just about the right amount. As in writing a letter, the children should follow certain formal rules of conduct, or "netiquette" as these are called in email jargon. Like in any other form of communication there should also be room for such talk in email exchanges.

Dimension 3. Motivation. This dimension consists of the categories Evaluation and Problem and Trouble.

Evaluation refers to all expressions containing a judgement or assessment. Judgements may relate to a situation, a product, or a personal characteristic. For example, a group might write "our group is cozy", or label an event as "funny". Evaluations could also involve the flying object, as in "Our plane did not go very far". Examples of Evaluation as an assessment of personal qualities or capacities are expressions such as "I am pretty good in many things in school" and "I know a lot about computers".

The category Problem and Trouble contains a rather mixed variety of expressions that all share an implicit or explicit request for help or information. The subcategories here are expressions of ignorance and doubt and social conflict. Ignorance refers to segments such as "We just don't know what we should build" and "Do you have tips for us on this?" Expressions of ignorance say very little about what constitutes a satisfactory response. Expressions of doubt, in contrast, refer to a more clearly voiced uncertainty about what to do or think (eg, "We do not know exactly how to insert the elastic"). Social conflict refers to a disagreement among group members, or between partner groups.

Table 3: The mean appearance of a motivational expression in an email

	Mean	*Standard deviation*
Evaluation	2.14	2.48
Problem and Trouble	1.22	1.30

Table 3 shows that Evaluations are found in 19% of the average email and Problem and Trouble in 11% of the cases. Apart from their apparent function as an outlet for certain emotions, both types of motivational expressions may be important for improving commitment. Expressed emotions such as feeling unsure or having a row, now become distributed and possibly shared. Thereby they may fortify the bond within and between groups.

Dimension 4. Connectivity. This dimension contains all expressions of interactivity or connected discourse. We distinguish three types: Connected Reactions, Unconnected Reactions, and Adoption. In a Connected Reaction the children explicitly refer to, or repeat, (part of) their partner's question or statement before reacting. A typical example is "The gas you asked about is called helium". Email programs have a reply feature to facilitate this type of connectivity, but none of the groups used this feature. All groups created their emails from scratch.

In an Unconnected Reaction groups respond to an expression without making this known explicitly. An example is the expression "The answer is four" which can be understood only within the context of an ongoing exchange. For the coding by the researchers this meant that the context had to be (re)constructed by consulting the email of the corresponding group. For the receiving group of children an Unconnected Reaction is

Table 4: The mean appearance of connective discourse in an email

	Mean	*Standard deviation*
Connected Reaction	0.85	1.68
Unconnected Reaction	0.42	1.03
Adoption	4.26	7.73

likewise incomprehensible unless the children consult the original email, or remember the statement or question that triggered the response.

Adoption is an important and unique subcategory. It refers to expressions that are connected to each other by type similarity. In Adoption a group or child imitates a particular style or typology from another group or child. Among others, Adoption is found in introductory emails when group members use the same format for presenting themselves (eg, "I am... and my hobbies are..."). To our knowledge, this format was spontaneously adopted by the other children in a group after being introduced by one of them. Adoption occurs within groups as well as across groups.

About one segment (9%) of the average email connects directly or indirectly to the email content of the partner group. The paucity of this aspect of connected discourse is compensated for by the presence of Adoption. Adoptions makes up 39% of the average email. The score for Adoption varies considerably for the four lessons. There is a preponderance in the first lesson with a 70% score, then a drop to 21% and 16% in the second and third lesson and an increase to 45% for the final lesson. When Adoption is used it typically leads to a series of emails that can be characterised as "We tell you our story—You tell us yours".

Conclusion

The important role of the task is stressed in several key notions from distributed cognition theory (eg, Cole and Engeström, 1993). Not surprisingly then, the task played a key role in the project. As indicated in the introduction, we chose to have children use email as a tool as opposed to training them in the skills acquisition for email use as an end in itself. For some children and groups this clearly led to some tension between the need to learn to use and the need to use. Often this problem was solved by mixing skilled and non-skilled children in a group so that the more experienced children could support the less experienced ones during their turn to work with email. In this fashion email was used in the way in which we think children are most likely to benefit from the experience, namely by embedding its use in solving a real task.

Distributed cognition theory also points to a strong impact of the task on teamwork. Among others, the task gives groups and group members a shared goal and perspective. The presence of a structural exchange pattern and findings on the topic of the emails and email connectivity suggest that some of our efforts to create a shared (eg, connected) discourse were successful. But looking back we think that the definition of the task for teaming up groups from different schools was not precise enough. That is, the project departed from the simple notion that the goal of creating a flying object would yield a sufficiently shared interest for the exchanges. It worked because, say, a balloon building group could communicate about general issues of design with an airplane building group. It would have been better, however, if we had teamed up groups who set out to create the *same* flying object. Then issues such as problem definition, choice of materials, and construction problems are even more likely to be really shared between groups.

Task factors also emerged in the differences that existed between the findings for the average email, and the emails sent out during a particular lesson. Both the broader picture of the first and the detailed view of the latter were affected by task features. For example, what some teachers feared did not happen. The children did not use email predominantly to chat about Madonna, soaps or hobbies. Email was used predominantly for task and domain-related purposes. In a similar vein, we think that not reducing email usage to an exchange of questions and answers has had a positive effect on the communications. The link between a specific lesson, and hence task, and what gets communicated, most clearly transpires in the findings on the topic dimension. Among others the to-be-expected spike for social talk in the first communication is illustrative.

In conclusion, email in school is not yet the integrated communication tool that it is in business settings. There is yet much to be studied and understood. There is yet a long way to go. We see the project as a first step towards defining the *genre* of email use in elementary school (see Baron, 1998). But, just as in mountaineering, with the right equipment, motivation and endurance there are good chances for success.

References

Anderson P A and Guerrero L K (1998) Principles of communication and emotion in social interaction *in* Anderson P A and Guerrero L K (eds) *Handbook of communication and emotion* Academic Press, San Diego, CA, 49–96.

Atkinson-Christie A (1997) Using e-mail within a classroom based feminine pedagogy *Journal of Research on Computing in Education* **30** (2) 146–176.

Baker M J, Hansen T, Joiner R and Traum D (1999) The role of grounding in collaborative learning tasks *in* Dillenbourg P (ed) *Collaborative learning. Cognitive and computational perspectives* Pergamon, Amsterdam, 31–63.

Baron N S (1998) Letters by phone or speech by other means: the linguistics of e-mail *Language and Communication* **18** 133–170.

Cohen E G (1994) Restructuring the classroom: Conditions for productive small groups *Review of Educational Research* **64** (1) 1–35.

Cole M and Engeström Y (1993) A cultural-historical approach to distributed cognition *in* Salomon G (ed) *Distributed cognitions. Psychological and educational considerations* Cambridge University Press, Cambridge, NY, 1–46.

Duin A H and Archee R (1996) Collaboration via e-mail and internet relay chat: Understanding time and technology *Technical Communication* **43** (4) 402–412.

Dysthe O (1996) The multivoiced classroom *Written Communication* **13** (3) 385–425.

Mason L (1998) Sharing cognition to construct scientific knowledge in school context: The role of oral and written discourse *Instructional Science* **26** 359–389.

McKeon C A (1999) The nature of children's e-mails in one classroom *The Reading Teacher* **52** (7) 698–706.

Mercer N (1996) The quality of talk in children's collaborative activity in the classroom *Learning and Instruction* **6** (4) 359–377.

Mercer N, Wegerif R and Dawson L (1999) Children's talk and the development of reasoning in the classroom *British Educational Research Journal* **25** (1) 95–111.

Pea R D (1993) Practices of distributed intelligence and designs for education *in* Salomon G (ed) *Distributed cognitions. Psychological and educational considerations* Cambridge University Press, Cambridge, NY, 47–87.

Salomon G (1995) *What does the design of effective CSCL require and how do we study its effects?* [On-line] Available: http://www-cscl95.indiana.edu/cscl95/outlook/62_Salomon.html

Scardamalia M and Bereiter C (1993). Technologies for knowledge-building discourse. *Communications of the ACM* **36** (3) 37–41.
Ten Brummelhuis A and Drent M (2000) *ICT-Monitor 1998–1999 basisonderwijs* OCTO, Enschede.
Williams H L and Meredith E M (1996) On-line communication patterns of novice internet users *Computers in the Schools* **12** (3) 21–31.