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Investigating the impact of ICT-based multimodal mapping in developing effective learning dialogues

Nigel R Riley
Knowle Primary School, Plymouth, UK.

ABSTRACT

Assessment of student's writing shows a deficiency in developing coherent ideas, with student's following the prompts of the teacher and showing little individual extension. In order to improve this situation, this paper explores the potential of multimodal mapping as an intermediary tool that mediates between talk and writing in the creation and development of ideas collaboratively. Mapping is employed to provide a structure for making first thoughts more visible as well as providing opportunities for revision and refinement before writing takes place. This small-scale, illuminative case study explores the use of ICT-based mapping in developing effective learning dialogues to generate concepts and ideas that will transfer into writing. The sample is a group of 22 students aged 10-11 years old within a large urban primary school in the United Kingdom. The students have a wide range of academic attainment and social backgrounds. The intention is to use digital multimodal mapping as a tool to make ideation in group discussions more effective for planning for writing by reducing social and cognitive constraints to developing coherent ideas. Data for this study is collected from transcribed discussions of groups of students engaged in concept mapping tasks using ICT-based multimodal mapping and individually written texts. Four methods of data analysis are used: a dialogical framework for the social modes of thinking; a framework for thinking skills based on Bloom's Taxonomy; a study of the complexity of the concept map, and tracking the transfer of lexical concepts and propositions from discussions into concept maps and texts. The findings from this study suggests that using ICT-based multimodal mapping increases the transfer of lexical concepts from talk into writing and suggests that learning dialogues develop higher-order thinking during the compositional phase in expository writing tasks. The study concludes that using ICT-based multimodal mapping has positive effects in developing transfer of ideation from learning dialogues to writing in expository writing tasks.

FRAMING LEARNING THROUGH LANGUAGE

Language as described by Mercer is a tool that provides a system for 'thinking collectively' (Mercer, 2000:15). The importance of language in education is recognised as being 'an integral part of most learning. Compositional drafting is considered a learning space where individuals engage with challenges that require solutions to be thought through, revised and refined and finally presented. However, my assessment of children's writing shows that ideas are frequently limited and there is a deficiency in developing coherent ideas. More often than not the writing follows the teacher's initial stimulus and direction with little or no individual extension outward.

The theory that oral language has a key role in classroom teaching and learning' (DfES, 2003) has been the basis for using small group discussions in class practice to generate ideas and learning dialogues in order to overcome weaknesses in writing. However, the use

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of small group discussion work to improve the drafting process does not always produce the extension of ideation that is expected. My classroom observation indicates a reluctance of children to talk effectively in ways that generate solutions to challenges that particular writing task activities produce.

Development of ideas in talk is also dependent on the ability of participants to reflect on the content of ideas and to develop or rework them. This includes a social dimension as well as a cognitive dimension to such learning dialogues with both dimensions exerting constraints on compositional thinking. Social constraints involve such factors as competitiveness, disagreement, disengagement from the task and lack of interpersonal communication ability. Cognitive constraints involve inability to memorise previous contributions, lack of reflection time, and a lack of internal representation of the discussion topic. Such constraints reduce and limit learning dialogues thus reducing their impact on collaborative and individual learning. The problems faced in the mixed class of 10-11 year olds are a combination of these social and cognitive dimensions.

It seemed to me that what was required was an intermediary tool to mediate between the teacher's spoken explanation and the children's writing. The tool would need to provide both structure and revisibility during discussions. This drafting tool, used to structure the discussions, should allow the flexibility needed for revision and refinement of ideas. The mediating tool also needed to address the challenges of social behaviour and cognitive recall. The purpose of this tool would be to promote more effective learning dialogues.

Several theorists have recognised that the use of ICT around a screen can produce talk of a type that has educational significance when children work in small groups at computers (Fisher, 1997:81; Wegerif, Littleton and Jones, 2005). I decided, therefore, to explore the potential of digital concept mapping in order to improve the quality of collaborative talk, drafting and writing in my classroom. This use of ICT-based collaborative multimodal mapping offered a method of tracking a discussion, which the children could use as a visual anchor when they were thinking about ideas, recording them and reflecting on them. The maps help in the generation and development of ideas by making them visible.

THE LITERATURE

Two fields of literature about multimodal concept mapping in writing and learning dialogues provide the underpinning theory for this study. The literature about mapping and learning dialogues is further divided into two sections: the social dimensions and the cognitive aspects.

The links between multimodal concept mapping and writing

In writing, composition involves retrieval and evaluation of information and the evolving and synthesis of ideas (Smith, 1982, 1991; Wray and Medwell, 1991) and drafting, which promotes writing as 'revising inner speech' (Moffett, 1981). Multimodal mapping provides a means by which such compositional ideas are made explicit (Ahlberg, 1997; Novak and Gowin, 1984) and ICT-based multimodal mapping software provides a conceptual space

that enables thoughts to be recorded and revised prior to drafting and text construction (Riley& Ahlberg, 2004).

Multimodal mapping produces both the narrative and conceptual patterns. Kress and van Leeuwen, in their study of the Grammar of Visual Design, found they needed to structure ideas in a proto-propositional manner, similar in fact to notes. In their view, narrative patterns are similar to flow charts, as they are linear in terms of chronology or sequence of events and use temporal connectives in their labels. Conceptual patterns, on the other hand, are non-linear, representing meaning or structure, and are 'classificatory, analytical or symbolic' utilising causal connectives (Kress and van Leeuwen, 1996:56). Conceptual patterns, similar to schema, are important in language processing in that they contain the 'knowledge that is used to facilitate understanding of what we perceive' (Bransford and Johnson, 1972). It follows, therefore, that multimodal mapping can be used in a flexible manner that represents the ideas being generated in talk, and structures them in a way that lends itself to easy text drafting.

These conceptual patterns in multimodal mapping are similar to nominalised writing in that meaning is emphasized in nouns rather than verbs (Kress and Van Leeuwen, 1996:59). This aligns more with expository drafting rather than narrative drafting since nominalised writing is more explanatory and descriptive than narrative. Thus, employing conceptual pattern generating mapping techniques using ICT-based multimodal mapping software could be used to plan writing into sentences and paragraphs using nominalised conceptual patterns providing a scaffold as a writing frame.

A study into critical learning using online discussion forums demonstrates that lexical concepts formed in the discussion forums successfully transferred into ICT-based multimodal mapping (Riley, 2006). Theoretically ICT-based multimodal mapping software could, likewise, mediate in the transfer of lexical concepts and the representation of ideas from learning dialogues into writing using techniques of concept mapping.

The links between multimodal concept mapping and learning dialogues

My definition of multimodal concept mapping is that this is a technique for representing knowledge and ideas externally so that elements of both propositional and analogical representation (see below) are incorporated to represent propositional formations (Figure.1). This shows how the nodes and the links work together to define a proposition or an analogy.

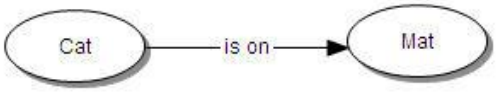


Figure 1: Propositional formation represented in concept mapping.

Eysenck and Keane (2000:247) present this formation in a more complex way by explaining that there are types of formation: analogical representation and propositional

representations. Analogical representations tend to be perceptual images: visual, auditory or kinaesthetic. They are non-discrete, implicit, less constrained by rules or grammars and tend to be concrete or modality specific. Propositional representations, on the other hand, capture the ideational contents of mind. These representations are language-like in that they are discrete, explicit, constrained by rules or grammars and tend to be abstract. Shaw and Hazlett explain more details about propositional representations. They say these representations contain object and relational concepts that can be extended into more complex combinations forming a structure that may represent events, sequences of events, perceptions, situations, relations and objects equating to a schema (1986:56-57).

In Table 1 I have indicated how multimodal concept mapping can combine both the linguistic and the visual. The table shows how the relational connection of two object concepts, linguistically and visually, interconnect. This tabular categorisation exemplifies how the combination of both visual and linguistic notation in concept mapping composition develops a closer definition of the concept being represented by reducing the number of possible interpretations.

The labelled vectors or links in the maps are a key component here. The inclusion of vectors in examples B and D (Table 1) create analogical 'propositions' (Kress and Van Leeuwen, 1996:57). They enhance the connections and relational interpretation between concepts, making the relationship more meaningful in terms of action and transactional structure (Unsworth, 2000:73). The inclusion of labelled links in examples C and D (Table 1) have a similar impact propositionally, making explicit the specific relations between the concepts, in terms of subject/object relations. The increase in combination of both graphic and linguistic notation in such external representations more closely defines, therefore, the concept being represented and reduces the possible number of interpretations as shown in the second column (Table 1).

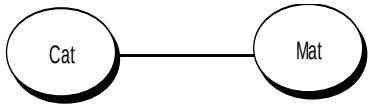
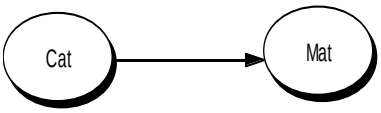
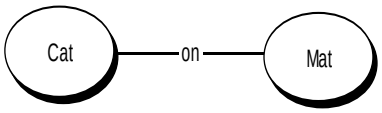
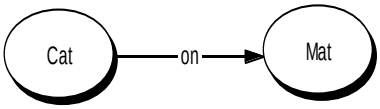
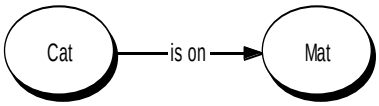
Concept mapping compositionality	Interpretations from concept mapping	Interaction between the visual and linguistic elements.
A 	could mean; The cat ate the mat. The cat went to the mat. The cat walked over the mat. The mat belongs to the cat. The mat is near the cat.	The number of possible interactions and types of different relations between the cat and mat are many and diverse.
B 	could mean; The cat went to the mat. The cat saw the mat. The cat likes the mat.	The directionality given by the vector is explicit although the definition of the relationship is unclear. It gives a structure to the possible linguistic interpretations in terms of subject/object order.
C 	could mean; The cat ate on the mat. The cat ran on the mat. The cat sleeps on the mat. The mat is on the cat.	Although the relationship has been given more clarity in terms of relation by naming the link, the interaction is still lacking clarity in terms of the order of relationship.
D 	could mean; The cat went on the mat. The cat is on the mat.	The combination of vector and naming of the link reduces the number of possibilities in interpretation. The relationship achieves more definition and the whole representation becomes more meaningful.
E 	could only mean; The cat is on the mat.	The inclusion of a more constrained label to the vector achieves an accurate and meaningful proposition in terms of objects and their relations.

Table 1: Compositionality of representation in concept mapping.

Connectivity in the maps is scored by counting the number of links and the number of nodes and dividing the nodes by the links. This gives a connectivity score which is believed to represent the level of cognitive activity in the brain of the learner. As connectivity between concepts in a concept map increases, changes in the analogical and propositional composition reflect changes in the thinking processes that are happening during the mapping process (Somekh et al, 2000; Åhlberg, 1997). The study uses analysis of concept mapping composition and connectivity to represent changes in order of thinking during the mapping process and these methods are described later in the section describing methodology.

This flexibility in compositionality in ICT-based multimodal mapping provides a 'mindtool' (Jonassen, 1996) or a form of 'conceptual space' (Boden, 1991) conducive to quality exploratory behaviour that is both generative and productive (Riley and Åhlberg, 2004). It is this exploration and generation of proposition formation in concept mapping that stimulates learning dialogues as children reason and evaluate the compositionality of the concept mapping.

In digital mapping as opposed to hand drawn maps features of revisibility, capacity and automatic functions enables storage and revisiting of mapping and ease in creating concepts and links (Loveless, 2003:10). Mapping software provides a simple, easy-to-use interface for graphic generation of concept maps (Riley and Åhlberg, 2004). The use of laptop computers in the classroom enables children to work in groups, pairs or individually on multimodal mapping tasks with the small or large screen as the focus and locus of collaborative activity.

This research on concept mapping and conceptual representation provides a firm theoretical basis for using digitally-based multimodal mapping software from two key perspectives: the social dimension and the cognitive approach that are now discussed in terms of learning dialogues.

In the next two sections learning dialogues are discussed from the point of view of their social dimension as well as their cognitive dimension. Both these dimensions indicate how learning is developing. The theoretical frameworks that can be used to analyse these dimensions in learning dialogues are also discussed more fully in the two sections. In summary, the social dimension the Wegerif and Mercer's (1997) theories are used as they have been developed directly from observations of children talking in small groups around computers. For the cognitive dimension, Bloom's Revised Taxonomy of Educational Objectives by Anderson and Krathwohl (2001) is used. I have additional thinking skills identifiers in speech as a means of analysing the cognitive dimension. Both frameworks provide a theory-based approach to analysing the learning dialogues generated by ICT-based multimodal mapping.

Social dimension of learning dialogues

The ideation and generation of ICT-based multimodal mapping is conducted through speech, a cultural tool for sharing and developing knowledge. Vygotsky's claim that, 'all that is internal in the higher mental functions was at one time external' (1962) suggests that learning dialogues generated in groups provide modelling (oral rehearsal) that enhances independent and individual ability in similar tasks. Wegerif and Mercer (1997:52) argue that thinking, as both internal and external functions, generates meaning when occurring as 'different voices' from 'different perspectives'. In the light of this thinking, ICT-based multimodal mapping in groups provides an opportunity to generate meaningful learning dialogues that have an impact on the group and on the individual.

The framework used in this study comes from Wegerif and Mercer (1997) who developed a dialogue-based theory for understanding language based on a social thinking tool .Their framework describes three types of talking: disputational, cumulative and exploratory:

> *Disputational talk* is individualistic with interactions being competitive, maintaining the speaker's position. This features short exchanges of assertions, challenges counter assertions and disagreements.
>
> *Cumulative talk* is defined by more positive interactions and feedback to contributions. There is the accumulation of common knowledge through

> accumulation of related experiences emphasised by repetitions, confirmations and elaborations where the speakers define themselves.
>
> *Exploratory talk* involves the critical engagement of participants offering constructive statements and suggestions, where joint offerings and hypotheses have justified challenges and counter challenges.
>
> 'Knowledge is more publicly accountable' and 'reasoning is more visible in talk' (Wegerif and Mercer, 1997, p54).

The framework for social modes of thinking reflects a progression in the ability of individuals to share and collaborate with others, which represents the social quality of thinking and reasoning taking place within collaborative discussions. It is, therefore, used in this study to provide discourse analysis data (Mercer et al., 2004) to assess the quality of learning dialogues.

Cognitive dimension of learning dialogues

The other quality of learning dialogues is the cognitive dimension for which the higher order thinking skills are used as evidence. The framework used for analysing cognitive dimensions is a revision of Bloom's Taxonomy (1956) by Anderson and Krathwohl (2001), updated to include a more detailed range of thinking skills (see Table 2). This framework of thinking skills is used to identify lower order and higher order thinking taking place in dialogues through using aligned identifiers in speech that I devised as shown below in Table 2.

Thinking skills	Thinking skills - descriptors	Thinking skill indicators in speech - identifiers
LOWER ORDER THINKING SKILLS – Remember; Understand; Apply		
1. REMEMBER	**Memory Processes**	
1.1 Recognition	identification	Isn't that…?
1.2 Recalling	retrieval	I remember….
2. UNDERSTAND	**Comprehension Processes**	
2.1 Interpreting	clarifying, representing, paraphrasing, translating, supporting, challenging	Do you mean……? Is that like…? That's not like…? No it isn't …….I agree
2.2 Exemplifying	illustrating, instantiating	Isn't that like…? That's like…
2.3 Classifying	categorising, defining, ordering, sequencing, naming	That's a ……. That belongs to…. That's called….
2.4 Summarizing	abstracting, generalising	In short…….
2.5 Inferring	concluding, predicting, estimating, deducing, pattern recognition	If……. then…… …therefore….. ….thus… …..so….
2.6 Comparing	contrasting, mapping, matching, discerning	…the same as… ….different from…
2.7 Explaining	constructing models, demonstrating	….because….. …since…..then…. …that is why… …so that….
3. APPLY	**Methodological processes**	
3.1 Executing	following procedures, instructions	…first…. …then…. …next…after….
3.2 Implementing	using procedures, instructions	…we can use… …let's do this…
HIGHER ORDER THINKING SKILLS – Analyze; Evaluate; Create.		
4. ANALYZE	**Analytic processes**	
4.1 Differentiating	distinguishing, selecting, focusing, discriminating	…that's the same as…different from….. …that's good…bad… ..that's not important..
4.2 Organizing	connecting, integrating, outlining, parsing, structuring	…that relate to that.. … that make sense…connects to... …how is that related..?
4.3 Attributing	deconstructing	…they are thinking like this… …it's because of this…that…
5. EVALUATE	**Reflective processes**	
5.1 Checking	detecting, monitoring, testing, revising	…is that good or not? ...does that work? Do we know if…?
5.2 Critiquing	judging, testing, editing, assessing, deciding	I think that works well…… It doesn't work because… Maybe we could do this….? Why don't you...? Shall we try…?
6. CREATE	**Creative processes**	
6.1 Generating	hypothesising, inducing, suggesting, questioning	If…….then……. What about if…?
6.2 Planning	designing, composing	We could do this…or that?
6.3 Producing	constructing, producing,	Indicated also by parsing

Table 2: Cognitive Processes Dimension of Bloom's Revised Taxonomy of Educational Objectives (Anderson and Krathwohl, 2001) adapted as a thinking skills framework

These frameworks for analysing both the social and cognitive dimensions of speech provide useful criteria against which to analyse and compare the development of the learning dialogues taking place when using digital multimodal mapping.

RESEARCH QUESTION

The aim of this study was to find a method to generate and promote extended discussions to develop compositional ideas and to enable students to use these ideas in their own writing.

This study investigated the use of ICT-based multimodal mapping software to stimulate and develop learning dialogues that enhance thinking and ideation that will transfer into compositional expository writing. The objectives of the study related to the use of digital multimodal mapping software to increase the quality of learning dialogues that transfers into writing.

- Does using ICT-based collaborative multimodal mapping improve the quality of learning dialogues during the compositional of drafting process?

This question is designed to discover whether the data shows that using ICT-based multimodal mapping increases the social modes of thinking in the compositional process and increases the quality of thinking in group talk.

- Does using ICT-based collaborative multimodal mapping increase lexical concept and propositional transfer from learning dialogues into writing?

This question analyses whether using ICT-based multimodal mapping increases the complexity of concept mapping and the lexical concept and propositional transfer from talk into writing.

RESEARCH DESIGN

This small-scale illuminative case study aims to establish whether students aged 10 to 11 years old benefit from using ICT-based multimodal mapping to collaboratively discuss compositional ideas in expository writing tasks.

The sample is a group of 22 students aged 10-11 years old within a large urban primary school in the United Kingdom. The students have a wide range of academic attainment and social backgrounds.

The study uses data from the sample at pre- and post-intervention points. The data is analysed qualitatively since the study is small and there are no controls. Data is collected from:

- fully transcribed discussions from 5 groups while concept mapping during 20 minute activities;
- analysis of the ICT-based multimodal mapping from the 5 groups using: nodes, links, propositions;
- tracking of lexical concepts as they transfer from talk into ICT-based multimodal mapping and into 22 individually written texts.

The intervention (Table 3) uses collaborative ICT-based multimodal mapping during 20 minute group activities in literacy lessons to plan for writing. The study is not represented as being 'special' or 'different' to everyday learning.

Intervention Activities **Literacy Blocks of Work**	***Introduction Activities*** **TERM 2** **Spring 2**	***Development Activities*** **TERM 3** **Summer 1**	***Consolidation Activities*** **TERM 3** **Summer 2**
ICT-based multimodal mapping planning activities	Using ICT-based multimodal mapping with an interactive whiteboard to analyse a story structure and plot plan. Groups concept map the plot of *Matilda* in groups.	Teacher demonstrates ICT-based multimodal mapping for planning, importing content from a text on 'Antarctica' and organising into a skeleton-frame while discussing the layout. Groups practise constructing a similar ICT-based multimodal map based on an information text.	Teacher models writing and planning strategies using ICT-based multimodal mapping strategies. Use concept mapping to extend ideation and creative directions of writing. Model and demonstrate how to adapt concept mapping planning for writing.
Report composition and writing activities using ICT-based multimodal mapping	***Pre-intervention activity*** Group use ICT-based multimodal mapping to plan and organise sub-topics into paragraphs for report writing on *A Newcomers Guide to Plymouth* - Using concept mapping to as a writing frame children write a non-fiction report.	Discuss and model how to plan a commentary on a poem. - Using ICT-based multimodal mapping as a writing frame to organise paragraphing and content - Groups re-read poem to suggest themes to concept map into a commentary - Individuals use the group multimodal map to model the structuring of sentences and paragraphs in writing.	***Post-intervention activity*** Group use ICT-based multimodal mapping to plan and organise sub-topics into paragraphs for report writing on the book *Kensuke's Kingdom* by Michael Morpurgo. - Using concept mapping to as a writing frame children write a non-fiction report.
Poetry composition activities using ICT-based multimodal mapping	Groups use ICT-based multimodal mapping to explore ideas and figurative features for describing *Night*.	Groups use ICT-based multimodal mapping to brainstorm drafts for a poem with a message.	Groups use ICT-based multimodal mapping to brainstorm ideas for poems with a theme.
Narrative composition activities using ICT-based multimodal mapping	Groups plan story idea using concept mapping: paragraphing the text. Individuals draft a story using concept maps as scaffolds.	Groups structure the plot of a known story Harry Potter, using Inspiration-based concept mapping to revise narrative structure.	Groups produce Inspiration-based concept mapping to parody the '007 Bond' genre revising the features of a story to concept map the beginning, middle and ending for a writing frame.

Table 3: Intervention activities

The intervention is separated into three phases; introduction, development and consolidation.

The introduction to ICT-based multimodal mapping took place through teacher modelling with guided and directed activities to help groups become equally experienced at using the software interface and functions and to establish consistency in collaborative practices. This also allows management of groups and collaborative routines to become embedded during the independent group work in the literacy hour. Students were expected to generate simple

multimodal maps to express group ideation within simple tasks at first. Students quickly become familiar with the software interface.

The development of ICT-based multimodal mapping extends the use of multimodal mapping across several blocks of work and genres of writing. Since the focus is on how multimodal mapping impacts on learning dialogues in composition tasks no other input about ICT-based multimodal mapping was considered necessary. This maintains a natural development of use of ICT-based multimodal mapping by the students.

A standard for the consolidation of ICT-based multimodal mapping is considered to be the acceptance by students of ICT-based multimodal mapping as normal practice during group activities in literacy lessons to plan for writing. In literacy group activities small groups of 5 pupils used ICT-based multimodal mapping to produce a shared concept map that provides a writing frame to support the writing tasks.

Quantitative methods are used to extract data and provide simple formats for a qualitative comparison of impact of the intervention. In the early-intervention task during the introduction phase this was an expository report about a town (A Newcomers Guide to Plymouth). During the consolidation phase the late-intervention task was a report of a book (Kensuke's Kingdom by Michael Morpurgo). These activities were embedded within normal lesson planning for 10-11 year old students.

Report writing activities were chosen as the activity for the study as this is a familiar and continually practised genre in writing across the curriculum as well as in literacy. The subject specific content of the reports assumed a secondary role since compositionality through concepts and proposition formation were being compared. In this instance lexical concepts and propositions were used as components of report writing for quantitative analysis.

Group dialogues were recorded during ICT-based multimodal mapping using laptop microphones. The ICT-based multimodal mapping software files and audio files were saved and labelled according to the group and date. Texts were collected after writing in normal marking practice. All procedures of informed consent were followed with anonymity and confidentiality of data preserved.

Data collection and analysis

Data collection and analysis were described according to data type; discussion data, multimodal mapping data and text data.

a) Propositions and lexical concepts recorded in discussions were tracked across full transcripts of group talk, resultant group ICT-based concept mapping and individual writing based on the discussed topics. Key words and phrases were extracted from talk and verified in concept mapping and text. Tracking the transfer of lexical concepts and propositions formed in speech provided evidence of validity of the effectiveness of learning dialogues.

b) Multimodal mapping was analysed for complexity and componential content in accordance to procedures taken from the Impact2 study (Somekh et al, 2000):

1. nodes (each object counted as one)
2. links (links emanating from each node counted and totalled)
3. connectivity (number of links divided number of nodes).

The frequencies of lexical concepts, labelled links, unlabelled links and propositions were recorded to provide observation of increased complexity of mapping.

c) Dialogue transcripts were analysed according to the framework for the social modes of thinking. The framework maintained three talk types labelled as; Disputational talk (D), Cumulative talk (C),Exploratory talk (E). These three talk types had a set of criteria in which judgements of talk-type are referenced qualitatively (Wegerif and Mercer, 1997:54).

Discussions are analysed according to the thinking skills framework in Table 2. Identifiers are marked for appropriate contributions on the transcripts then frequencies are aggregated for lower order and higher order thinking skills.

These frameworks provided different approaches against which to make judgements and identifications of possible changes in thinking during learning dialogues. The analysis of group talk identifying social modes of thinking and cognitive thinking skills relied on the ability of the researcher to accurately define and identified such incidences in transcribed speech using stable constructs for rating. The social modes of thinking described collaborative ability and these were readily visible in more extended exchanges.

The main problem in this study lies in attributing any changes in learning dialogues directly to the introduction of ICT-based multimodal mapping. As this is a small study the qualitative analysis must accept that observations are illuminative as far as this sample is concerned. It should also be noted that the tracking of concepts is an accurate description of the concept transfer from one modality to another since the data is 'visible'.

RESULTS

The results are displayed and analyzed according to the data type presented in the data collection:

- proposition and lexical concept tracking,
- multimodal mapping analysis,
- talk analysis for the framework for the social modes of thinking,
- talk analysis data for the cognitive thinking skills framework.

Proposition and concept tracking

	Proposition and concept frequencies in TALK (mean) N=22	Proposition and concept frequencies in MULTIMODAL MAPPING (mean) N=5	Proposition and concept frequency in WRITING (mean) N=22	Range of propositions and concepts used in WRITING (as % of talk frequency) N= 22
PRE-TEST	**80** *(3.6)*	**23** *(4.6)*	**70** *(3.2)*	**30** (37%)
POST-TEST	**95** ***(****4.3)*	**37** *(7.4)*	**132** *(6)*	**41** (43%)

Table 4: Total frequency and mean frequency of propositions and concepts formed in talk and occurrence in concept mapping and writing

Proposition and lexical concept frequencies increased in talk, multimodal mapping and writing from the introduction phase to the consolidation phase. The range of propositions and lexical concepts in writing as a percentage of their frequency in talk also showed an increase. Proposition and lexical concept frequency in talk increased in the consolidation phase writing activity. All the mean frequency scores increased in the consolidation phase. The mean frequency scores remained static from talk to writing in the introduction, but increased in consolidation.

These results suggest there is some small increase in ideation generated in talk and multimodal mapping that transfers into writing. This is supported by the increase in the range of ideas generated in talk and multimodal mapping being used in consolidation phase writing.

Multimodal mapping analysis

	NODES	LINKS	CONNECTIVITY	LABELLED LINKS	PROPOSITIONS
PRE-TEST	40	35	0.875	19	14
POST-TEST	41	38	0.927	23	15

Table 5: Multimodal mapping component frequencies for whole sample mapping.

The multimodal mapping component frequencies maintained a similar order in the introduction and consolidation phases. There was some increase in connectivity that suggested a small increase in proposition formation in mapping in the consolidation phase that might have been an indicator of higher-order thinking (Åhlberg, 1997). Figure 2 is an example of the level of composition of multimodal mapping in the introduction phase and Figure 3 is an example of multimodal mapping in the consolidation phase.

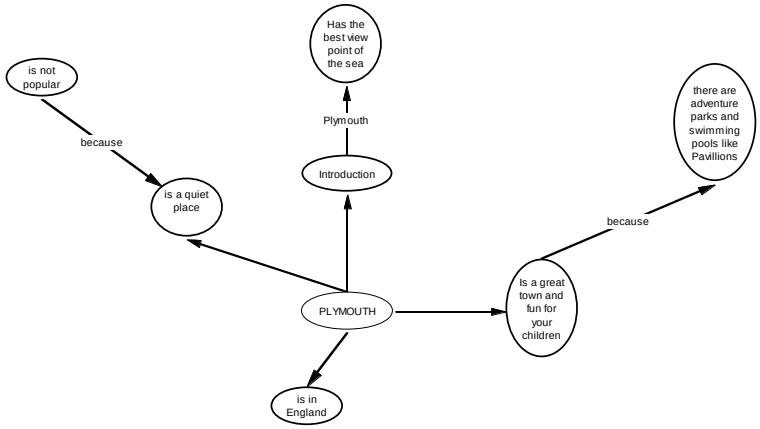


Figure 2: Example of introduction phase ICT-based multimodal mapping

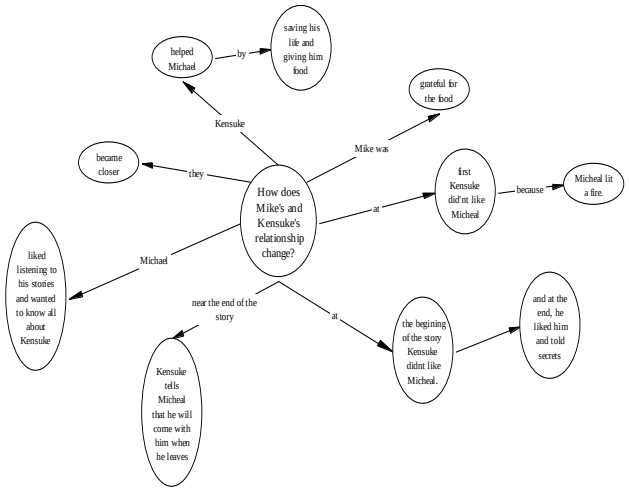


Figure 3: Example of consolidation phase ICT-based multimodal mapping

When we compare the examples of multimodal mapping (Figures 2 and 3) by the same group we notice immediately how the pattern of mapping has increased in lexical concepts formed and labelled links used to join them in a propositional form in the consolidation phase. The organisation of ideas is more developed in the consolidation phase and this would be more conducive to more organised drafting.

Talk analysis for the framework of the social modes of thinking

PHASE	TOTAL CONTRIBUTIONS	Frequency (%) identified contributions for the social modes of thinking in each test		
		DISPUTATIONAL	CUMULATIVE	EXPLORATORY
INTRODUCTION	1094 (42%)	110 (10%)	194 (18%)	73 (7%)
CONSOLIDATION	1514 (58%)	30 (2%)	266 (18%)	67 (4%)
TOTAL	2608			

Table 6: Frequency and percentage analysis for the social modes thinking.

The total contributions represent the total talk frequencies for the task while the percentages represent the percentages of task talk. The social mode of thinking is represented as frequencies and percentages of talk in the introduction and consolidation phase task. Not all talk equated to the criteria for the social modes of thinking as is shown by the lower percentage scores. Total contributions increased in the consolidation phase indicating more talk.

The percentage frequencies of disputational talk decreased throughout the tests from 10% to 2%. Cumulative talk remained static at 18%. Exploratory talk decreased from 7% to 4%. When examining the raw frequencies there was a reduction of disputational talk, an increase in cumulative talk and similar frequencies of exploratory talk. Sequence 1 shows an example of disputational, cumulative and exploratory talk.

6. How does Mike's and Kensuke's relationship change? [Exploratory talk]
7. Well, when they first met each other… [Cumulative talk]
8. They didn't like each other. That's what I wrote last time. [Cumulative talk]
9. No, when they first met, Kensuke helped him, didn't he? [Exploratory talk]
10. No, he didn't like him. [Cumulative talk]
11. Yeah, but he left him food, didn't he? [Cumulative talk]
12. Just write, 'They found… ' [Disputational talk]
13. 'They met.' [Disputational talk]
14. They met in Kensuke's… I know. They met when Kensuke dragged him out of the water because he felt sorry for him. [Exploratory talk]

Sequence 1: Extract from post-test transcript indicating the social modes of thinking.

In this extract exploratory talk is expressed through participants proactively developing the discussion by introducing new concepts, questioning, and with reasoning statements using 'because', an identifier of exploratory talk (Mercer, 2000, p154). Cumulative talk is more open with suggestions being offered and follow-ups made to previous contributions. Disputational talk is shown as individualised and oppositional.

Talk analysis data for the thinking skills framework

Analysis of thinking skills in introduction and consolidation task talk contributions		
Thinking Skills	Introduction	Consolidation
Lower order (% frequency of the total contributions for the task)	177 (60%)	139 (48%)
Higher order (% frequency of the total contributions for the task)	116 (40%)	147 (52%)
Totals	293	286

Table 7: Frequency and percentage frequency analysis for thinking skills.

The lower order thinking skills decreased in numerical frequency while higher order thinking skills increased in numerical frequency from the introduction to the consolidation phase tasks.

Sequence 2 is an example of thinking skills analysis according to the thinking skills framework

64. What style do you reckon it's written in? [5. Evaluate - 5.1 Checking]
65. It don't have a sort of style… [2. Understand - 2.1 Interpreting]
66. Yeah..it does… [2. Understand - 2.1 Interpreting]
67. It means it's written in paragraphs and sentences. [2. Understand - 2.2 Exemplifying]
68. It isn't…
69. It is…
70. Come on Kirst write it or something.
71. Like.., in the poem… [3. Apply – 3.1 Executing]
72. Yeah…
73. It is written in… [4. Analyze – 4.2 Organizing]
74. Not in the same way… [2. Understand - 2.1 Interpreting]
75. It is written with… [4. Analyze – 4.2 Organizing]
76. ...repeated lines… [6. Create- 6.1 Generating]
77. …rep…
78. I know…
79. In the poem it is written with repeated lines and ... what else it was… [4. Analyze – 4.2 Organizing]
80. ... and repetition… [6. Create- 6.1 Generating]

Sequence 2: Extract from pre-test transcript indicating thinking skills.

In sequence 2 the discussion starts a new thread and opens with a request for an evaluation. There is no consensus on a suggestion and a participant is asked to start writing in the multimodal mapping programme. This generates organizing and parsing activity, which results in the generation of ideas relating to the opening request. The contributions are rated

according to the ability of the researcher to align contributions with the descriptors and identifiers in the cognitive thinking skills framework.

FINDINGS

Does using ICT-based multimodal mapping improve the quality of learning dialogues during the compositional process?

The concept mapping component analysis suggests a small increase in proposition formation in mapping, an indicator of higher-order thinking. In conjunction with the cognitive thinking skills data of an increase in use of higher-order thinking skills, this provides some indication that the quality of talk using ICT-based multimodal mapping is improving.

Findings from the social modes of thinking analysis show a similar frequency of exploratory talk, a decrease in disputational talk and an increase in cumulative talk frequency in the consolidation phase, suggesting there are some limited positive effects.

The social modes of thinking data does indicate some increase in agreement in talk, but this may also reflect passivity to the task not indicated in the transcripts, a form of Hawthorn effect. The discrepancies between thinking skill scores and social modes of thinking scores in the expository writing tasks suggests that task variables such as inherent 'cognitive load' (Sweller,1994) may have a larger role in framing learning dialogues and preparation for such tasks has been shown to have an important impact (Wegerif,1996; Mercer et al., 2004).

The findings suggest that using ICT-based multimodal mapping in compositional activities increases the incidence of higher-order thinking during the compositional process and this corresponds with the concept mapping connectivity data. The concomitant increases in concept and propositional transfer from talk into writing and limited increase in the connectivity of the concept mapping suggests that using ICT-based multimodal mapping may enhance the quality of thinking of compositional ideas in group talk. However, attributing the impact of using ICT-based multimodal mapping may be described as weak, since differences were of a small magnitude and do not indicate a significant social development during the learning dialogues.

Does using ICT-based multimodal mapping increase concept and propositional transfer from learning dialogues into writing?

The data suggests that ideation in talk is reciprocated in concept mapping and in writing and increases in the consolidation phase. There is the transfer of similar ideas from talk and concept mapping into writing and an example of this is appended. The mean proposition and lexical concept frequency is higher in the consolidation phase in writing and an increase in talk-generated ideas supports the suggestion that learning dialogues with ICT-based multimodal mapping may enhance transfer of ideation into writing.

The findings suggest that using ICT-based multimodal mapping in compositional activities increases lexical concept and propositional transfer from talk into writing and tentatively suggests that the dynamic interactions between the group talk and resulting concept mapping enhances propositional transfer from talk to concept mapping and into writing. The issue of attributing effects to the use of ICT-based multimodal mapping is still difficult due to other effects that may be active within the classroom setting. One observation that is important to describe, and is evident in the transcripts, is the sequential repetition of certain sentences obviously intended for written text. This suggests that the mapping of compositional ideas is generating 'oral rehearsal' of compositional ideas. It may well be that the graphic modelling of ideas stimulating 'oral rehearsal' rather than critical learning dialogue may be affecting transfer of ideas from talk into text. More work needs to be done in the next stage to reduce the effect of the other variables and achieve a more robust result over time with larger numbers.

However, overall the research suggests that using ICT-based multimodal mapping has no negative effects in improving the quality of learning dialogues in expository writing tasks and may have some beneficial influences.

CONCLUDING THOUGHTS

This exploratory study suggests that the use of ICT-based multimodal mapping provides an additional learning tool in the classroom and offers opportunities to develop speaking and listening strategies that promote learning dialogues. The introduction of this strategy requires whole class teaching to model and demonstrate how processes can be used in individual, paired and group learning situations. The use of group collaborative mapping then becomes a routine particularly if laptops are available and hardcopies can be printed off immediately as a writing scaffold or for further individual development using pen or pencil. The concept maps become more orderly and more easily followed providing a better structure from which to draft reports. None of the other multimodal tools available on the software were used in the groups as the focus of the study was to generate ideas for writing.

I have already established that the generation of keywords is important in the utilisation of ideas (Riley, 2006). So the study was confined to using text and graphics only. The use of images and hyperlinks would also generate their own range of interpretative problems. The issues created by using only lexical concepts shows how difficult it can be to attribute effects and to isolate affects in this type of study. Using images and icons would increase the complexity of this task and reduce the ability to analyse a larger sample since individual maps would require greater time for analysis. However, there will be mileage for teachers who want to consider the progress of individuals and groups in a formative assessment environment.

What the study does clarify, however, is that the use of ICT-based multimodal mapping facilitates new dimensions in the representation of understanding using the multimodality of new digital media. The focus on learning that this generates in children appears to be greater than can be achieved with pencil and paper. In addition, the instant presentation, revision and storage of maps facilitates a risk-free environment where creativity and

exploration of ideas and knowledge can be discussed with developing coherence and effectiveness.

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Nigel Riley

Biography (PDF format)

Correspondence: Nigel Riley, nrriley@hotmail.com

APPENDICES

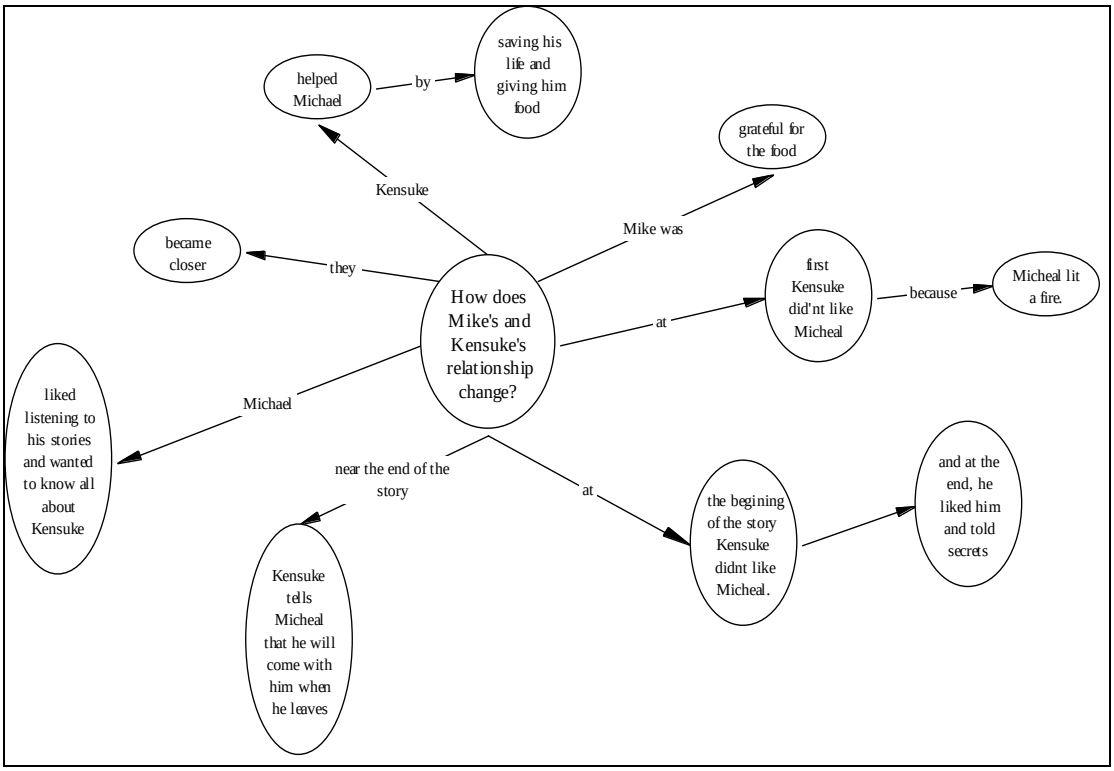
Example of concept and proposition tracking

Appendix 1 Concepts and propositions formed in Blue group post-test discussion.

Concepts and proposition formed in talk
When they first met they didn't like each other.
When they first met, Kensuke helped him.
They met when Kensuke dragged him out of the water because he did.
He felt sorry for him so he left him food.
Yeah, but he might have liked him at the beginning because he didn't know anything about it.
He (K) was intrigued by him.
He didn't know who he was.
He didn't like him because he destroyed his fire.
He pulled him out of the sea.
He was in the sea and then he woke up on the beach.
He thought that he had drowned, and he was holding onto the football and he thought that he had died.
First Kensuke didn't like Michael.
Michael was grateful of Kensuke because Kensuke gave him food and Michael was grateful.
Michael lit a fire.
Michael wanted to know everything about Kensuke.
He liked all Kensuke's stories.
He is supposed to be secret.
His kingdom is supposed to be secret.
Michael is on his kingdom so he's telling Michael.
He don't want no visitors.
The relationship changed during the story.
They got off the ship right, went on Kensuke's Kingdom.
He tells Michael his stories.
There's Orang-utans there.
They can listen to Kensuke.
Yeah, they're not really going to tell a human being are they.
Kensuke decides that he's going to go with Michael back to the mainland to find out about thingy.
K tells Michael that he will come with him when he leaves.
The hunter men come and they shot the mother.
They take babies from the orang-utan.
Yeah, but they killed the parents first.
What they do is they bring the parents down to the sandy bit and the babies follow and they take them away.
They all go into a cave.
He had to help them because they went into the cave or something and they had to shoo away the birds.
He showed Michael the turtles going into the sea.

Bold type shows the propositions transferred into writing which are underlined in the text below. These can be compared to the propositions in the concept mapping.

Appendix 2 Concept map formed during Blue group post-test discussion.



Appendix 3 Example of text formed from Blue group post-test concept map.

How does Mike's and Kensuke's relationship change? By Natasha.

At the beginning of the story (or the part where Michael meets Kensuke) Kensuke doesn't like Michael because Michael lit a fire. Kensuke then told Michael the rules that he had to follow. When Kensuke catches Michael making another fire he smashes the piece of glass that Michael was using to make the fire. Michael then becomes angry with Kensuke and breaks the rules that Kensuke had told him to follow.

From then onwards Michael and Kensuke become more friendly until Kensuke tells Michael about his life and shows Michael the turtles.

After a while their relationship becomes even better and Kensuke tells Michael that when Michael leaves the island Kensuke will come with him. I think that this is a true act of friendship.