

Towards a Dialogic Understanding of the Relationship between CSCL and Teaching Thinking Skills

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Abstract. This paper reviews the literature linking information and communications technology (ICT) to teaching thinking skills and advocates a dialogic framework which has implications for practice. The computer supported collaborative learning (CSCL) movement is critiqued for not always taking into account the radical implications of the concept of ‘dialogic’ which is the idea that meaning-making requires the inter-animation of more than one perspective. It is argued that dialogue and dialogic is the key to ‘learning to learn’ and other higher order thinking skills and that the unique features of ICT particularly suit it to inducting learners into learning dialogues and to the deepening and broadening of dialogues as an end in itself.

Keywords: Affordances; CSCL; Creativity; Dialogic; Learning to learn; Thinking skills.

INTRODUCTION

From its inception the use of computers in education has been linked to the teaching of thinking skills. However the relationship between computers and teaching thinking has been conceptualised in a range of different ways. Initially computers were seen as teaching machines programmed to directly instruct students in content and skills. Papert and others responded to this with a constructivist learning theory and software that could serve as tools and environments for actively learning thinking skills. Both these movements tended to focus on individual learners. In the last two decades there has been a development of research on computer supported collaborative learning (CSCL) drawing on various theoretical sources including socio-cultural theory and situated learning theory. In the CSCL movement there is considerable interest in teaching group thinking skills in the form of computer mediated collaborative problem-solving and argumentation. This paper argues that a truly ‘dialogic’ perspective could clarify the relationship between information and communications technology (ICT) and teaching thinking in a way that can guide practice within the field of CSCL. This dialogic view shares with socio-cultural theory the idea that individual thinking skills originate in mediated dialogues, however it goes further in claiming that it is not the appropriation of tools but induction into dialogue which is the primary thinking skill, reconceptualised as ‘learning to learn’, with all other thinking skills following from this induction. This perspective suggests that the main role of technology in teaching thinking skills should be to open and maintain dialogic spaces in which different perspectives co-exist and inter-animate each other.

In order to develop this argument the paper begins with a brief account of thinking skills and a recapitulation of some of the main positions relating thinking skills to ICT.

THINKING SKILLS AND ICT

‘Thinking skills’ and related terms such as ‘learning to learn’, are used to indicate a desire to teach processes of thinking and learning that can be applied in a wide range of real-life contexts. The list of thinking skills in the English National Curriculum is similar to many such lists in including information-processing, reasoning, enquiry, creative thinking and evaluation. While some approaches to teaching thinking treat such skills as separate, other approaches treat them all as aspects of high quality thinking or ‘higher order thinking’. Higher order thinking is said to be complex thinking that requires effort and produces valued outcomes (Resnick, 1987). In practice thinking skills programmes do not all focus on the narrowly cognitive but promote a variety of apparently quite different kinds of things including, strategies, habits, attitudes, emotions, motivations, aspects of character or self-identity and also engagement in dialogue and in a community of enquiry. These ‘thinking skills’ are not united by any single psychological theory. The only unity they have is that they are all those sorts of things that practitioners believe can and should be taught or encouraged in order to improve the perceived quality and/or the effectiveness of their students’ thinking. (Wegerif, 2003)

Surveys of the use of computers to promote thinking skills (e.g. Hughes, 1990; Underwood and Underwood, 1990) draw a sharp distinction between the use of computers as a tutor to teach thinking skills and the use of computers as a tool in order to develop skills indirectly. According to Solomon (1987) these conceptualisations, computer as tutor and computer as tool (from Taylor, 1980) are reflections of two traditions in educational psychology: the Behaviourist/Empiricist tradition that conceptualises learning as acquiring and applying associations and the Cognitivist/Rationalist tradition that conceptualises learning as acquiring and using conceptual and cognitive structures. In the handbook of educational psychology Greeno, Collins and Resnick (Greeno, et al 1996) re-iterate this distinction and also outline a third, more recent, strand which they refer to as the Situative/Pragmatist-Sociohistoric tradition, conceptualising learning as becoming attuned to constraints and affordances through participation. This third tradition, essentially the socio-cultural tradition referred to by Koschmann (2001), has become an important influence in studies of ICT in education (see, for example, Crook 1994; Littleton and Light 1998). However, as Greeno et al point out, the idea of thinking skills that transfer from one context to another is highly problematic in the participative paradigm and on the whole this tradition of research has avoided the question of teaching general thinking skills in favour of studies of how learners appropriate local and situated cognitive skills (e.g. Rogoff et al, 1991). The approach of locating thinking skills in types of dialogue that is proposed in this paper and elsewhere (Wegerif, 2004a), could be seen as an attempt to extend the participative paradigm to include a better understanding of how general thinking skills can be taught.

Computer as tutor

The earliest conceptualisation of the role of computers in teaching and learning, saw the computer as a kind of teaching machine able to directly teach not only content knowledge but also some general thinking and learning skills. This conceptualisation, building on the mechanical teaching machines built by Skinner and associated with the work of Suppes (1979) is linked to the behaviourist tradition in psychology. Although it tends to be applied to drill and practice software teaching what Bloom (1956) would call 'lower order' skills such as basic arithmetic, it can equally be applied to teaching what Bloom would call 'higher order skills' such as making effective generalisations. Gagné's instructional design principles recommend breaking down desired learning outcomes into a learning hierarchy with more complex skills resting on simpler skills (Gagné et al, 1992). To support 'transfer' he recommends, for example, providing practice of that skill in a variety of contexts with feed-back and assessment. This approach has been applied directly to teaching general thinking skills using reasoning test problems as the content to be taught (for example, Riding and Powell, 1985)

Computer as providing 'mind tools'.

Papert applied constructivism to the role of computers (1981, 1993) advocating the use of programming and other active modelling environments to support learning (where learning is seen as the active construction of meaning).

Underlying Papert's work is the theory of Jean Piaget and its distinction between 'concrete' and 'formal' thinking. Papert regards the computer experience as a way of making concrete and personal the abstract and formal:

... it is not just another powerful educational tool. It is unique in providing us with the means for addressing what Piaget and many others see as the obstacle which is overcome in the passage from child to adult thinking. I believe that it can allow us to shift the boundary separating concrete and formal.

(Papert, 1981, p. 21)

This exciting insight inspired many educational technologists and constructivism is probably the dominant paradigm in the design of educational multimedia (Boyle, 1997, p83). The main idea of Jonassen (2000) and others in this tradition, (e.g. Underwood and Underwood, 1990; Salomon et al, 1991), is not that computers will directly teach thinking but that, after working in partnership with computers, the students will internalize the way that computers think as a cognitive tool for their own use.

Computer Supported Collaborative Learning.

In a ground-breaking book entitled 'Understanding Computers and Cognition' (1987) Winograd, one of the leaders in Artificial Intelligence research, and his co-author, Flores, convincingly criticised the view of minds as symbol processing machines like computers. They argued that that computers do not help us think by mimicking human intelligence but that they can support those human practices, particularly communicative practices, in which cognition is embedded. Crook (1994, p 67) argues similarly that computers are not capable of sustaining the kind of intersubjectivity that teaching and learning requires but that they have a potential role in resourcing and supporting collaborative learning. Although their arguments have similarities, they reference different

intellectual traditions. It is interesting that Winograd and Flores (1987) refer to Heidegger frequently and Vygotsky not at all while Crook (1994) refers to Vygotsky frequently and Heidegger not at all.

The development of a focus on computer supported collaborative learning (CSCL) has been marked in the last decade with new CSCL societies, conferences and publications. Numerous and varied intellectual sources are referred to by writers who situate themselves in this new CSCL tradition. Koschmann refers to CSCL as a new paradigm in instructional technology research defined through socio-cultural theories of learning (Koschman, 2000), but writers in CSCL also draw on Hermeneutics (e.g Stahl, in press), situated learning theory, distributed cognition, social constructivism, Bandura's social learning theory (Ravenscroft, 2003), phenomenology (McConnell, 2000) amongst other sources.

While some of the claims for the coherence of CSCL as a new paradigm might be exaggerated nonetheless there is clearly a focus on social rather than individual learning that distinguishes this new approach from both the behaviourist and the cognitivist/constructivist traditions that underlay previous approaches to ICT and teaching thinking. Most writers in the CSCL tradition refer to the ideas of educational psychologist Vygotsky to provide intellectual authority for a turn towards the social dimension of learning. Vygotsky is often presented as providing a psychological version of Marx's claim that individual thought is a product of the social and historical context (e.g. Edwards, 1996, p43). In particular Vygotsky claims that language is a tool-system that mediates thought and the development of thought. If language can play the role of a cognitive technology mediating and supporting thought then this implies that so too can other technologies of communication. Vygotsky claimed that the higher mental faculties, including reason and creativity, are internalized versions of forms of social interaction. Some neo-Vygotskians move from this to focus on the forms of interactions themselves as embodying higher order thought (Mercer, 2000). In the CSCL literature the idea of information and communications technology is intimately connected with the idea of teaching thinking in the form of social interactions such as argumentation and collaborative problem solving.

The roots of the enterprise of teaching critical thinking are not necessarily individualist. Dewey, an advocate of teaching thinking, saw thinking as at least in part a product of social interaction and teaching thinking as a way of contributing to the creation of a better society (Dewey, 1933). This is reflected in statements from leaders of the applied teaching thinking movement that locate 'thinking skills' in dialogues and in communities of inquiry (Paul, 1987; Lipman, 2002). Habermas (1991), has argued that rationality implies the ideal of a more genuinely democratic society in which all relevant voices are really listened to and decisions are taken on the basis of convincing arguments rather than on the basis of coercive power. One educational implication of Habermas's argument is that teaching thinking skills involves changing the social context to create conditions that approximate to what he calls an 'ideal speech situation'. There have been a number of claims that the structural properties of CMC, the ease with which anyone can 'take the floor' and the possibility of multiple threading, for example, make it a better medium for an 'ideal speech situation' than face-to-face dialogue (Graddol, 1989; McConnell, 2002). There have also been suggestions that new technology could serve to support better collective thinking in institutions such as schools and in society at large (Selwyn, 2003).

TOWARDS A 'DIALOGIC' PARADIGM

The term dialogic is now used quite loosely for anything pertaining to dialogue in education. This misses an opportunity to make a more radical and useful distinction between truly dialogic and essentially monologic approaches. In the next sections I turn to communications studies and philosophy to outline the true nature and potentially radical significance of dialogic.

The approach to dialogic from communication studies

One source for the dialogical paradigm in the social sciences is the writings of Rommetveit (1992) and Linell (2001) which systematically compare dialogical assumptions with monological assumptions. The monological paradigm, still very much the dominant paradigm in all areas of science, seeks a reduction to a single perspective – its aim is a stable and settled 'truth' in the form of a representation of some kind. Both Rommetveit and Linell argue that, while monologism is clearly very useful in some contexts, it needs to be understood within a deeper and broader dialogical framework. Two key assumptions of this framework can be stated as:

- any communicative act is interdependent with other acts, it responds to what has gone before and anticipates future responses; it is similarly 'in dialogue' with other aspects of context such as the social setting
- meaning does not exist 'ready-made' beforehand but is always constructed in dialogues (which may well be the internal dialogues of thought).

(For a more detailed account of the assumptions of a dialogical paradigm in the context of communication studies see Linell, 1998, p 48)

According to Rommetveit, dialogic means not merely that participants in interactions respond to what other participants do but, more dynamically, that they respond in a way that takes into account how they feel other people are going to respond to them. Rommetveit, quoting Barwise and Perry, refers to this circularity as 'atunement to the atunement of the other' (Rommetveit, 1992). Bakhtin (writing under the name Volosinov) makes a similar point writing that the words of the other 'meet our answering words' and continues that meaning 'is like an electric spark that occurs only when two different terminals are hooked together' (Volosinov, 1986, p 102). Elsewhere Bakhtin sums this up by referring to the 'interanimation' of voices in dialogue (Bakhtin 1986). Bakhtin defined dialogue as 'shared enquiry' but the idea that dialogue is 'like an electric spark' and includes the 'interanimation of perspectives' points to an underlying dialogic principle which challenges common assumptions about the nature of meaning and thinking.

The approach to dialogic from Heideggerian philosophy

The various traditions of teaching thinking tend to provide positive views of thinking which assume a principle of identity which is the common sense principle that things are what they are and not other things. To simplify in order to summarise: for associationists thinking involved links between facts, for cognitivists thinking implied some kind of underlying algorithm and for constructivists it required the building of internal 'cognitive structures'. In his later work Heidegger challenged all of these traditions and offered an alternative view of thinking based not upon identity but upon difference. In a lecture, entitled 'Identity and Difference' (Heidegger, 1969), Heidegger contrasted the principle of identity in the history of western metaphysics, a principle he referred to simply as $A=A$, with the idea of ontological difference, which he claimed underlay the possibility of there being identity and meaning in the first place. Meaning, Heidegger claims, depends upon an implicit background of assumptions and practices from which things emerge and against which they stand out (This point is brought out well by Gerry Stahl, in press). We only see 'beings' against the background of Being (they are therefore referred to as 'the beings of Being'); we also only know Being as the background Being behind the things that stand out (as 'the Being of beings'). The ontological difference is the difference between beings and Being which brings both into awareness. Merleau-Ponty (1964), a Heideggerian thinker, describes the emergence of meaning in perception as revolving around an invisible hinge between the foreground and the background. In much the same way Heidegger described thinking, by which he meant creative thought or poesis, as the 'circling (ineinander) of Being and beings around one another' (Heidegger, 1969, p 69). Heidegger's term 'ineinander' is translated by Merleau-Ponty as 'mutual envelopment' and illustrated with the example of the horizon that we form around us simply by standing in a landscape: on the one hand the horizon is formed by us out of our perspective, on the other hand we are located within it.

The exciting departure here, one that was picked up by Derrida in his essay 'La Différance' (Derrida, 1968), as well as by Merleau-Ponty in his later work, is the realization that meaning making in general is not a product of identity but of difference. One implication is that meaning depends upon a prior invisible and unnoticed differentiating process that carves out identities. The concept of constitutive difference in Heidegger has been related to the Taoist claim that apparent form is a product of the differentiation of an underlying potential for meaning that in itself is 'empty' or 'an uncarved block' (Lao Tze, 1972, especially chapters 1 and 2). Thinking, for Heidegger, involves not accepting any identity or algorithm but 'stepping back' into the unmediated relation described by the ontological difference and through this stepping back allowing thought to occur as 'emergence' rather than as in any way mechanically caused by a thinker who has an object of thought.

The claim from Bakhtin and Linell that meaning originates in dialogues implies that the space of dialogue, or dialogic space, a space of possibility opened up by an initial difference between two people or two perspectives, is a similar principle to the ontological difference of Heidegger and also to Derrida's closely related concept (or, non-concept or anti-concept) of 'différance'.

A developmental link between dialogue and thinking skills

The claim that dialogic is a version of Heidegger's ontological difference only makes sense if we understand dialogue at two different levels, the surface level of actual dialogues and the underlying level or the dialogic principle which is the original opening of meaning. Empirical dialogues do not necessarily exemplify the idea of an opening of meaning, but they have the potential to question and create because of their intrinsic connection to an underlying dialogic principle. This distinction between surface and depth notions of dialogue can also be understood ontogenetically in terms of the first opening of dialogue in early childhood and a later capacity to engage in dialogues. Hobson argues that babies and toddlers first learn to think through being drawn into a dialogic relationship with their mother, or primary care-giver, which enables them to see things from at least two

perspectives at once (Hobson 2002: 1998). Hobson goes on to argue that an individual sense of self-awareness and an ability to think creatively when alone are a product of an internalization of the interanimation of perspectives that occurs in such dialogues (Hobson, 1998). He refers to these dialogues, beginning with peek-a-boo games in the cradle, as opening up what he calls 'mental space', a space of possibilities through which things become thinkable.

Hobson's idea of dialogic as mental space suggests a link between dialogic and thinking skills. Dialogue itself, a capacity to engage in dialogue and to see things dialogically, appears to be the primary thinking skill, a 'learning to learn' skill, upon which all other 'higher order' skills are dependent and from which they are derivative.

Hobson mainly worked with babies up to 18 months. He also conducted experiments with three year olds which found a link between their IQ scores and the dialogic quality of their relationship with their mothers (Crandell and Hobson, 1999). This relationship between dialogic and IQ relates his work to experimental evidence with nine and ten year old children in primary schools that the quality of individual thinking, measured using Raven's non-verbal reasoning tests, (a test that correlates well with IQ) can be improved through improving the quality of dialogue in small group work (Wegerif, 2001; Wegerif, Mercer and Dawes, 1999). This experimental evidence, supports the theory that individual thinking skills, even those measured according to the most traditional tests of intelligence, originate in those kinds of dialogues where we learn to open ourselves to creative play and the interanimation of perspectives, and in which we learn to listen and to be responsible to others in dialogues.

Dialogue with social and historical context

While the socio-cultural perspective and activity theory argue that cognition is embedded in social and historical contexts a dialogic perspective would argue that this is only one half of the story. What counts as social and historical context is an interpretation that is created within and through dialogues. One implication of the assumptions of activity theory is that the social and historical context is a relatively fixed framework in which the distinctions pointed to by Engeström's analytic triangles (Engeström, 2001) are always pertinent, distinctions such as 'subjects', 'objects', 'tools' and 'division of labour' which describe a Marxist materialist world view. However in creative dialogues people can and do categorise the world in multiple ways and these categories then have an impact on their actions. It is only in and through dialogues that history and culture are given meaning, a meaning that is always open to interpretation. In other words dialogues situate and frame history and culture as much as they are situated and framed by history and culture. This circling or mutual envelopment relationship makes it possible for us to challenge tradition and to create new and different understandings. The dialogic principle presupposes that ideas of space, time, history and culture emerge from distinctions made within dialogues, distinctions such as here/there; now/then; us/them, and so that there is an aspect of every dialogue that is in some way unsituated because it precedes and exceeds every attempt to situate it. It is this opening onto an outside of the system which makes it possible to question, think and be creative in the first place.

Dialogic, thinking and technology

From a Heideggerian or *différance* informed perspective meaning is a flow within a field (the circling of Being and beings). Words and other mediations of meaning, do not contain meaning in themselves but they structure or articulate the flow of meaning within a field of possible meaning that is opened or catalysed by the opening of dialogue. The dialogic principle can be characterized, in contrast to the principle of identity, as the interanimation of different perspectives where the difference is seen as generative and essential to meaning and therefore as not reducible to identity.

Heidegger expressed concern that technology 'enframed' possible experience, ordering everything in advance in a way that could prevent a deep flow of meaning. This critique has implication for how we use communications technology. It is hard, for example, to engage in a truly thoughtful dialogue when every move has to be labeled in advance according to a drop-down menu with a pre-set 'ontology' of possible types of thought (e.g. Motto et al, 2000). On the other hand many commentators have noted that Heidegger did not do justice to the empowering potential of technology. Pre-set frames can easily appear constraining but can also offer affordances. Providing students with a menu of openers in a synchronous chat forum looks limiting but can actually serve to deepen and enrich dialogue because of the way in which the software interface enters into online social relations, providing a justification and support for challenges and probes that would not have been made otherwise (McAlister et al, 2004).

It follows from the understanding of dialogic and learning dialogues presented above, that methods which attempt to pin down the exact meaning of utterances in a dialogue are misguided because the meaning depends upon a dynamic context of interpretation which can never be completely closed or finalised. Dialogues do not

only work through exchanging more or less precise meanings but also through opening up a space of multiple possible meanings. Approaches, sociocultural or otherwise, which refer to computers supporting learning through dialogue without acknowledging the dialogic nature of the creative space opened up by dialogue, remain in danger of a reduction to identity thinking. Some researchers study the learning in dialogues in terms of explicit outcomes resulting from explicit mechanisms as if machines without consciousness or creativity could have learnt equally well from the dialogue as humans. Through a reduction to identity such approaches are clearly not dialogic, they miss the ‘opening’ that makes thought possible in the first place. Such monologic approaches can work in some respects but they obscure the important possibility that teaching thinking skills is not only about teaching explicit skills but also about deepening and extending dialogue as an end in itself.

A FRAMEWORK FOR TEACHING THINKING WITH CSCL

Although Vygotsky is not a dialogic thinker his account of internalization and externalization suggests a vision of the how dialogues relate to the learning of thinking skills and of how the teaching and learning of thinking skills is part of a larger social movement of dialogue mediated by technology. Vygotsky famously claimed that the development of higher order thinking resulted from an internalization of social interaction. He was also interested in the creative externalization of thought into speech and into the transformation of social contexts. This combination of externalization and internalization is present from moment to moment in a dialogue as we ‘take on board’ ideas, reformulate and respond to them internally and then express our response in new patterns of signs. It is also true over a larger scale and longer timescale. In any shared enquiry we are not only in dialogue with a dialogue partner, we are also in dialogue with a culture and a tradition.

To picture thinking as a whole circular movement it might help to think of the way that we all, as creative speakers and writers, use words and phrases that we find already here, external to us, in the language around us, and yet we also shape the development of that shared resource of language. Language is a useful example because, following Vygotsky, it is possible to refer to language as a cognitive technology that mediates the circle of thought. If language can be referred to metaphorically as a technology mediating the whole flowing movement of thought the same is more literally true for those information and communications technologies that carry and resource dialogues. The social realm of institutions and culture mediate the whole flowing movement of thinking. This makes the picture of how to intervene effectively to support the learning of higher order thinking complex but it does suggest three possible moments in the whole circle of thought where interventions could be focused, the moment of internalization, the moment of externalization and the moment of mediation. From a Heideggerian perspective these are limited concepts because apparent internalisation is a part of a larger movement of ‘implication’ in which foregrounds become backgrounds and ‘externalisation’ is not an individual process but creative emergence from the gap between beings and Being. However the more Vygotskian vision of a transformatory circle of internalization, externalisation and mediation is helpful in making a link between the whole flowing social movement of thought and the teaching of thinking. Most approaches to teaching thinking have focussed on the movement of internalisation when cognitive tools move from the social to become appropriated by the individual. It could equally make sense to support the moment of externalisation when collective thought is creatively transformed or to intervene to improve the cognitive affordances of the technological mediation of shared thinking.

The particular strengths of ICT for education (sometimes called affordances) can be mapped as:

- Speed and Automatic functions: enabling large amounts of information to be handled and routine tasks to be automated
- Provisionality: the ability to change texts and other outputs with minimum cost
- Interactivity: the capacity for feedback and response
- Range: the capacity to overcome barriers of time and distance
- Multi-modality: the capacity to integrate a range of modes of communication including film, graphics, sounds and texts.

(adapted and expanded from Loveless, 2003). A dialogic perspective suggests a number of principles that can be used to guide to the analysis, design and practice of CSCL. In particular it suggests that these features and potentials of ICT can be applied to effectively induct students into dialogues, to deepen and broaden dialogues and to support all stages of the whole circling movement of thought.

Scaffolded induction into dialogues

Provisionality can support reflection and the development of joint ideas through products, including texts and other artefacts, that are not as ephemeral as speech and not as apparently fixed and changeless as print. Interactivity can be used to provide contingent support for dialogues, even the simple prompts, ‘what do you think?’ and ‘why do you think that?’ in the right place can have a profound effect on learning (Wegerif, 2004b).

Interactivity makes it easy for software to simulate multiple points of view in a dialogue thus allowing learners to be inducted into a field of dialogue rather than into fixed 'truths'.

Deepening and broadening

Range and speed allows ICT to expand dialogues to almost every corner of the world and to include almost every perspective on any given question. Broadening can be done through the use of the internet to exchange in real dialogues about global issues. An illustration of this is Oxfams 'tv.oneworld.net site', where video stories from across the world are exchanged and discussed. Broadening in the classroom can be done through structured web-quests where an issue is posed and learners are sent to different web-sites to explore it. With the right pedagogy this broadening potential of internet dialogues also becomes a deepening as students are led to become more reflective and dialogic through the encounter with difference.

Multi-modality

Dialogues consist of a relationship between people or perspectives framing a flow of meaning. This flow of meaning is focused and articulated by signs and communications technologies but not in any way reducible to those signs or technologies. Unlike versions of the socio-cultural perspective which tend to reduce thinking to the use of particular cultural tools, especially concepts and language structures, (e.g Wertsch, 1998) this dialogic understanding provides us with a way to appreciate how different modalities of representation can work together and how different levels and types of dialogue can be integrated into flows of meaning. For example when groups of children talk together to create emails that they send to other groups of children who talk together to interpret them (Van der Meij et al, 2004) then the written email dialogue needs to be interpreted in the light of the oral dialogue. The multi-modal dialogue made possible by ICT with video conferencing and audio conferencing as well as collaborative graphics and music, allows the interesting possibility of dialogic interaction between different representations of meaning as well as between people and perspectives. According to the dialogical paradigm, understanding occurs more through appropriating the gaps between tools than through appropriating the tools themselves.

Internalisation/implication

Vygotsky's idea of how teachers work through a 'zone of proximal development' to help learners acquire new skills refers to the moment of the internalisation by individuals of pre-existing cultural tools mediated by the scaffolding work of tutors. To give an example, the strategy of thinking up a range of alternative possible answers to a problem set could be modelled in group dialogue using concept-mapping, mediated by a tutor, and appropriated by an individual who is then able to use the same strategy alone with and without a physical external concept map (e.g Roth and Roychoudhury, 1994). The concept of implication goes beyond this to also account for embedding into the environment of thinking, for example technologies such as calculators that become ubiquitous and pervasive can augment and develop thinking without internalization of any kind occurring.

Mediation

Although the primary relation between self and other which makes dialogue possible is not mediated the thinking that emerges out of that difference is mediated. Internalisation and externalization, as well as implication and expression, are always mediated, and the affordances of the mediating technology can sometimes be addressed directly as a way of improving the quality of collective thought. The educational technologist can work to improve the affordances for clear and productive thinking provided by the conferencing system or software interface that mediates collaboration. A simple example of this is to provide effective tools for decision making and the shared visualization of relevant information. Once we see thought as not individual or collective but as a larger dialogue or whole flowing movement uniting these two moments then we can see that attention to mediating technologies is also part of teaching thinking.

Creative expression

An individual or group's capacity to participate in shared social dialogues can be supported through the use of technology. There are many ways in which ICT can augment and support creative expression from word-processors through to web-sites. Cobb and McClain illustrate how visualisation tools that allow users to grasp and manipulate complex statistical relationships can empower learners to participate in dialogues about public policy (Cobb and McClain, 2000). This form of empowerment enabling expression and participation, is also a way of improving the quality of individual and collective thinking.

DISCUSSION AND CONCLUSIONS

In 'What calls for thinking' Heidegger writes: 'the proper teacher lets nothing else be learned than – learning.' (1978, p380). This paper is not quite so extreme in its claims. There are many things to learn and many ways to learn them. However the paper does argue that one of the most essential and important things to be learnt, how to learn through engaging in dialogues, has been overlooked. The dialogic understanding of thinking and of learning to think that is sketched in this paper is not intended to replace monologic accounts of thinking and of learning to think but to augment them. Many of the claims about the way ICT can support thinking made in this paper could also be made from constructivist or socio-cultural perspective. However a truly dialogic perspective goes further than these perspectives in providing justifications for the argument that the aim of teaching thinking should not only be the development of specific cognitive techniques and technologies but also developing dialogue as an end in itself. Dialogic has been presented as a principle of non-identity and the inter-animation of perspectives but paradoxically this is a principle that individuals and organizations can learn to identify with more. The extent that individuals and organizations become more dialogic is the extent to which they learn how to learn. The meta-skill of 'learning to learn' is one upon which all other higher order thinking skills depend and from which they are derivative. This paper argues that a dialogic perspective fits with CSCL because the strengths of ICT in education are particularly suited to inducting learners into dialogues and to deepening and broadening those dialogues. The dialogic framework put forward for understanding the relationship between CSCL and teaching thinking suggests that we need to teach dialogue as an end in itself and also that higher order thinking should be understood as a circling movement uniting individual with social thinking, implicit background thinking and explicit signs, and combining different levels and type of dialogue within a flow of meaning. At least three further implications for practice follow from this framework: firstly, that rather than focus only on the moment of internalisation or on the moment of expression or the technological mediation of thought, to teach thinking effectively it is best to support all three moments of the circle of thought in a coherent way: secondly, that to have a maximum impact on the quality of thinking we should look at ways to support the integration of different levels and types of dialogue, perceptual, oral and written modes for example: and thirdly, that we should design for creativity and a resonant relationship with the foreground and background of thought rather than try to use design 'ontologies' that pre-define what can and what cannot be expressed.

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