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An examination of interactional coherence in email use in elementary school

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Abstract

This paper reports on a study of email use in elementary school. An analytic model consisting of a contextual, rhetorical and semantic dimension is proposed as a means to measure interactional coherence. In describing this CRS-model special attention is given to the dialogue types distinguished by Burbules (1993) [*Dialogue in teaching: Theory and practice*. New York, NY: Teachers College Press] and to other research that seeks to qualify and quantify computer mediated communication. Findings from the empirical study indicate, among others, that a pivotal role is played by the turn-taking pattern. In addition, there were signs that the children compensated for some of the limitations of communicating by computer (e.g., by using meta-tags). The study also indicates a predominant usage of email for conducting dialogues as conversations. The conclusion suggests that contextual factors are important in qualifying and quantifying interactions. This suggestion is further strengthened by the fact that Burbules' typology partly hinges on getting to know the attitudes of the conversational partners and hence lie beyond what an analysis of the dialogues themselves can reveal.

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1. Introduction

A computer mediated communication (CMC) system that has gained popularity almost overnight is email. While email is now well-established in business and for private purposes its usage in elementary schools has lagged behind. In Dutch schools this was initially caused by a lack of infrastructure. An important obstacle now lies in its functional embedding. How can children benefit from using email?

One of the reasons why email has become very popular very rapidly in business settings is that it better suited the people's need for a fast and cheap means of communication than did the fax, telephone or business letter. In elementary school, there is no such obvious alternative for email to replace. Although there are arguments that elementary school children should learn to use email as part of their computer skills training, it is not self-evident how email usage can be functionally integrated in school work (see Simons, 2002).

In examining email use one should bear in mind that the tool has limitations that can complicate communication. Email conversations can suffer from lack of simultaneous feedback, reduced audio-visual cues and deficient turn-taking (Baron, 2000; Crystal, 2001; Herring, 1999). Tell-tales of these complications are: "Didn't you get my e-mail yesterday?", "Why did I get this invitation twice?", "Couldn't you have let me know by phone so that I could have explained it properly?", and "Does this mean that you are mad at me?" Because email use is not as easy as it seems, it is important to attend to the ways in which communicating partners are getting attuned to each other.

Burbules (1993) argues that there are four types of dialogues that summarize the research literature on interactions: dialogues as (1) instruction, (2) conversation, (3) inquiry, and (4) debate. In dialogues as instruction a knowledgeable discussion leader guides the other participants to the desired learning outcome. These dialogues are characterized by their goal-directedness. The assumption is that the instructor has the knowledge and skill to guide the learner to the desired outcome. In dialogues as conversation the focus is on developing mutual understanding, intersubjectivity and consensus. In these dialogues questions serve to promote a sharing of information and experiences; they help create a community of learners. In dialogues as inquiries the discussions focus around a specific question or dilemma. The questions in these dialogues invite participants to propose ideas, to reason or to clarify a notion. In dialogues as debates speakers alternate in arguing about a case or proposition. The goal of the debate is to propose as strong a case as possible; it is a tactic to stimulate the formation of arguments based on evidence and reason.

The four dialogues are ideal types and not rigid categories. "Any actual dialogue may be a hybrid of various elements from each" (Burbules, 1993, p. 125). In addition, Burbules notes that it is often necessary to move from one type of dialogue to another. This is especially the case for dialogues as inquiry and debate because these "probably cannot sustain a long-term relationship all by themselves" (Burbules, 1993, p. 125).

A previous study suggested that children from elementary school used email predominantly to engage in a conversation by exchanging stories of learning experiences

(Van der Meij & Boersma, 2002). Moments of dialogues as debate or inquiry were also found, but their appearance was relatively scarce. The study did not analyze the communications in sufficient detail to afford a view of how various aspects of email use conspire to create these dialogues. This is the goal of the present paper: to develop and test an analytic model that captures email dialogues in elementary school.

Linguists often refer to the notion of interactional coherence for qualifying dialogues. Tannen (1984) defines interactional coherence as the "underlying organizing structure making the *words and sentences* into a *unified discourse* that has *cultural significance* for those who create or comprehend it" (p. xiv, emphasis added). To understand and influence the *cultural significance* of email dialogues it is necessary to attend to the context in which these dialogues occur. This leads to the contextual dimension of the analytic model. To understand the presence of a *unified discourse* it is necessary to study the dynamics of the interactions. This leads to the rhetorical dimension of the model. To capture the *words and sentences* in the dialogues it is necessary to examine the topic of the basic units of meaning in an email. This leads to the semantic dimension of the model. The research questions concerning the model are:

1. Contextual – Which factors must be taken into consideration in designing for email use in elementary school so that it is likely to serve a meaningful role?
2. Rhetorical – What signals are there of a unified discourse?
3. Semantic – What are the main elements of email dialogues?

First, we introduce the contextual, rhetorical and semantic model for analyzing email use in elementary school. Next the method and findings of an empirical study on email are presented. The paper concludes with a discussion on the merits of using email in elementary school to stimulate dialogues as conversations.

1.1. The contextual, rhetorical, and semantic (CRS) model

The *Contextual dimension* is critical for the embedded use of email. It characterizes the situation in which email is used and it determines its functionality. The contextual dimension thus addresses the first research question. Among others, classroom observations and recordings of group discussions, student writings, teacher and student interviews can contribute to a better understanding of the data from the emails themselves. The features in this dimension are: task, time and setting (see Table 1).

Email must be relevant for what the children learn in school and the *Task* plays a pivotal role in designing for its functional use. At least two distinct contributions can be distinguished: domain-relevance and communication-relevance.

Domain-relevance refers to the meaningfulness of engaging in email dialogues about the topic of the lesson(s). Several studies point to the impact of this task aspect on the communications between students (e.g., Schellens & Valcke, 2002; Van Boxtel, 2000; Veerman & Veldhuis-Diermanse, 2001). Their main research question is to

Table 1
An overview of the CRS model, with measures for the main features of the contextual dimension, rhetorical dimension, and semantic dimension

Features	Measures
The contextual dimension	
Task	Domain-relevance, communication-relevance
Time	Production time, schedule time, project time
Setting	Instructional design approach, teacher training, facilities
The rhetorical dimension	
Frequency	Number of emails, exchange pattern
Structure	Size, macro-structure[a]
Grammar	Speech acts (statements, direct vs. indirect questions, reactions), meta-tags, communication threads
The semantic dimension	
Topic	Content – what (domain talk, talk about communication, personal talk), content – how (adoptation, adaptation)
Motivation and emotion	Expression of affect (non-affect, indirect, emotive), valence of affect

[a] Macro-structure is not measured in the present study.

what degree CMC invites students to engage in higher-order thinking. Their analytic models accordingly have a predominantly (meta) cognitive focus. This focus sometimes leads to an 'on task' 'off task' distinction in which the task only refers to domain-relevance. That is, CMC dialogues about the domain are classified as 'on task'. All other communication is classified as 'off task'.

Communication-relevance refers to the importance of using email for the purpose of learning to communicate with other children and benefitting from these communications. Part of what makes email use meaningful and attractive is that it facilitates an interaction between children from different schools and cultures. It is a valuable experience for children to broaden their horizon and get to know different perspectives. When email use is designed around a topic with educational relevance it can thus help establish a community of learners. In designing for this effort, it is important for a partnership to have a shared goal such as working on the same project.

In *Time* important measures are 'production time', 'schedule time' and 'project time'. Production time refers to time needed to produce and send an email. Production time sometimes is simply the time spent typing and sending an already written message. An email can also be created behind the computer, however. In such a situation, production time also includes the time needed to compose a message. Schedule time refers to the difference between the moment of sending an email and actual reading by the recipient. In elementary schools this time-lag probably needs to be measured in days rather than the seconds needed for physical transfer. Project time refers to the connection between the type of domain assignment that the children are working on in class and the topic discussed in the email they are processing. When the two overlap all kinds of dialogues are possible. But our previous study indicated that schools found it very difficult to create such an overlap. Most schools failed at

realizing a speedily exchange of emails. Email use for a quick exchange of questions and answers hardly ever materialized reducing the possibilities of using email for dialogues as inquiry or debate (Van der Meij & Boersma, 2002). In dialogues as conversations project time is a less critical factor because questions and answers serve more to share experiences.

The rubric *Setting* includes a broad array of factors from the school context. Among others, pedagogy, instructional design approach, teacher roles, facilities, prior knowledge and skill of teachers and children play a role here. In discussing these factors we will restrict ourselves to those aspects that could be dealt with, to a certain degree, in the empirical study that will be reported later on in the paper. These are: instructional design approach, teacher training and facilities.

In the instructional design of lessons it is important to find a proper fit between the dialogues that take place in the classroom and the type of dialogue that email seeks to stimulate. When CMC is part of a wider array of possibilities for communication, attention must be given to the atunement of activities. Questions then arise such as "Should email be used to initiate an inquiry or debate?" and "How can email be functional as part of a larger set of dialogues?" Observations from our previous study, suggested that the children tended to round off most of their topical inquiries or debates in class. This reduces the need for holding a similar dialogue through email and probably increases the need for exchanging views and engaging in dialogues as conversations.

Our earlier study also showed that teachers needed special help in handling the logistics of an email exchange. They were not used to setting up a joint agenda with another teacher from another school for running a series of lessons. In addition, most of the teachers were not familiar with some of the technical aspects of an email project such as storing emails in a folder and using the subject field in the email envelope to speed up its transfer to the right group in the classroom. Teachers are therefore likely to need some prior training in the management required by an email project.

An important aspect of setting concerns the presence of facilities such as computers, a network connection and working space. In Dutch schools the technical facilities have greatly improved the last couple of years. For example, in the year 2002–2003 the pupil–computer ratio in Dutch elementary schools has increased to 7.2 – from 12 three years earlier (Braam et al., 2003).

The *Rhetorical dimension* describes the general dynamics of communicating through email. These dynamics include aspects such as turn-taking and communication threads. Several analyses on this dimension strongly depend on the linguistic means used in the dialogues. The rhetorical dimension is especially important for addressing the second research question. The features on this dimension are: frequency, structure, and grammar (see Table 1).

Two important measures in *Frequency* are 'number of emails' and 'exchange pattern'. The first is a count of the emails that are sent. This count can signal the motivation and active participation in an exchange. The exchange pattern captures the distributed nature of email use by referring to what linguists call the turn-taking sequence (e.g., Herring, 1999). When communicating partners always send each

other an email one after the other this yields a perfect zigzag pattern. A deviation from this pattern is likely to affect the ease with which partners can attune to each other's email.

The rubric *Structure* of an email contains the measures 'size' and 'macro-structure'. Size can be measured in number of words or meaningful units in an email (Honeycutt, 2001). Just like email count, size can be a measure of the children's commitment to engaging in an email dialogue. In Henri's (1992) model both size and the number of emails therefore fall under the participative dimension. When emails have a size of around 12 meaningful units the whole email tends to be visible within a single screen view. No scrolling is required even when the upper part of the screen is consumed by email envelope fields.

The term macro-structure refers to the compositional make-up of an email. Herring (1996) distinguishes five sections in an email: epistolary convention (at start and end), introduction, body, and close. An introduction can be important for a complete or swift understanding of an email. Epistolary conventions are standardized sections that can help strengthen the social bond between two email partners (Crystal, 2001). In our study, macro-structure was not measured.

Grammar refers to communicative acts that can link emails. Measures are 'speech acts', 'meta-tags' and 'communication threads'. Speech acts such as statements, questions and responses are acts performed by utterances that may evoke certain reactions of the partner (Searle, 1976). We distinguish between three types: statements, questions and reactions. Statements are declaratives that are neither a reaction nor a question. More so than statements, questions signal attempts to inter-act. For questions a distinction is made between direct and indirect ones (cf., Burbules, 1993). Direct questions have the formal characteristics of questions such as inversion of subject and predicate and the presence of an interrogative. Indirect questions lack these characteristics but are still recognizable as questions (e.g., ''We wondered whether you have any tips for us''). Direct questions are stronger attempts to evoke a reaction from the partner than are indirect questions. Responses to questions or statements are classified as reactions. As such this speech act is an important measure of interactional coherence.

Speech acts can be emphasized by meta-tags. Meta-tags resemble the explicit linguistic means used to fortify the bond between messages, only these tags do so within a message. Meta-tags thus strengthen the internal coherence of an email. Because of their similarity, Henri (1992) includes both kinds of linguistic means on an ''Interactive'' dimension. Examples of meta-tags are preambles (e.g., ''We have a question for you'') and post ambles (e.g., ''That's what we wanted to ask you''). When added to an expression to explain or stress its intent, meta-tags illustrate a grounding effort. Because email is a lean medium that lacks cues that are available in a face to face communication, meta-tags may also signal an awareness of the limitations of email as a communicative tool.

Communication threads signal interactional coherence as they reveal the presence of connected discourse. In the research literature, these threads are sometimes called chains or episodes (e.g., Henri, 1992; Lemke, 1998; Van Boxtel, 2000). Communication threads generally are defined as links between the expressions of two

partners that deal with the same topic. To find these threads one must therefore look for shared or matched topics in their communication (e.g., emails). Some models on CMC in education make these matches on a relatively high analytic level. For example, they may distinguish between the processes of advancing, discussing, testing and evaluating domain-related ideas (e.g., Gunawardena, Lowe, & Anderson, 1997; Veerman, 2000). The present study makes this match on a lower analytic level, namely on the basis of the "unit of meaning" or idea level. A good example is the interaction in which a group asks which light-weight material one could use and receives a response to try balsa wood. Compared to other analytic models, this means that we study a thread (e.g., materials) within a thread (e.g., domain).

Communication threads can differ in the transparency of how they are connected. A connection can be implicit or explicit (see Henri, 1992). A connection is called implicit when its relation to an idea is obvious but not explicitly referred to. A thread is defined as explicit when the connection is mentioned specifically. Linguistic means signal the connection, as in "we *too* did not succeed" or "our response to your question is". In the present study implicit connections between domain-related communications are to be expected from the set-up of the project. Therefore, we concentrated on explicit communication threads. A relative dearth of explicit threads does not automatically diminish the value of the communication in dialogues as conversations, however. Children may still find that they learn a lot about their partner's message when they recognize the topics that are discussed (see Henri, 1992).

The type of tool that is used in CMC can have an important influence on the transparency of connections between messages. In email explicit connections can be made via non-linguistic means, namely by using the tool's facility for including the original message. Users can copy the original message as a whole or in parts into their own email. To highlight its presence, a '>' sign can be used before such section(s). The use of this function makes it easier to realize communication threads from which all kinds of dialogues can benefit. A disadvantage can be that emails become mainly reactive. Partners may focus too much on addressing each others' concerns at the expense of advancing their own learning experiences. This could hamper the establishment of a conversational dialogue.

The *Semantic dimension* focuses on what and how is communicated. The main concern here is to qualify the content of an interaction, but also focus on motivation and emotion. However, most analyses on this dimension concentrate on the kind of thinking involved. The Semantic dimension addresses the third research question. Two features in this dimension are: topic, motivation and emotion (see Table 1).

The main measure for *Topic* is 'content'. A distinction is made here between 'what was said' about the subject and 'how it was said' (Henri, 1992). Just as in our previous study, in 'what was said' we make a distinction between domain talk, talk about communication, and personal talk (see Van der Meij & Boersma, 2002). Domain talk is communication about various issues of the learning task. Expressions that discuss the contact with the partner are categorized as talk about

communication. In personal talk children present themselves, their school or non-project related activities. Depending on the research question a more detailed classification may be called for. To get a good view of what the children discussed with each other in their emails, subcategories were distinguished within all three content categories in the present study (for details, see Van der Meij, 2002). As indicated earlier, these detailed classifications were also used in the analyses of communication threads.

Many analytic models on CMC in education address the issue of 'how it was said' by examining changes in the level of (meta) cognitive processing of information (e.g., Gunawardena et al., 1997; Van Boxtel, 2000; Veerman & Veldhuis-Diermanse, 2001). For example, they may distinguish between the processes of advancing, discussing, testing and evaluating ideas and then test whether there is a progression of thinking over time. Henri (1992) proposes a similar point of view from which to look at the information processing. She suggests making a distinction between surface level processing and deep level processing (also see Lockhorst, Admiraal, Pilot, & Veen, 2003). Likewise, Mercer (1994) and Wegerif (2000) code communications as cumulative (e.g., elaboration), disputational (e.g., defending one's position) or exploratory (e.g., discussions about each other's knowledge). They value exploratory communications more as these interactions deal in a constructive way with the other types of communication. A shared characteristic of these analytic models is their evaluative nature. Some forms of interaction are valued more than others.

In the present study there is no such valuation. Rather, the analyses focus on the different ways in which the children react to a message of their partner. We make a distinction between the processes of 'adoption' and 'adaptation'. In an adoptive reaction a group repeats an idea advanced by the other group. According to Tannen (1989) repetition is an efficient way to converse and connect with one's partner. Adoptive reactions can also be characterized as attempts to share meaning and express affective and cognitive involvement. In an adaptive reaction an idea introduced by a partner is extended, doubted or discussed. Adaptive reactions are attempts to negotiate meaning by advancing new or contrasting ideas to what the partner has written.

Very few models of CMC pay special attention to the motivational issues involved in CMC. Indeed, when expressions of affect are coded at all, they tend to be classified as metacognitive (e.g., Hara, Bonk, & Angeli, 2000; Henri, 1992) and hence as a special case of cognition. Although they interact with each other it is preferable to separate cognitive processes on the one hand from motivational processes and emotions on the other (Astleiner, 2000). In addition, it is important to bear in mind that email is a medium in which one easily expresses one's feelings (e.g., Baron, 1998; Gains, 1999; Hill & Monk, 2000) and that these expressions can fortify the social bond between partners (Wegerif, 1998). The two main measures in *Motivation and Emotion* are 'affect' and 'valence'.

An expression of affect is an utterance that expresses a valenced judgment or emotive condition. In line with Ortony, Clore, and Foss (1987) the present study classifies expressions of affect on the basis of affect words (also see Guerrero, Anderson, &

Trost, 1998). Finding and coding expressions of affect is a notoriously difficult process. Ortony et al. offer a good starting point as they present a sample of 500 recognized affect words such as silly, calm, surprised, pleased and troubled. In addition, they introduce a scale for classifying affect expressions that is very helpful in coding. In the present study we distinguish between the following types: non-affect expression, indirect expressions of affect and emotive expressions of affect. Non-expressions of affect are all speech acts that do not refer (in)directly to an inner motivational state or feeling. Indirect expressions consist of objective descriptions (e.g., "we were lucky") and subjective evaluations (e.g., "it is untrustworthy"). Emotive expressions include statements about motivational conditions (e.g., "we are happy") and expressions that refer to mixed conditions of a combination of affective, behavioral or cognitive nature (e.g., "I am uncertain"). Expressions of affect that appear in epistolary conventions are ignored in the analyses because their presence is decreed to a certain extent.

Expressions of affect are usually also categorized as positive or negative (Astleiner, 2000; Guerrero et al., 1998; Shimanoff, 1985). An example of a positive expression of affect is "nice of you to mail us back", an example of a negative expression of affect is "we terribly regret…". When seen in conjunction with the factor time the valence of expressions of affect gives insight in the change of direction of the children's motivation.

The CRS-model was tested in an empirical study on email use in elementary school. In the study, operationalizations of the task and other features in the contextual dimensions primarily support the use of email as a conversational dialogue as will be detailed in Section 2. The results then present the findings for the rhetorical and semantic dimension. The main question that the empirical study addresses is whether the various measures on the CRS-dimensions converge and signal a predominant presence of dialogues as conversations.

2. Method

2.1. Participants

Twelve classrooms (fifth and sixth grade) from ten elementary schools volunteered to participate in the study. The total number of children involved was 279. Their mean age was 11 years and 3 months.

2.2. Materials

An intake interview inquired after the school's technical facilities. In three schools the children could access the Internet through one or more computers situated in the classroom. Seven schools provided access via computers located outside the classroom (e.g., the school director's office) and their planned use was settled in advance of the project. Teachers were advised to reserve the Internet computer(s) only for email use to ascertain their accessibility during the project.

The intake interview also inquired after the teacher's and children's experience in using email. Teachers' email knowledge and skill varied considerably. Four teachers rated themselves as experienced; five considered themselves beginners and three teachers were novices who had never worked with email before. A majority of children had never worked with email in school. In one classroom the children used email regularly. Two other classrooms had used email once.

Before and after the project the children filled in a self-esteem and a self-efficacy questionnaire. The questionnaires ask a series of closed questions with responses arranged on a four or five-point Likert scale. The self-esteem questionnaire assesses a child's estimation of its own ability in the domain of design and technology. The self-efficacy questionnaire (adapted from Boekaerts, 1987) measures a child's affective state (i.e., task anxiety) and assessment of interest in, and attractivity and importance of the task. For both instruments good reliability coefficients for its scales (Cronbach's α of around 0.80) have been found in the previous study on email use.

An interview held after project completion asked teachers, among others, to evaluate the project, to comment on their contact with the other school, to evaluate the lessons and supportive materials, and to give their opinion about email use in school. During this visit also four to five children from each school were asked for their views about the project, the use of email, working together in a group and the lessons.

2.3. Procedure

About a month before the project an intake interview by telephone was held with the teachers to ascertain that there would be sufficient facilities available during the project and to discover whether there were special training needs of teachers and children. About two weeks later a meeting was held in which teachers were informed about the set-up of the project and the lessons. During this meeting special attention was given to the logistic of running an email project in school. Also, each classroom was coupled to a classroom from one of the other schools. Teachers were told that this partnership would be the same throughout the project. Teachers were given the option of attending a hands-on email training a few days after the meeting. Eleven of the 12 teachers participating in the project attended this session.

About one week before the planned kick-off one of the researchers visited the school to hand out the questionnaires. Also, teachers were asked whether they had enough time to study the lessons and make the necessary arrangements for the project (which included testing the connection with the other school). Teachers from six schools indicated that they needed a little more time to prepare themselves. In these cases a new arrangement for handling the logistics was drafted between partner schools. Four schools started right on time. Two began one week later. The remainder followed one week thereafter. Because all schools used the same lesson plan and partner schools had been attuned to each others' agenda the delay in kick off had no consequences for the set-up of the study.

One or two days before the start of the project the children filled in the self-esteem questionnaire. After introducing the project, the children filled in the self-efficacy questionnaire. During the first lesson teachers paired the communicating groups of children in their classrooms. This partnership too was to remain unchanged for the duration of the project. Fixed coupling made it possible for groups to develop their relationship and track each others' progress. In all, there were 60 communicating groups – 30 partnerships.

During the lessons observers recorded a sample of group discussions. Immediately after the last lesson the children completed the self-efficacy questionnaire. In that week also the self-esteem questionnaire was to be filled in. Teachers and some children were interviewed about one week after completion of the project to gain insight in their opinions about the project, the lessons and the use of email therein.

2.4. Lessons and other contextual features

2.4.1. Task: domain-relevance

In the empirical study reported here the children could engage in dialogues to help them in dealing with a complex assignment in the domain of design and technology. The children worked on an ill-structured problem (i.e., the construction of a plane). During the six lessons of the project the children worked in design groups to promote the open exchanges and elaborated discussions and reflections that are helpful in dealing with such a problem (see Cohen, 1994; Dysthe, 1996; Mason, 2001; Rivard & Straw, 2000). Email use could extend these dialogues as each group was to communicate with another group from another school that also participated in the study.

2.4.2. Task: communication-relevance

In the present study email use should afford conversational dialogues between children. Emails were expected to hold only a few moments of dialogues as inquiry or debate (see Van der Meij & Boersma, 2002). Little advice was given about what the children should write to each other. They were instructed to introduce themselves to their partner in the first part of their first email but no other directions were given on what to write. The absence of advice rested on three considerations. One, it is the freedom of speech that makes CMC attractive for people. Email gives children a possibility to say what they want. It also affords language play; it is a mixture of speech and writing (Baron, 1998, 2000; Herring, 1999). Two, little is known about how children use email. Their use of email may vary considerably from adults' usage (cf., Cook-Gumperz & Green, 1984). It is, therefore, desirable to begin by trying to understand their email usage as a first step towards improving it. Three, the set-up of the project provided for a meaningful context and structure for email use. This use was embedded in a series of lessons and various efforts were taken to ensure its relevance for school learning. Thus, a context of structured freedom was created in which we expected email to be used primarily as a means to engage children in conversational dialogues that would establish a community of learners.

2.4.3. Time: project time

In view of our prior experience it was deemed unrealistic to ask schools to make possible a swift exchange of emails. Instead, they were stimulated to aim for a zigzag pattern in which each group would at least send out and receive one email about each lesson. Project time was therefore expected to be most conductive for dialogues as conversations.

2.4.4. Setting: instructional design

Just as in the previous study the children were expected to round off most of their discussions during the lessons and within their own group. The role of email was therefore expected to be primarily one of exchanging one's learning experiences.

2.4.5. Setting: teacher training

Special attention was given to the logistic involved in running an email project in school. In a meeting teachers from partner schools were stimulated to set a fixed day and time for handling emails as a minimum condition for the exchange. They were attended to the idea that it would be easiest for the children to inter-act when the exchange pattern would be such that groups would send emails in alternative turns, yielding a zigzag pattern.

During the meeting teachers were acquainted with the set-up of the lessons. Schools were coupled to each other and the teachers had a chance to get acquainted and make arrangements for the project. In addition, teachers received a manual with detailed lesson plans and information about email use in school. The manual further included two optional lessons for acquainting the children with the use of email and with working in small groups. Teachers could obtain further information about running an email project through a website. Just like some of its English language counterparts (e.g., BECTA, 2003) this website contained a great number of tips for using email in school (see Van der Meij, 2000). Teachers could also follow a special hands-on training in email use. Apart from dealing with the basics of email, this training also included exercises in which teachers could practice handling managerial issues involved in running an email project in school.

2.4.6. Setting: facilities

Participating schools had made the necessary reservations of the available computer to afford the group-by-group communication called for by the set-up of the study. To help teachers in handling modest computer facilities, the manual included tips such as the suggestion that emails could first be written on paper to reduce production time, and the suggestion to use computers that were not connected to Internet for typing the message and then to paste the text into an email programme.

The tool email affords an inclusion and annotation of a received message. The manual attended teachers to this option but neither encouraged or discouraged its use. Data-analyses showed that none of the groups used this option.

2.5. Coding and scoring

A carbon copy was obtained of all electronic messages via the 'cc' option in the email application. Upon arrival, the time of reception was noted along with a number indicating the sequential position of an email in the exchange between partners. Coding then progressed in a two-step approach: segmentation and classification.

First, each email was decomposed into segments which formed the unit of analysis for most of the measures on the rhetorical and semantic dimension (Exchange patterns depended on emails and communication threads on joined segments). Finding a reliable procedure to determine the unit of analysis is not an easy matter. Rourke, Anderson, Garrison, and Archer (2001), articulate the problem clearly: "Fixed units such as single words or entire messages are objectively recognizable, but they do not always properly encompass the construct under investigation. Dynamic units such as.. "unit of meaning" properly delimit the construct, but invite subjective and inconsistent identification of the unit" (p. 11). A detailed set of guidelines was developed for the segmentation process (see Van der Meij, 2002). These guidelines combined syntax, punctuation and meaning to arrive at segments or units of meaning. Independently of the present study, Strijbos and Martens (2003) arrived at an almost identical set of guidelines in their attempts to define the 'unit of analysis' in emails.

The segmented email was then saved and merged with all other emails from a group and its partner so that the order of reception of the emails of communicating partners was maintained. In other words, if two communicating groups A and B would have a perfect zigzag pattern for their exchange, the (Excel) file would start with the first email from A, then the first email from B, then A2, B2 and so on and so forth. Segmentation yields basic measures on the rhetorical dimension such as number of emails, exchange pattern and size. Storing the emails one after the other in their consecutive order of reception is important for an analyses of communication threads between emails (cf., Herring, 1996; Honeycutt, 2001).

Second, all segments were classified into mutually exclusive categories on the rhetorical and semantic dimension. For example, three speech acts were distinguished (i.e., statements, questions and responses) and Questions were further classified as direct or indirect. A detailed codebook described the (sub)classes and procedures for coding and scoring (see Van der Meij, 2002). Fig. 1 illustrates the outcome of the coding method.

Two coders realized an average agreement of 95% for segmentation. Classifications on the various categories of the model yielded a Cohen κ score of 0.79 and higher (see Van der Meij, 2002).

Most of the analyses in the study involved basic descriptive statistics such as frequency counts, proportions, standard deviations and the like. Relationships between measures were usually calculated with Pearson correlations with two-sided tests for statistical significance. For comparisons between groups t tests were used. Groups with missing data on a particular measure were removed from the analyses on an item per item basis.

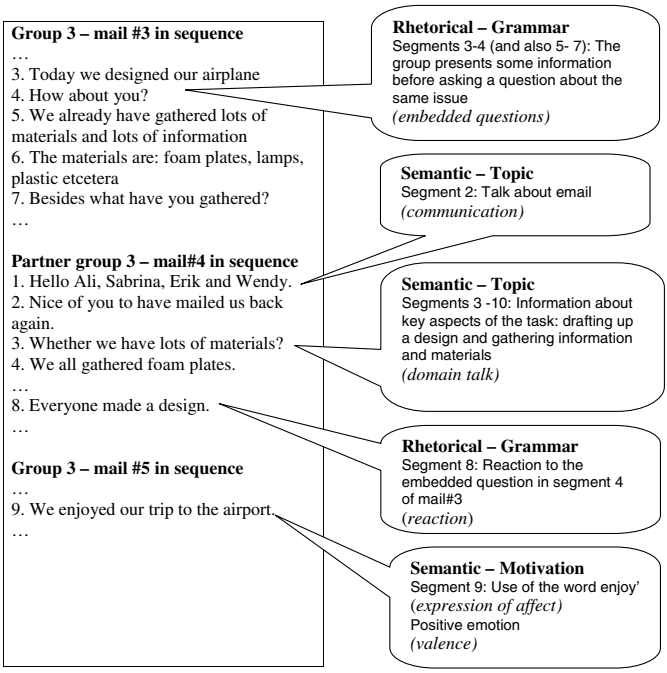

Fig. 1. Illustrated usage of the CRS-model for coding emails. Segments have been numbered by the coders. In actual coding, segments are scored on all measures rather than just one. Note that poor use of English here is an intentional translation used to reflect poor use of Dutch in the original.

3. Results

3.1. Rhetorical dimension

3.1.1. Frequency – number of emails and exchange patterns

The sixty groups sent out a total of 220 emails during the project. Table 2 shows the mean frequency of emails per group in each classroom. In addition, it shows how well partnerships realized a zigzag exchange pattern. The two measures are also related to each other. That is, the groups in the two partnerships with the lowest scores for the exchange pattern (27% and 48%) also sent out statistically significant fewer emails than did the others ($t(58) = 3.69$, $p < .001$).

Several problems with achieving an optimal zigzag pattern were mentioned by teachers in post-project interviews. Some teachers mentioned the fact that the heavy demand for computers strained their facilities. Others said that children had difficulties in working together as a group. Yet other teachers mentioned a strong impact of logistic problems, including obstacles from a failure to contact the other teacher on a regular basis.

Table 2
Mean scores for the exchange patterns in the six paired classrooms

Coupled classrooms	*M* (%)	(SD)
Class 1 (n = 4.60) and Class 2 (n = 1.25)	27	(28)
Class 3 (n = 1.80) and Class 4 (n = 2.25)	48	(31)
Class 5 (n = 2.20) and Class 6 (n = 4.60)	57	(18)
Class 7 (n = 3.00) and Class 8 (n = 6.00)	65	(18)
Class 9 (n = 6.00) and Class 10 (n = 5.00)	80	(7)
Class 11 (n = 3.50) and Class 12 (n = 3.17)	82	(16)

n = Mean number of emails per group per classroom.

3.1.2. Structure – size

The mean size of the average email was 12.2 (SD = 4.21) meaningful units. This means that children generally could see the whole email within a single screen view. Just as in our previous study (Van der Meij & Boersma, 2002), size correlated positively with number of emails sent (r = 0.22, n = 60, p < .05, one-sided test).

3.1.3. Grammar – speech acts: statements, questions and reactions

Table 3 shows the distribution of speech acts in the average email. About 70% of an email consists of statements. In other words, the major part of an email is dedicated to informing one's partner. Statements too yield responses, but considerably less so than questions. The mean chance of getting a reaction to a question was 35%. For statements this was 5.4%.

There was a statistically significant correlation between the exchange pattern of a group and the distribution of speech acts in the emails. Groups with a more optimal zigzag pattern gave relatively more questions and responses (r = 0.58, n = 60, p < .001). Perhaps this is because the communication benefits from regular turn-taking. Perhaps the reverse is true in that more 'interactive' emails help optimize the exchange pattern.

A statistically significant correlation was also found between the presence of reactions and a group's interest in the domain as measured by the self-efficacy questionnaire (r = 0.29, n = 59, p < .05). The higher a group's domain interest the more this group included reactions in their email. The CRS-model invites

Table 3
Distribution of speech acts in the average email

Type of speech act	*M*	(SD)
Statements (70%)	8.55	(4.31)
Questions (12%)	1.49	(0.97)
Reactions (18%)	2.15	(2.14)
All speech acts	12.20	(4.21)

explorations such as these. If meaningful statistically significant correlations are found, they can provide a focus for further research and perhaps provide grounds for special teacher actions.

3.1.4. Grammar-Meta-tags

Meta-tags made up an average of 13.8% (SD = 12.7) of all utterances on Communication. There was a statistically significant correlation between meta-tags and size of an email ($r = 0.49$, $n = 60$, $p < .001$). The positive correlation indicates that longer emails had a higher percentage of meta-tags. Likewise, there was a statistically significant correlation between meta-tags and interactivity ($r = 0.33$, $n = 60$, $p < .01$). This correlation shows that groups with a relatively higher proportion of reactions in their emails also included a higher percentage of meta-tags. These findings suggest a sensitivity to communicating by computer. The children seem to compensate for the leanness of the medium by giving explicit statements about what they intend to say.

3.1.5. Grammar – communication threads: question–reaction links

About a third of all questions received a response. The linkage was best for direct questions of which 58% yielded a reaction. The difference with the 17%-score for indirect questions is statistically significant ($t(116) = 7.86$, $p < .001$). Correlational data also indicated a dependency on the exchange patterns. A higher score for the exchange pattern coincided with a higher score for question–reaction links ($r = 0.38$, $n = 57$, $p < .01$). A similar relationship was reported in the studies of Graddol (1989) and Herring (1999).

The presence of a good linkage only partly signals how groups inter-act. There are also differences in style, in how questions are addressed and in how grounding takes place, among others. Fig. 2 illustrates these issues. Group K begins its email by rephrasing and summarizing the questions of its partner. Thereafter it reacts to these questions and apologizes for not knowing something. The email then continues with a number of assertions about task-related activities, some of which are offered as hints to the partner (segments 11–13). K's partner likewise starts by addressing its partner's questions. Unlike K, this group does not rephrase or even repeat the questions of the partner. The reaction is in staccato style. The group, like K, appears to be sensitive to a possible need of its partner by giving a tip. In addition, K is asked to elaborate upon a suggestion that was not understood.

3.2. Semantic dimension

3.2.1. Topic – content: what was said

Table 4 shows that expressions about the domain and about communication appeared with about the same frequency. Talk about personal issues was relatively rare. The frequent presence of domain talk signals the impact of the set-up of the email project. Some expressions indicate that the high incidence of talk about communication comes from the novelty of using email in school. Other expressions also signaled the children's awareness of the difficulties of communicating through email.

Email from group K - mail #4 in the sequence
1. Hi Flying Children
2. You asked us how we construct our plane,
3. which materials we are going to use
4. and how we will let it fly.
5. We don't know yet how we will construct it,
6. but we think we'll use kite-wood, plastic {trays} and maybe cloth.
7. How we will let it fly we don't know yet
8. We apologize for knowing so little.
9. We hope to know more next time
10. Today we worked on the design.
11. Friday march 19th we went to the library.
12. where we found siso numbers 659.2, 640.5, 659.6
13. maybe you can do something with it.
14. Lars brought a K'nex model to school
15. We have a question yet.
16. Which materials do you have
17. And how will you let it fly?
…

Email from group K's partner - mail #5 in the sequence
1. Hello flying four
2. These are the answers to your questions.
3. We use triplex for the plane.
4. We throw it in the air.
5. We are going to stand on the climbing frame
6. and throw it away.
7. We have a tip for you.
8. You can go to a home centre
9. and ask for cast-away wood
10. We were given something to take home
11. Would you please mention some titles of books that you use.
12. Because we don't understand that siso number at all.

Fig. 2. A selected set of segments from three consecutive emails from groups with a high score for question–reaction linkage. Note that poor use of English here is an intentional translation used to reflect poor use of Dutch in the original.

Detailed analyses show a strong impact of time on the topics of the children's writings. Table 4 illustrates that the share of talk about communication remains stable over time. In addition, more than a third (34.8%) of the children's first emails is taken up by personal talk in which groups are getting acquainted. After this prescribed part the presence of personal talk drops strongly ($t(52) = -9.09$, $p < .001$). The reverse pattern occurs for domain talk which becomes more prominent after the first email ($t(52) = 10.53$, $p < .001$).

3.2.2. Topic – content: how it was said

The findings for "how it was said" concentrate on the reactions. Most of these reactions dealt with a topic from the domain ($n = 313$, 58.5%, see Table 5). Reactions to communication (25.8%) and personal talk (15.7%) were much less common. The

Table 4
Distribution of topics in the average email

	Talk about Communication		Personal talk		Domain talk	
	M (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)
First email	42.5	(17.9)	34.8	(23.7)	22.8	(19.9)
Later emails	43.1	(15.3)	4.7	(5.0)	52.2	(15.0)
All emails	42.3	(13.6)	16.4	(14.0)	41.4	(17.8)

data also show that almost 70% of the reactions were adoptions. A good thirty percent of the reactions elaborated, doubted or discussed an utterance of the partner. Of these adaptations a majority (79.0%) were elaborate reactions that occasionally were accompanied by a new question for the partner. Adaptive reactions in the form of evaluations were scarce and almost evenly divided into positive (7.9%) and negative (9.7%). An example of a positive evaluation is "That was a good idea". Examples of negative evaluations are "we think you are wrong", "a motor is not very useful" and "where is that fax you were supposed to send us?"

3.2.3. Motivation and emotion

An expression of affect was present in 11% of all utterances (see Table 6). These expressions were found predominantly in personal talk. On average one of every six segments of personal talk contained an expression of affect. The mean chance of finding an expression of affect in talk about communication or domain talk was, respectively, 8.8% and 10.8%.

The presence of expressions of affect increased in a statistically significant way over time for personal talk ($t(28) = 3.85$, $p < .001$). This could signal the growth of a social bond between the two email partners, or an intensified effort to realize such a bond.

Nearly 83.2% (SD = 21.7) of the expressions of affect signaled a positive appreciation (see Table 7). This appreciation decreases slightly over time from 92% in the first email to 82.3% in the emails that follow ($t(33) = 1.79$, $p < .10$). Noteworthy is the stable positive appreciation in expressions about the domain. This positive appreciation also transpires in the results for self-efficacy as the results on the moti-

Table 5
Distribution of type of reaction

	Talk about Communication		Personal talk		Domain talk		All topics	
	(*n* = 138)		(*n* = 84)		(*n* = 313)		(*n* = 535)	
	M (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)
Adopt	76.8	(42.4)	69.0	(46.5)	63.6	(48.2)	67.9	(46.7)
Adapt	23.2	(42.4)	31.0	(46.5)	36.4	(48.2)	32.1	(46.7)

n = number of reactions.

Table 6
Presence of expression of affect in the average email

	Talk about Communication		Personal talk		Domain talk		All topics	
	M (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)
First email	10.0	(13.8)	10.0	(17.8)	28.0	(35.2)	14.7	(14.3)
Later emails	8.1	(8.6)	38.7	(38.0)	8.7	(8.3)	10.6	(7.6)
All emails	8.8	(8.0)	16.9	(24.4)	10.8	(9.0)	11.0	(6.9)

Table 7
Percentage of positive expressions of affect in the average email

	Talk about Communication		Personal talk		Domain talk		All topics	
	M (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)	*M* (%)	(SD)
First email	95.7	(20.9)	82.6	(34.1)	95.8	(14.1)	92.0	(20.1)
Later emails	73.4	(41.3)	70.3	(34.3)	87.0	(24.9)	82.3	(22.8)
All emails	79.8	(36.3)	77.2	(32.5)	89.9	(19.0)	83.2	(21.8)

vation questionnaire indicated a decrease of task anxiety ($t(203) = 1.89$, $p < .05$) and an increase of self-esteem ($t(237) = 5.19$, $p < .001$).

4. Conclusion and discussion

In several ways, the CRS-model differs from other models that seek to qualify and quantify CMC. Perhaps the most notable difference comes from the inclusion of a contextual dimension. By describing how email is embedded in the broader learning situation, this dimension qualifies the context in which the dialogues take place. Key measures for task, time and setting are discussed, but a certain arbitrariness remains in their choice and in the level of detail in which these measures are treated. Apart from helping to qualify the dialogues that take place, measures from the contextual dimension can also be used to quantify the relationship between contextual factors and what takes place in the communications. This is illustrated, among others, in the correlational analyses involving the questionnaire data.

The empirical study supports the contention that turn-taking plays an important role in the inter-active nature of the dialogues. That is, as turn-taking more closely fitted a perfect zigzag pattern it was found to be associated with: (a) more emails were being sent, (b) a higher presence of questions and reactions, and (c) a stronger link between questions and responses. The empirical study also presents other findings that signal a convergence of measures (e.g., meta-tags and interactivity). These findings indicate that the CRS-model affords specific, detailed analysis of the presence or absence of interactional coherence.

In addition, the findings give insight into the question of how the communications are best characterized as dialogue type in the classification of Burbules (1993). To be

able do so, however, we first need to address the background of that typology. Burbules came to his classification by considering a distinction between inclusive and critical attitudes towards one's partner in communication and a distinction between convergent and divergent views of knowledge. In an inclusive orientation towards one's partner the dialogue revolves around understanding. There is an attitude of accepting each other's beliefs, feelings or experiences. A critical orientation is more skeptical and dialogues emphasize judgment and asking for proof and testing. In a convergent view of dialogue the various positions of the communicating partners are "at least in principle, resolvable into a consensus around a correct answer" (p. 110). In contrast, a divergent view emphasizes plurality. Multiple meanings are possible and to a certain extent to be expected. Ordering these distinctions two-by-two led Burbules to the distinction between dialogues as inquiry (inclusive-convergent), as conversation (inclusive-divergent), as instruction (critical-convergent) and as debate (critical-divergent).

The email dialogues in the present study predominantly exhibit the characteristics of the inclusive-divergent nature of dialogues as conversation. The inclusive orientation transpires in the presence of mainly positive expressions of affect and very few critical adaptive reactions. Further support for this view comes from, among others, a majority of statements dealing with the children's learning experiences, a fair share of attention to the process of communication and the presence of questions that mainly serve to promote a sharing of information and experiences. The presence of a divergent view of knowledge is supported by a preponderance of statements and the finding that a majority of the children's reactions were of an adoptive nature.

These findings cannot conceal, however, that there is a certain tension between the CRS-model and the empirical study on the one hand and the classification of Burbules (1993) on the other. The CRS-model emerged from an attempt to understand the nature of email communications in school. The model connects with other research on interactions, but the resulting coding scheme also had to fit the data from the empirical study. These data were analyzed until saturation was obtained. Data were categorized until they all fitted in the scheme and no new class needed to be added. As such, the coding scheme is very concrete, affording a detailed look at children's dialogues. Burbules' typology is more abstract, characterizing dialogues in a way that extends beyond what an objective analysis of the dialogues themselves can reveal. That is, in speaking about 'attitudes' Burbules refers to the intentions of the communicating partners. Such intentions may transpire in the dialogue, but there is also a need to address these more directly. In this sense the measures now proposed in the contextual dimension may need to be attuned more to Burbules' classification.

If we accept the premise that email is a proper medium for engaging children primarily in dialogues as conversations this raises the question of how such conversations contribute to the children's learning processes. One possible answer is that email use is a catalyst for reflection. It provides a meaningful goal for reflecting upon one's learning experiences as these reflections yield the input for the email dialogue. And, conversely, the reception of feedback and new information from one's partner provides another moment of reflection. This view is consistent with research that

indicates that writing and CMC use can be important stimuli for reflection (e.g., Mason, 1998; Salmon, 2002).

In qualifying and quantifying the children's dialogues the CRS-model illustrates that realizing interactional coherence depends on a complex variety of factors. One possible avenue for further research in this area would be the inclusion of more factors in the analyses such as the important aspect of teacher implementation. Likewise, one could pay more attention to the issue of group dynamics and group collaboration. Such a choice would lead to a more fundamental scientific route. Another option would be to opt for a more applied scientific route. Here one could opt for an instructional design approach in which only those factors are attended to that need to be explicited and can be controlled. In essence, one then aims for structured freedom. Teachers and children then have considerable freedom to act as they deem most appropriate. Recording these actions, as done in the present study, is a useful step towards the development of practical know-how on the conditions in which CMC can be useful in education (see Simons, 2002).

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