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BetterBlether: The Design and Evaluation of a Discussion Tool for education

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Abstract. Communication skills play a prominent role in the primary school curriculum. Children are first expected to acquire these skills within a supervised group environment in which the teacher guides and sets the pace for the discussion, and later transfer them to a less dependent setting. This paper describes BetterBlether[1], a computer mediated educational communication tool designed to facilitate and promote effective group interaction skills. BetterBlether uses a sentence opener approach (McManus & Aiken, 1995) in order to scaffold the use of a range of discussion skills. In so doing, it provides support for the move from teacher dominated discussions to ones in which the pupils play a more active part. We first provide an overview of BetterBlether before going on to describe an empirical evaluation which was carried out in a local primary school. Finally, we compare these results with outcomes of research on both supervised and unsupervised group discussions (Harwood, 1995).

FOSTERING GROUP DISCUSSION SKILLS

In recent years the Scottish National Curriculum has highlighted the important role which talking and listening skills play in the teaching of English Language. Communication skills are essential for effective learning, cultivating an awareness and knowledge of language, and play an important part in every child's adult life. Children are required to participate in small group discussions as part of an integrated programme to develop these skills (Scottish Office Education Department, 1991). The attainment targets of the "talking in groups" strand of English Language development include asking and answering questions, showing awareness of the ideas and feelings of others, and making relevant comments on the ideas of group members. There are corresponding targets for the listening in groups strand: offering and supporting opinions, questioning other opinions and suggesting other points of view.

It has been shown that children benefit from group discussions if the class teacher takes an active part in the group interaction (Harwood, 1995). Harwood observed that children as young as eight can conduct fruitful group discussions without the presence of a teacher, but group discussions in which the teacher actively participated and encouraged the pupils to use certain collaborative skills were more successful. In particular, children working in unsupervised groups were unlikely to use questioning and listening skills during the discussion, their discussions tended to lack continuity, and they experienced problems with group relations. The participation of the teacher prompted group members to elaborate on and justify their opinions. For these reasons, Harwood states that "in the early stages with young children the teacher's presence and support in modelling group work skills can be crucial." (Harwood, 1995, p. 1). Yet Harwood acknowledges that children need the experience of working in an unsupervised group so that they can develop for themselves the skills of managing group relations. Such discussions also provide an opportunity for pupils to learn to formulate and test their own ideas. Further analysis of Harwood's results suggests that the presence of the teacher decreases the opportunities for children to take the initiative in the discussion, or to ask questions.

[1] "Blether" is a Scottish word meaning "to chat animatedly". It can also be used as a noun to describe a person who talks with enthusiasm, as in "She's a wee blether!". Thanks are due to Mr Donald Robertson for thinking of the name "BetterBlether".

In the first stages of the curriculum, teachers are expected to spend time interacting with small groups to support and encourage pupils as they learn talking and listening skills. In the more advanced stages of the curriculum, groups of pupils are assessed on group skills as they work independently of the teacher. Thus, the teacher's role moves progressively from one of group leader, to one of facilitator, where she provides scaffolding for the discussion but does not take an active role, and finally, to one of observer. In order to facilitate this transition, it would be useful for children to receive some guidance towards using appropriate skills while gaining experience in group interaction when the teacher is not present.

Computer-Mediated Discussions

The nature of discussion varies considerably depending on whether the group is supervised or unsupervised: the presence of a teacher in supervised group discussions seems to encourage group members to justify their opinions and elaborate on their comments. However, a teacher is likely to dominate the discussion; Harwood (1995) found that pupils in unsupervised groups were more likely to initiate their own ideas, move the conversation onto a new topic, and interact with their peers. A computer mediated communication environment might bridge between supervised and unsupervised group work. The environment would provide some support and structure in an otherwise unsupervised group discussion and reinforce and consolidate the skills found in a supervised discussion, while encouraging the pupils to take responsibility for using the skills encouraged by the teacher in a supervised discussion. It could be a useful tool for the intermediary stage between supervised and unsupervised group discussions and could help children working towards the later stages of the National Curriculum to attain the goal of fruitful and focused group discussions.

Monitoring the discussion that takes place in teacher supervised discussions is not easy when the teacher is playing a role in the discussion. However, when the discussion is unsupervised the teacher's presence as passive observer, without participation, may sometimes be hard to maintain. Additionally, if the discussion groups are small (groups of 4 being a common size) observation of several groups, taking place in parallel, is not possible. A computer based tool, if used to record written (typed) discussions, could have some advantages in this respect. A record of the discussion that has taken place could easily be made, and provided for reference. This could be of use to the teacher, allowing her to detect when particular children are having difficulties; to identify skills which seem to be generally weak across a group of children, and may also suggest when a group of children are not working well together. This might lead to the identification of skills to be addressed through teaching or prompting in teacher supported discussion, or to giving the whole class further teaching on skills identified as weak. It may also provide material for further analysis of group dynamics by the teacher.

The children may also benefit from access to such a record. They can look back in the discussion to see what has been said, and can also "listen to two people at once", as this could be recorded. Furthermore, communication by this means, in a text medium, may be of benefit to some shy or less confident children: the physical presence of the teacher, and of other children, may make it difficult for them to put their views forward. A computer mediated communication environment could allow them to contribute without fear of interruption or comment.

This paper describes BetterBlether, a computer mediated communication environment for use in primary school classrooms. BetterBlether provides structured support for children developing their communication skills in unsupervised group discussion, thereby bridging the transition from supervised to unsupervised discussion, whilst facilitating some skills that may not be well supported in either. Other research that is relevant to the development of BetterBlether is described and an overview of the tool given. Evaluation of BetterBlether, and comparison with supervised and unsupervised discussion groups, is provided through the results of an empirical study carried out using BetterBlether in the classroom.

RELATED WORK

Harwood (1995) analysed video recordings of twenty two small group discussions between children aged between nine and thirteen to gather data on the presence or absence of desirable group skills. The two 10-11 year old groups are of interest to us here. He used this data to compare the levels of skills between groups under supervision and groups in which the pupils worked independently. Harwood identified five attributes of effective group discussions and then analysed the recorded discussions to discover how often these skills were brought into play. The skills were: initiating ideas about a topic, following the existing focus of a conversation by responding to previous discussion contributions, justifying opinions, questioning other group members and keeping the conversation on task.

The discussions were always on task, whether the teacher was present or not. However, when the teacher was present, either as a group member or chairing a debriefing session after the discussions, the nature of the conversations was different. The teacher's presence prompted the pupils to justify their opinions and to provide evidence for their statements. The teacher naturally assumes a dominant role when interacting with the children. For example, the children did not initiate their own ideas or ask questions of their peers as often in the supervised situation. They were also inclined to follow the existing thread of the conversation without proposing a new discussion topic. Perhaps the children and the teachers felt that the responsibility for these sorts of interactions lay with the teacher. However, it is important that children learn to use these skills for themselves.

Johnson & Johnson (1994) also identified a series of discussion skills and associated subskills which are grouped into communication skills, trust skills, leadership skills and creative conflict skills. As this categorisation was used in BetterBlether, it is discussed in more detail in the next section.

Following on from Johnson and Johnson's work, McManus & Aiken (1995) investigated, as part of an integrated collaborative learning system, the use of on-line support for communication skills through file sharing. The Group Leader Tutor was intended to promote the collaboration skills identified in (Johnson & Johnson, 1994) during the course of problem solving discussions between two students. The students sent messages to each other by selecting a sentence opener from a menu and then elaborating on this opener with additional text. There was a one to one correspondence between the sentence openers and the skills identified by Johnson and Johnson. An intelligent tutoring system offered advice and feedback on the students' skill use during the course of the discussion, and generated feedback at the end of the discussion. The tutoring system's suggestions were based on patterns of interaction denoted by the use of the sentence openers. McManus and Aiken (1995) found that the students had no difficulty using the system, and that they thought it was useful for collaborative work.

However, the Group Leader tutor is limited in its flexibility. The tutor monitors contributions from the students and compares them to an ideal model of interaction. The interaction model is similar to the "language/action perspective" as described in Winograd (1987). From this perspective, language can vary in purpose through: action, clarification, possibilities and orientation. The Group Leader tutor's knowledge was based on an encoding of language action models but it is not clear how the authors arrived at the models. It has models for comment, request, promise and debate discussions. These model describes how conversations which are initiated in order to accomplish a particular act can progress. If a user's contribution conflicts with the ideal model, the tutor suggests an alternative and refuses to pass the contribution on to the other student. This is problematic because a tutoring program which uses no natural language understanding is not in an ideal position to criticise students' discussion skills through analysis of sentence openers. (for further discussion of this point see the "Discussion" section).

Another limitation of the Group Leader Tutor is that it is confined to a LAN, and the method of message passing through files is neither robust or elegant. A web based communication environment in which messages are passed through TCP sockets would address the later problems. One advantage of this form of communication is that the group members do not have to be in the same physical location. Using the Internet as the communication medium,

children can engage in discussions with people from other schools or even other countries. In this way they can enjoy exchanging viewpoints with people having different social or cultural perspectives. As a simple medium for discussion, a synchronous text-based discussion tool such as Unix talk or Internet Relay Chat could be used, however, these types of tools do not provide any support for specific discussion skills.

There has been further interest in the sentence opener approach to supporting discussion skills; Baker & Lund (1996) and Soller et al. (1998) both describe educational computer based communication tools which support effective discussions through structured interfaces.

Soller et al. (1998) describe an intelligent collaborative learning system designed to teach groups of engineers how to work together on software design problems. The system combines speech acts and sentence openers in a structured interface to help students provide effective help to their peers and to encourage them to engage in active learning. Sentence openers are grouped by speech act types in the interface. The speech act types are: *request*, *inform*, *motivate*, *maintenance*, *task*, *acknowledge*, *argue* and *mediate*. Sentence openers are listed beneath these headings, and users can click on the sentence openers such as "Let me explain this" or "To justify" (both from the *inform* speech act type). The interface also displays logs of the numbers of each type of speech act used in the conversation, and the number of contributions from each group member. The idea behind this display is that when students have access to information of this type, they are in a better position to diagnose and repair problems in the group interactions, for example: overdominant group members, or too many requests with no information. Further more, it may encourage students to reflect on their own contributions to the group and make an extra effort to improve weak skills. This is an appropriate approach for teaching adults, however children are likely to have difficulty with the abstract categories of speech acts, and might find it hard to adjust their performance based on a quantitative breakdown of contributions by speech act. The users also use a task window to construct OMS software design diagrams, and can share these diagrams with their group members. Soller and her colleagues are in the process of evaluating this system.

Baker and Lund (1996) developed the C-CHENE collaborative learning environment to support discussions between pairs of sixteen year old physics pupils as they worked together on constructing energy chains. The pupils worked with a task window for constructing the energy chain and a communication window for discussing the problem with their partner. The communication window was structured in a flexible way by the headings "construct the chain", "come to agreement" "manage the interaction" and "do something else". Sentence openers belonging to these categories were listed below the headings, and students could select any opener. For example, the "come to agreement" heading included the sentence openers "Do you agree" and "I don't know". The interface enforced turn taking. Initial results indicated that this structured form of interface, in comparison to an unstructured "chat box", allows interactions which consist of more task related communication where the students jointly understand the problem, propose solutions and reflect on those solutions. Further evaluation is ongoing. This style of interface, which includes both a task window and a discussion window, is not suited to a system designed to teach more general group discussion skills, as discussions of the latter type do not necessarily involve task based, problem solving activities.

DESIGN AND DEVELOPMENT OF BETTERBLETHER

The design constraints for a computer mediated communication environment for use in primary school classrooms are as follows:

Four appears to be a suitable number for a live group discussion – smaller groups do not require group management skills to the same degree, while larger groups can be characterised by interactions between dominant group members and silences from the others. Groups of four are common in classroom discussion work. Obviously the characteristics of a computer mediated discussion will differ, and the dynamics of the discussion may consequently be affected in various ways: previously shy members may take a more active role, the relative

anonymity afforded by the interface may prevent the forming of cliques, etc. In the absence of such data, it was decided maintain a group size of four when designing BetterBlether.

The National Curriculum encourages respect and understanding of other cultures. From this perspective it would be an advantage to have a facility for discussion with distributed remotely located groups. The system should promote a range of discussion skills, including the attainment targets in the National Curriculum and the skills other studies have found to be weak in classroom discussions. Discussion skills should be appropriate to children who have reached intermediate or higher levels in the (Scottish) National Curriculum. Contributors should have sufficient typing skills to enable them to carry out a typewritten discussion. It is expected that pupils who are at the higher levels in the National Curriculum for talking and listening skills (c. 10 to 11 years old) will have sufficient computer experience to meet this requirement. The tool should provide a setting which promotes specific skills but one in which the pupils are free to elaborate on their own ideas. Input should be structured but not restricted. For the tool to be of general use, the domain and topic of discussion should not be fixed. The teacher should be able to specify the questions for discussion.

BetterBlether is a tool for use in primary school classrooms. It was designed and implemented by the first author in the Java programming language. This choice of language has the advantage that it will run from a web browser on any commonly used platform and so is accessible to most schools (for technical details of the implementation see Robertson, 1997). It is used to facilitate discussion between four children working at computers which are connected by either a local area network or by the Internet. The system can be used to discuss any topic, for example, subjects related to current classroom projects or National Curriculum material. The class teacher can specify a series of discussion questions related to the topic.

BetterBlether has a graphical interface which allows users to communicate with each other via a combination of buttons and free text. Users can send messages which express their views on the subject to a particular group member or to the group as a whole. Users also receive messages from the other group members which, together, form a group discussion. Users are not constrained to take turns in the conversation because it was felt that this would exaggerate the process of turn-taking to an unrealistic extent.

When pupils start a session with BetterBlether, the first question is displayed on screen to stimulate their ideas and opinions about the topic. When the group feel that they have fully covered the question, they have the option of moving on to another of the questions.

The Interface

Figure 1 shows the contribution window where the user creates messages to send to other group members. The user selects the recipient of the message from the list of group members at the top of the screen. The actual message is constructed from one of the coloured sentence opener buttons followed by additional text typed into the white box at the bottom of the screen. The sentence openers correspond to discussion skills as described in the next section. The sentence openers are arranged and coloured by skill category, but the names of the skill categories are not stated. A decision was made not to teach the skill categories explicitly, because some sentence openers could fit into more than one category. The aim is to encourage users to use the skill represented by each sentence opener appropriately. When the user is satisfied with her contribution, the send button will relay it to the other group members.

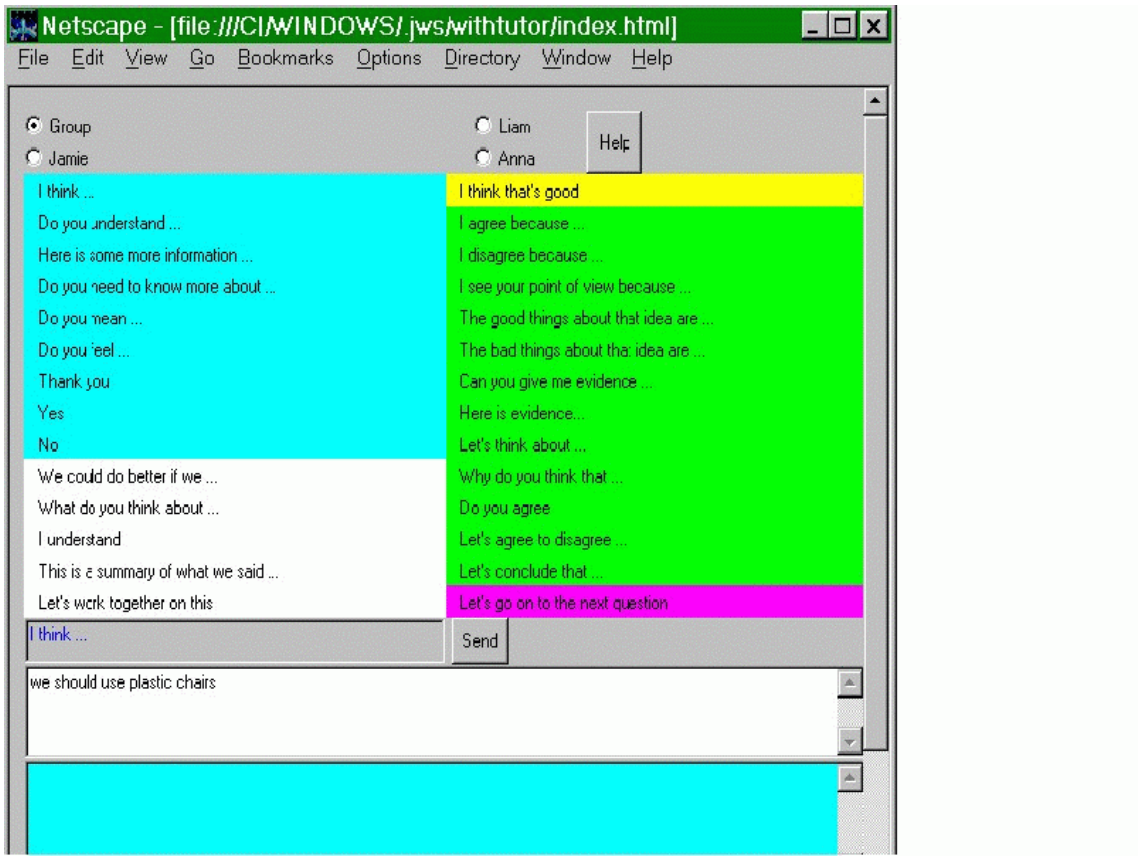

Figure 1. The Contribution Window

Figure 2 shows the discussion window. This window shows the conversation so far. Contributions from all group members are shown in the order they were made, labelled with the name of the contributor. The current discussion question is displayed at the top of the screen.

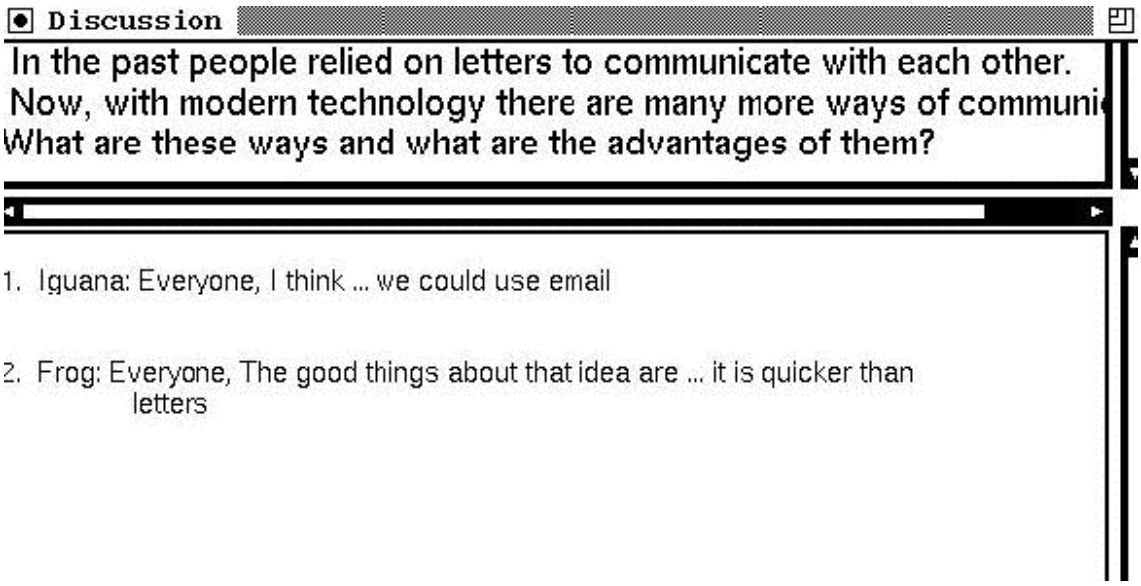

Figure 2. The Discussion Window

All discussion contributions are logged to a text file which can then be reviewed by the teacher or by the group members themselves. Contributions can be addressed to all the group members ("Everyone..") or one particular member.

Discussion Skills

BetterBlether is based on a series of discussion skills which were identified by Johnson & Johnson (1994) and later implemented in the form of "sentence openers" by McManus & Aiken (1995) and Soller (1997). The skills are : i) communication skills, ii) trust skills, iii) leadership skills and iv) creative conflict skills. These are described below, and when appropriate, related to the skills identified by Harwood (1995). The sentence openers are intended to give an example of a particular skill. For example, the opener "Here is evidence" is intended to remind pupils to justify their claims. Notice that there is often more than one interpretation of the opener and this occasionally caused confusion during the field study.

Communication is essential in a group situation. First and foremost, each group member should ensure that her colleagues interpret her contributions in the way she intended. Furthermore, each group member has a responsibility to listen to others and try to understand the meaning of a contribution before passing judgement on it. Communication is composed of three skills - sending, receiving and acknowledgement. Good sending takes place when group members ensure that other people understand them. Receiving is a listening skill - the listener should check that she understood the speaker properly. It is also important to acknowledge the contributions of others. The questioning, listening, continuity and elaboration skills identified by Harwood can be considered as communication skills in this framework.

It is important that group members **trust** each other. The group operates more effectively if people make it clear that they support and value others in the group. There are two aspects to trust. A group member should be both trustworthy and trusting. A trustworthy group member makes it clear that they value the contributions of other, and a trusting group member feels confident enough to share their thoughts with the group. Both are necessary for effective group work.

Leadership is not a static role played by one group member. Everyone in the group should be capable of diagnosing how the group can progress, and all should make an effort to maintain good group relations. Everyone should encourage the rest of the group to participate and summarise proceedings in order to direct the conversation to fruitful areas. This summarising skill was found by Harwood to be lacking in unsupervised group interactions.

Far from damaging group cohesion, **creative conflict** can be useful if it is carefully managed. If pupils are taught how to negotiate and structure controversy then it can produce creative interactions. It is often this phase of a discussion that is most productive if group members are aware that criticisms are directed at ideas rather than people. Justification, questioning and elaboration skills are important during creative conflict.

The following sections describe how the discussion skills identified above relate to the sentence openers which are used in BetterBlether. The sentence openers are adapted to suit primary school children from (McManus & Aiken, 1995). Some sentence openers could be classed in more than one category, for example “I agree” could be categorised as a creative conflict skill, or a trust skill.

Communications skills

Communications skills can be further subdivided into sending, receiving and acknowledging skills. Each of these skills have associated sentence openers which are examples of the skill. These are described below, along with the reason the user might want to choose it, or the circumstances in which it might be appropriate.

Sending skills

I think

The pupil’s opinion is important to the discussion.

Do you understand

Participants should check that they have put a point across clearly.

Here is some more information
Group members should provide as much useful information as possible.

Do you need to know more about
Perhaps one participant has some information that the others are not aware of.

Acknowledgement Skills

Yes
This opener is essential to encourage clear answers to questions.

No
This opener is essential to encourage clear answers to questions

Thank you
Pupils should be polite to their team.

Receiving skills

Do you mean
It's a good idea for pupils to check that they understand fully what the other person said.

Do you feel
It is useful for pupils to know which emotions the other people feel about these issues.

Trust skills

There is only one trust skill - "I think that's good". The reason this is included is to encourage the group to be supportive to each other.

Leadership skills

There are two types of leadership skill - maintenance and task. The first is concerned with group relations while the second concentrates on how the group can complete the task at hand. The leadership sentence openers are shown by class below.

Maintenance skills

We could do better if we
Suggestions about how the group could improve are always useful.

What do you think about
A group member should show that he or she is interested in hearing other people's opinions.

I understand
Students should let the others know that they follow what they say.

Task Skills

This is a summary of what we said
A summary is useful to remind everyone what the group has been talking about.

Let's work together on this
Everyone should try to keep the group working together.

Let's go on to the next question

It is the responsibility of all group members to change the focus of the discussion at appropriate points.

Creative Conflict Skills

If pupils are taught how to negotiate and structure controversy then it can produce creative interactions. The sentence openers for this class and the reasons for using them are shown below.

I agree because
Students should be taught to state their own opinion clearly.

I disagree because
Students should be taught to state their own opinion clearly.

I see your point of view because
The National Curriculum stresses that pupils should try to see things from another angle.

The good things about that idea are
It is a useful skill to habitually identify the advantages of current ideas.

The bad things about that idea are
It is sometimes useful to identify the disadvantages of ideas, although negative feedback should be aimed at ideas and not at people.

Can you give me evidence
An important questioning skill is to ask for evidence of another person's viewpoint.

Here is evidence
A crucial skill is to solidify an argument by supporting it with evidence.

Let's think about
Sometimes it is useful to focus the discussion on a particular topic.

Why do you think that
Group members should find out how the other person formed their opinion.

Do you agree
Seeking support from other members of the group can be a helpful tactic.

Let's conclude that
If the group have come to an agreement about an issue then it is possible to draw a conclusion.

Let's agree to disagree
Pupils should be aware that they can accept that another person has a different opinion while still keeping their own opinion.

EVALUATION OF BETTERBLETHER

BetterBlether underwent both formative and summative evaluation, concentrating on both the usability and the educational aspects. These results are presented fully in (Robertson, 1997); this paper focuses on the summative evaluation, particularly from the educational perspective, and this section describes an observational study which was carried out in the classroom. To a certain extent, although summative, the evaluation process can seen to be iterative, as the results from this evaluation are expected to lead to further improvements in the system.

Questions addressed

The questions addressed in this evaluation were as follows:

- How do the discussion skills used with BetterBlether differ from those in supervised and unsupervised groups?
- Do children initiate new ideas and respond to those initiated by others?
- Do children keep to the topic under discussion?
- Do children justify their points?
- Do children question each other's points of view?
- Do children stay on task?
- How do children feel about using BetterBlether?
- Does the teacher find BetterBlether useful?

Method

The evaluation was carried out in the form of an experimental session at a local state funded Roman Catholic primary school. The participants were a class of eleven year old children, divided into three groups of four children and one group of five children for the purposes of the study. A further two experiments were carried out at the same school to investigate a coaching system (see the "Discussion" section). The pupils were placed into mixed ability groups by the class teacher. The class teacher was happy to participate in the experiment because it gave the pupils a chance to practice the discussion skills they are required to learn as part of the Scottish National Curriculum.

BetterBlether ran on four locally networked PCs under Windows'95. The school did not own this equipment; the authors brought it from Edinburgh University and set it up before the experiment. Schools often do not have sufficient funds to purchase such hardware, although it is common in Lothian region in Scotland for each class to have one computer, and all primary schools in the region will have Internet access in the near future. It is expected that BetterBlether could be used by remote groups with each member in a different school.

Each discussion comprised a group of four children, each working at a PC. One group comprised five children: in this case, two of the members shared a machine and took it in turns to make a contribution. The children sharing changed from week to week at their own request.

The groups used BetterBlether to discuss a topic. In this case, the topics were tropical rain forests and different types of communication methods, although any topic could be used, provided the appropriate questions were given to the system. The discussions varied in length between 15 minutes and half an hour.

Members of each discussion group were identified to others in their group by the names of their machine (gecko, iguana, frog and toad) rather than by their own names. The reason for this was to anonymise their contribution and to avoid the association of, for example, incorrect spelling with an individual. To a large extent this was effective, however in one case students did realise who one contributor was and commented negatively on his spelling: this could be problematic.

In terms of prior experience, many of the participants had already used Windows '95 and all were familiar with the classroom Macintosh LC III. Some had experience of using the World Wide Web and all were familiar with the concept of the Internet. The authors were present as observers during the whole of the study. Each observer noted down all verbal comments and questions for two of the four group members (or three of the five in the group with five people), and all visual indications of problems with the system based on eye movements, mouse movements and screen display. The observers were expected to answer all the questions from the users in a helpful way. Although this could be seen as detracting from the impartiality of the observations, it was considered important to provide support to the children to ensure it was a fruitful learning experience for them. Furthermore, the types of questions asked provides a rich source of information on possible difficulties with the system. The discussion contributions were logged to a file for future analysis.

Before using the system, the children received a short lesson on group skills and the related sentence openers. They were first asked to remember the group skills they had been taught in the previous term, for example, to be brave in expressing their own opinions and not to be afraid to speak to the rest of the group. They were then shown a set of cards on which BetterBlether's sentence openers had been written. The cards were coloured, and matched the colours of the sentence openers on the interface. The children were asked to choose which openers they felt would be appropriate in a given discussion situation. Finally, they were given a short demonstration of how to construct a contribution and how to view the discussion contributions from other group members.

Results

Overall, the evalution provided some positive indications as to the educational usefulness of BetterBlether. These are considered under the following headings:

- An evaluation of BetterBlether as a communication tool based on a conversational analysis and comparison of this analysis to the results of a previous study of supervised and unsupervised groups (Harwood, 1995).
- Affective and motivational assessment by the users of the system.
- An evaluation of the usefulness of the system from the teacher's perspective.

Conversational Analysis

The conversation logs from the four group discussions were analysed to investigate whether evidence could be found for the group skills mentioned above. The analysis made use of the categories defined in Harwood's experiment on supervised and unsupervised discussions (Harwood, 1995). This study differs from Harwood's in that the latter is based on spoken discussion while the study described here is based on typewritten discussion. However, it was felt that the categorisation developed by Harwood could usefully be applied to the conversation logs, and might also point to differences between the two means of communication.

A possible alternative method of analysis, which was not followed up, would have been based on sentence openers, and would involve counting the frequency of occurrence of each category of opener. However, this analysis is problematic in two respects: firstly, the sentence openers were not always used as intended, with the result that the contribution following the opener would not necessarily correspond to the discussion skill represented by the sentence opener. For example, the contribution "Do you feelÖ. Thank you for answering Iguana" as a whole is a response to another contribution, while the sentence opener itself is a question. A second difficulty with analysing sentence openers on their own is that there are currently no guidelines dictating how the skills represented by sentence openers combine to form a "good" discussion in terms of percentages of each type of skill, either individually or across groups.

Harwood describes criteria for identifying the characteristics of a good discussion, which were listed in the "Related Work" section above. These five criteria led to five categories according to which a discussion statement may be classified. Within each category, a statement will be further classified as being of one of two diametrically opposed types, as described below:

A: Initiating/Responding *Initiating* contributions are those in which students offered their opinion on a subject for the first time, or where they suggested a new procedure, such as going on to a new question. For example,

"I think we should not log trees because they help us breath."

Contributions were categorised as *responding* if they clearly were replying to a previous contribution, by answering a question or by commenting on another person's viewpoint. For example,

"I agree with you because we are destroying the animals homes."

B: Following/Changing *Following* contributions are classed as those which continue the conversation with the same focus, whereas *changing* contributions move the discussion into a new direction. A statement classified as *following* is:

"Yes, I do feel anger about cutting down the rainforests."

because it followed on to the question "Do you feel anger?"

An example of changing the focus of the discussion is:

"Let's go on to the next question does anyone agree."

C: With Reason/Without Reason Contributions were identified as *with reason* if they gave some justification. For example,

"I agree because we also need air from the trees."

A statement *without reason* is

"I think we shouldn't log rainforests."

D: Questions/Statements *Questions* were easily identified as those contributions which seek information, opinions, clarification or attempt to gauge emotion from other group members.

For example,

"Do you feel sad about the animals?"

All other types of contribution are classed as *statements*.

E: Off task/On task *Off task* contributions are those which do not relate directly to the topic, or those which seem facetious.

The categories are orthogonal, but not mutually exclusive. For example, a statement such as "I think people want to cut down the forests for furniture" may be classed as **initiating**, because the student states her opinion for the first time, **following**, because it continues the conversation topic, a **statement**, and **on-task.**

Furthermore, there is not a one-to-one mapping between the subcategorisations in each category and their desirability in terms of conversational effectiveness: for example, while one might expect that **on-task** behaviour is to be promoted at the expense of **off-task** behaviour, this does not hold for the **initiating/responding** distinction.

The method for analysing the statements was as follows: because of mismatches between the categorisation of the sentence opener and the contribution following it, each statement was considered as a whole. Every statement was considered with respect to all five categories: assuming the category in question was relevant to the statement, the statement was then either classified as one of the two subtypes in that category. The independently derived classifications were then compared and negotiated for all discussions.

In an attempt to compare our results to Harwood's, they have been reported in the following way. There are percentages for each of the five categories (A to E) indicating the *balance* of the subcategories. As an illustration, in table 1 the entry for group 1, initiating/responding should be interpreted as follows: *61% of the contributions which displayed either initiating or responding skills were initiating skills*. The actual number of all contributions which displayed each of the skills is shown in parentheses.

Table 1. Results of Conversational Analysis

	Group 1	Group 2	Group 3	Group 4
Initiating Responding	61% (11) 39% (7)	44% (4) 56% (5)	64% (7) 36% (4)	48% (14) 52% (15)
Following Changing	86% (19) 14% (3)	100%(14) 0% (0)	100% (18) 0% (0)	81% (30) 19% (7)
With Reasons Without Reasons	62% (8) 38% (5)	88% (7) 12% (1)	57% (4) 43% (3)	26% (5) 74% (14)
Questions Statements	21% (5) 79% (19)	20% (3) 80% (12)	37% (7) 63% (12)	23% (9) 78% (32)
On Task Off Task	100% (24) 0% (0)	93% (14) 7% (1)	100% (19) 0% (0)	100% (41) 0% (0)
Total Contributions	24	15	19	41

A. How far did the children independently initiate their own new ideas into the discussion and how far did they respond to an idea or question intiated by others?

The pupils were eager to offer their opinions about the discussion topic especially in response to the initial question provided by BetterBlether. On the other hand, there is evidence that they listened carefully to other people's contributions and responded to them with answers to questions, opinions, and comments. Observation suggests that the children particularly enjoyed answering contributions addressed directly to them. This phenomenon stems from the medium of communication and is perhaps similar to sitting waiting for a parcel to land on one's doorstep. In contrast, the supervised groups in Harwood's study did not initiate their own ideas or questions. The unsupervised groups were more likely to initiate their own ideas than to respond to comments from their peers. The balance of initiation and response seems to be better in BetterBlether.

B. How far did the children keep to the topic under discussion and how far did they change the focus?

Conversations with BetterBlether have a different style to spoken discussions. Because the users must type contributions, and because their typing speeds may vary, contributions are not displayed until they are completed. This can lead to a feeling that all the participants are "talking at once". Another problem is that one group member can change the discussion question while other members are still pursuing the previous question. However, in spite of these problems with the text based communication medium, most of the contributions followed the existing thread of conversation. Importantly, the children displayed the ability to change the focus of the conversation at appropriate points. In several cases when the pupils felt that the question had been discussed to the full, they suggested moving on. An improvement on this skill would be summarising the discussion so far and checking for consensus before doing this. Harwood's results for following up contributions are inconsistent across unsupervised groups, so it is difficult to compare our results with his. BetterBlether could be further extended to provide a graphical tool that could make the conversation threads explicit.

C. How far did the children justify their points with reason and evidence?

Harwood found that the children in unsupervised groups were not inclined to justify their opinions, although they are capable of doing so when prompted by the teacher. He suggests that children do not perceive the need to provide explanations for their thinking. The results in this study were mixed. Group 2 did exceptionally well at supplying reasons while Group 4 clearly has some trouble in this area. It could be that for the most part the children agreed with each other and assumed that they agreed for the same reasons. Perhaps if there had been more disagreements they might have been motivated to elaborate on their ideas in a effort to persuade their peers. Part of the problem may lie with the phrasing of the discussion questions. For example, "Should we be logging tropical rain forests?" might have produced more explicit reasoning if it had been phrased as "Should we be logging tropical rainforests? If so, why? If not, why not?." The sentence openers which were intended to promote justification skills (*Here is evidence, I agree because, I disagree because, The good things about that idea are, The bad things about that idea are*) were not used very often. The children would benefit from a lesson stressing the importance of justifying their statements. This highlights a useful aspect of BetterBlether - a class teacher can review the discussion logs and provide remedial assistance to groups with very weak skills such as Group 4. Individual weaknesses could also be targeted.

D. How far did pupils question other's points of view?

The group members questioned each other with enthusiasm, usually to find out other people's opinions. Questions were also used to clarify meaning and to discover people's feelings about a topic. Unfortunately, none of the questions used the sentence openers which were designed to

question points of view or ask for evidence. Group 3's discussion showed a high rate of questioning, almost to the point of interrogation. This indicates that much questioning with low responding is not a particularly good skill balance. In comparison to Harwood's findings, the groups used questions more than either his supervised or unsupervised groups.

E. How far were the Children On Task or Off Task?

In the four discussions only one contribution was off task. This high level of on task behaviour corresponds to Harwood's findings. This is not a surprising result given that the children were closely observed by the experimenters and that they knew the class teacher would be given a transcript of the discussion. This latter point will be an incentive for children to keep to the discussion topic when BetterBlether is used in the normal classroom situation.

Group relations

An aspect of the medium is that groups can form cliques without appearing rude. Subgroups form and two separate discussions take place at the same time. There may be a correlation between the aliases of the group members and the frequency of comments directed at them. For example, the gecko was usually a popular group member. Certainly in later experiments participants guessed each other's identities. While the participants were anonymous, though, the children were thoughtful towards each other and often thanked each other for support or answering a question.

Case Study: An example of a discussion using BetterBlether

The following excerpts from the same discussion are a particularly good example of a thoughtful debate. The children clearly know their facts about the rainforest and seem to have a good grasp of the controversial issues. This section of the discussion is interesting because it is at the point where the group discovers and deals with the key conflict surrounding the rainforest situation. To make the examples clearer, the contributions do not appear here in the order they reached BetterBlether. The group have been discussing whether tropical rain forests should be logged. Up to this point in the conversation the children have been in agreement that the forests should not be logged, on the grounds that we need trees to enable us to breathe, and that it is unfair to the animals who live in these areas.

At this point Gecko1, who was sharing a computer with Gecko2 because the group has five people, started to see that there may be valid reasons for cutting down the trees. This contrasts with the other groups where the children evidently felt strongly about the issue but were not sufficiently mature to consider the arguments for, as well as against, cutting down the forests.

20. ***Gecko2 and Gecko1:*** *Toad, Do you understand ... that we need the wood and papper.*
27. ***Toad:*** *Gecko2 and Gecko1, Yes but we need the rain forests too*
Contributions 20 and 27 neatly capture the impasse beween the environmentalists and the foresters.
28. ***Frog:*** *Everyone, We could do better if we ... stop wasting paper*
In contribution 28, Frog offers a compromise which could go some way to resolving the problem.
Later in the same discussion the children are asked to consider the animals in the rain forests:
QUESTION 4 - Is it more important to protect tigers, who live in forests, or people?
35. ***Iguana:*** *Everyone, I think ... it would be tigers more than peopple*
Here Iguana offered his opinion to the group, although he failed to explain why he believed it.
36. ***Gecko2 and Gecko1:*** *Toad, I think ... it is true.*
Gecko2 and Gecko1 agreed with this statement, again omitting the justification for it.
37. ***Toad:*** *Gecko2 and Gecko1, Do you feel ... that the animals suffer more than the people*

At this point Toad responds with a question which comes close to the heart of the matter. It is a pity that she did not specify which group of people she meant, because although her group members do not find it ambigous it is unclear whether "the people" refers to the people living in the rain forest, the people who chop down trees or to humans in general.

38. ***Iguana:*** *Toad, Yes i do*
39. ***Frog:*** *Everyone, I think ... that animals will soon DIE!!!*
40. ***Gecko2 and Gecko1:*** *Toad, Yes that is true!*
41. ***Toad:*** *Iguana, Do you feel ... thank you for awnsering Iguana*

Often the children are very courteous to each other. The sentence opener "Thank you" was intended to encourage this kind of interaction. In this case Toad has evidently not noticed the appropriate opener and has adapted another one.

Pupils' Perceptions of BetterBlether

It is important to the success of an educational program that the students enjoy using it, and this field study found that the pupils did enjoy using BetterBlether. They described it as "cool" and "smart", and one group was enthusiastic enough to forego their break in order to continue using it.

During a (verbal) discussion with one of the experimenters, the children compared communication with BetterBlether to ordinary spoken discussion. They mentioned the following points:

Positive comments:

"When you use the computer it's not so noisy so your views are always heard."

"You can forget what you were going to say when you talk but on the computer you have to practice what you are going to say so you don't forget to say it."

"Using the computer you can save what you've all said for years and years."

"If you use the computer you don't have to write down what you said afterwards because you can just print it out."

"Working on the computer is easier."

Less positive comments:

"It's quicker to talk because it takes a while to type in your comments."

"Computers break down more often than human voices."

Teacher's Perception of BetterBlether

Mrs Smith (the class teacher) thought that BetterBlether was beneficial to the children. She studied the logs of each conversation afterwards in order to gauge their progress. This was important to her because she is required to assess each child's communication skills as part of the Scottish National Test curriculum. She appreciated the ability to monitor each group's discussion, something which is not possible in a classroom setting due to the number of groups working simultaneously.

She remarked that one child in particular had extended his vocabulary by using the sentence openers and that although he was often quiet in the classroom, he was taking an active part in the electronic discussion. On a related note, she perceived the anonymity of the group members to be very useful as she finds it hard to encourage shy children to contribute to classroom discussions. She also volunteered that she intends to teach the other half of her class group interaction skills using a sentence openers approach.

However, she had some criticisms of BetterBlether too. She commented that she would have "expected more from them in a normal discussion." She mentioned a specific conversation

that made her think the group were "not thinking hard enough". She was referring to a particular debate in which some children show a good grasp of argument skills while others exhibit a lack of common sense or knowledge about the domain. Although the teacher did not see it as such, this debate can be seen as an extremely good example of an argument. The pupils are not afraid to state their own opinions, yet are open to other view points. The debate shows imagination and the ability to play with ideas in a discussion. Above all, the children definitely enjoyed the exchange.

The teacher also commented that the groups seemed to go on to a new question before they had properly discussed the current question. This happens on a few occasions. Possibly a requirement that all group members agree to go on to the next question would remedy this.

DISCUSSION

The class teacher was receptive to the system and would like to use it further. She has some reservations about the quality of the discussion content in comparison to the quality of ideas presented in a classroom discussion when she is present, but was generally enthusiastic. She offered some ideas of how BetterBlether could be integrated into the class communications project which surveys new and old fashioned ways of communicating. She was particularly interested in using it for joint discussions with the pupils' pen friends who are all at school in New York state.

The results of the first evaluative study suggest that BetterBlether has the potential to be a useful classroom tool. However, further development work and additional research would be necessary to examine this potential further.

Firstly, the sentence openers in the interface should be reconsidered. Analysis of the transcripts reveals that the pupils did not always use the sentence openers in the way the designer expected. For this reason, the results stated above were based on an analysis of whole contributions rather than the sentence openers alone. In some cases the pupils reinterpreted the openers. For example, the opener "We could do better if weÖ" was intended as a meta level leadership comment ("We could do better if we all listened to each other") but was often used as comment within the discussion domain ("We could do better if we stopped cutting down trees"). In other cases, they used one opener when another would have been more appropriate. This mainly occurred when pupils selected the opener "I think" and went on to type another opener to complete the contribution, as in "I think no we shouldn't do that". Here it would seem that the sentence opener "No" would have been better. The tendency to overuse the opener "I think" probably arises from its position in the interface. "I think" is the top left opener and the easiest to click on from the buttons for selecting the group members (see figure 1). In addition, it is the most general opener. Occasionally the choice of opener was not suited to the rest of the contribution. In one discussion a pupil selected the effective group discussion skill of "I disagree" and completed it by typing "because your wrong"! Although the sentence opener was meant to represent the skill of putting one's own opinion and supporting evidence across, it is not always used that way.

Discrepancy between the skill depicted by the opener and skill demonstrated in the succeeding contribution could cause problems, as demonstrated in related research. The first author designed and implemented an intelligent coaching system module for BetterBlether, based on the Group Leader tutor (McManus & Aiken, 1995). The coach analysed patterns of sentence openers during the group discussion in order to suggest appropriate openers to the students as well as alternatives to inappropriate openers. It also gave each student and the group as a whole feedback on their discussion skills at the end of the discussion. The authors evaluated the coach with BetterBlether in two studies. The same groups of children from the previous study used BetterBlether (with the addition of the coaching system) to discuss rain forests and their communications project using the same environment described in the "Evaluation" section. The results were not particularly good, with one of the major problems stemming from the fact that the coach had no natural language understanding. Its domain knowledge consisted of patterns of sentence openers which were meant to depict good and bad interaction patterns. This

knowledge was drawn largely from the authors' intuitions because at the time there appeared to be no principled theory of effective group discussions between four people.

McManus's Group Leader Tutor was developed from a language action perspective (Winograd, 1987) and used finite state machine encoding of request/inform/accept/reject dialogue moves to offer advice and corrections to the users. However, this approach could not easily be extended to the BetterBlether tutoring system, firstly because there are more than two people taking part in the conversation and secondly because BetterBlether is not geared towards a problem solving task, and so does not fit into the "conversation for action" model. Without the benefit of a linguistic theory, the knowledge encoded in the BetterBlether tutor was neither rich enough, nor flexible enough to provide useful feedback and suggestions to the pupils. As mentioned above, the discrepancy between the skill represented by the sentence opener and the skill level of the actual contribution proved problematic. The studies showed that the children tended to ignore suggestions by the coach, and the contributions they produced instead were more appropriate than the suggested opener. A further problem was that assessment based on analysis of the sentence opener use was not indicative of the effectiveness of the discussion as a whole, and so the feedback provided by the coach at the end was neither appropriate nor considered useful by the pupils. A coaching system based on a rigorous theory of effective group discussion drawn from empirical discourse analysis, and adapted for computer mediated communication might overcome some of these problems. The problem of mismatch between sentence openers and the rest of the contribution could only be solved with natural language processing. On the other hand, the results of the studies suggest that pupils do not require interventions from an artificial coaching system because the structured environment itself fosters the required skills.

Other studies are required to investigate the educational potential of BetterBlether (without the coaching system). It is important to establish whether skills used in BetterBlether would transfer to face to face discussions. It could be that the environment merely encourages the skills during a computer based discussion, rather than teaching skills that can be used later in unmediated unsupervised discussions. It would also be interesting to study the interactions between remote discussion groups and compare them to interactions between locally situated groups. Using such a system to link together pupils from different schools and even countries could have great educational value. Although Internet technology is not yet pervasive in education, the authors predict it will be increasingly important in the future.

CONCLUSION

BetterBlether is a computer based communication tool intended to support children as they learn how to work in small groups independently of a teacher.

Analysis of discussions between groups of children mediated by BetterBlether shows that group members displayed a good balance of group interaction skills. They initiated their own ideas during the conversation and were able to change the focus of the conversation when necessary. On the other hand, the pupils listened and responded to their peers and discussion remained focused on the topic. There was appropriate use of questioning skills during the discussions. However, some groups were weak on justification skills and the tool could be developed further to encourage use of this skill. Furthermore the children enjoyed using BetterBlether, and their teacher has indicated that this tool would be useful to her in supporting the teaching of discussion skills.

These preliminary results indicate that BetterBlether is a useful educational tool: it may be used to support the teacher and children in a variety of discussion based activities.

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