# LEARNING AND TEACHING FOR UNDERSTANDING: THE KEY ROLE OF COLLABORATIVE KNOWLEDGE BUILDING

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# **INTRODUCTION**

In this chapter, I wish to explore the role of language – and of meaning-making practices more generally – in promoting students' learning in all areas of the curriculum.<sup>1</sup> As might be expected, I shall give some attention to reading, broadly conceived, since acquiring information from books, maps, diagrams, and texts of all kinds, plays an increasingly important role in education as students increase in age (Kress, 1997; Lemke, in press). I shall also devote some attention to writing – in non-narrative as well as narrative genres – as, with Langer and Applebee (1987) I believe that it is in the writer's dialogue with his or her emerging text that an individual's understanding of an issue or topic is most effectively developed and refined.

However, meaning making is not restricted to interaction with texts. It can certainly also occur in design work, both aesthetic and practical (Smagorinsky, 1995), and in planning and carrying out experiments, surveys and other forms of empirical investigation. But, most importantly, it is taking place almost continuously in almost all classrooms, in the various kinds of talk that constitute or accompany the vast majority of activities. Some twenty years ago,

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it was calculated that, in a typical classroom, somebody is talking for at least two thirds of each lesson, and that two thirds of that talk is contributed by teachers (Flanders, 1970). Clearly that estimate needs to be qualified according to subject and grade level and will probably need to be radically revised for those classrooms in which group work for different purposes constitutes a significant form of activity. Nevertheless, until recently, the talk through which learning and teaching is enacted was treated – like water by fish – as transparent and taken for granted. It was therefore rarely considered as a matter for serious investigation or as a domain deserving efforts at improvement.

My argument will be, therefore, that, first, we need to give adequate recognition to all the modes of making and representing meaning through which the activities of learning and teaching are enacted and that, second, of these, talk in particular deserves sustained attention. This is because, as I have suggested, it is the medium in which meaning is most readily and ubiquitously negotiated. It is also, I believe, the foundation of a social constructivist approach to education. Before continuing, therefore, I need to justify this latter claim.

# THE SOCIAL CONSTRUCTION OF MIND: A VYGOTSKYAN PERSPECTIVE

The term "social constructivist", used in the title of this book and in several of the chapter titles, certainly identifies some key assumptions that all the authors share. For example, there would be general agreement that knowledge is constructed by individuals through an active relating of new information to their personal experience and their current frameworks for making sense of that experience. There would also be agreement about the ineluctably social nature of knowing and coming to know, if only because, in John John Donne's memorable words, "No man is an island ... " Therefore, although we each construct our own knowledge, we do so in the context of activities carried out in conjunction with others - in the family, the community, and in public institutions such as school, church and workplace. More disputable is the status of any particular item or body of knowledge. Some would make a distinction between 'public' knowledge and 'personal' knowledge - between 'what is known' and 'what I know' - treating the former as independent of individual knowers. For others, by contrast, the relativity of all knowledge seems to be an inescapable implication of acceptance of the fact that knowledge in any domain is constructed and reconstructed by countless unique individuals who occupy different locations in time and space and belong to different cultures that have diverse worldviews and systems of values (Chinn, 1998).<sup>2</sup>

A somewhat similar divergence also occurs with respect to learning and teaching. While there is a considerable degree of consensus about social constructivism as a theory of *learning*, when it comes to a social constructivist theory of teaching, on the other hand, there is probably much less agreement. Or at least there is disagreement about what such a theory might look like in practice and, indeed, whether it is appropriate to talk about social constructivist *teaching* at all. This latter position is the one that I believe follows from the conception of learning-and-teaching that is at the heart of the cultural historical activity theoretical (CHAT) approach to education, which has been derived from the work of Vygotsky (1978, 1981, 1987), Leont'ev (1978, 1981), Bakhtin (1986) and those who have developed their seminal ideas.

There are a number of key tenets of the CHAT approach:

- Purposeful collaborative activity is both the setting and the motivator for the interactions through which learning and development occur, both on the time-scale of cultural history and that of individual life trajectories.
- Such activities are always uniquely situated in space and time and are mediated by the particular cultural resources available, both the material and semiotic artifacts that are to hand and the practices in which they are deployed. They are also mediated by the knowledgeable skills of the human participants.
- Meaning making is an essential aspect of all activity, both mediating participants' actions and giving rise to semiotic artifacts in which the knowledge and skills developed in and through the activity are embodied for use as resources in future activity.
- From this perspective, learning can fruitfully be conceptualized as appropriating and personally transforming the knowledge and skills enacted in such activities, and developing the dispositions to use these resources responsibly and effectively to contribute to further projects of personal and social significance.
- Learning requires the assistance of other participants who both model the knowledgeable skills involved in activity and guide the learner toward independent mastery.
- Because new learning always builds on personal prior experience, individuals construct different meanings from the same event. Starting from different cultural niches, individual learning trajectories are therefore both diverse and unique, as are the identities that are formed over time. This diversity constitutes a rich resource within society, both for creatively meeting new demands and for challenging and transforming the status quo.

I have spelled out these tenets and their implications in considerable detail elsewhere (Wells, 1999, 2000, 2001), so here I shall focus only on those that help to clarify the role of teaching in a CHAT approach to education.

Fundamental to this approach is that teaching is construed as providing developmentally oriented assistance that enables learners to achieve the goals that they themselves have set or have taken over and made their own. Ideally, it is this 'ownership' that provides the major motivation for the "learning that leads development" (Holzman, 1995). Vygotsky (1978, 1987) proposed the metaphor of the "zone of proximal development" (ZPD) to characterize this conception of teaching. Teaching occurs when a more expert member of a culture assists a learner by managing the overall organization of a task to the extent necessary to enable the learner to participate within his or her current ability, and by providing guidance and assistance with those aspects that he or she cannot yet manage unaided. In recent years, the term "scaffolding" has been used to refer to such assistance when offered with a tutorial intention (Wood, Bruner & Ross, 1976; Cazden, 1988). However, the corollary of scaffolding is that its purpose is to enable the learner to manage without assistance in the future and to take over responsibility for all aspects of the task (Maybin et al., 1992). At the same time, it should also be emphasized that it is not only adults designated as 'teachers' who provide assistance in the zpd. Participants in a joint activity of any scope and complexity nearly always differ in their knowledgeable skills and so can both assist others and learn from them with respect to the different tasks involved. On many occasions, too, it is recognized that no-one has the answer sought or a solution to the problem involved but that, by working together, an outcome can be achieved that is superior to what any individual participant could have achieved alone.

However, the responsive support of individuals or groups of students is not the teacher's only responsibility – important though this is. There is also the responsibility for planning and organizing the sequence of activities through which students are brought into contact with the 'content' of the prescribed curriculum, and presented with tasks that challenge them to "go beyond themselves" (Vygotsky, 1987) in developing new interests, skills and understanding and in making connections between the new information and what they already know. For this reason, I have suggested that it is helpful to think of teaching as taking place on two levels. On the first level, that of 'curriculum manager', the teacher's responsibility is to manage and evaluate the learning trajectory of the class as a whole and, on the second, it is to work with individual students or similarly performing groups and to provide them with assistance that is responsive to their individual needs and appropriately pitched in their zones of proximal development (Wells, 1999). The challenge,

of course, is to carry out the first responsibility in such a way that it allows the opportunities necessary to fulfill the second.

A second consequence of adopting the CHAT approach is that due recognition is given to the situated nature of all activities, both in relation to the cultural and historical settings in which they occur and to the life trajectories and current identities of the individual students who make up the class community. From this it follows that it is inappropriate to think that the prescribed curriculum can or should be realized in the same way in all classes at the same grade level. If one takes seriously the need to build on what students bring to their encounters with curricular material as a consequence of their diverse cultural backgrounds, individual previous experiences, and current strengths and interests, it is clear that the activities through which the curriculum is enacted will differ, both in organization and in outcomes, according to the unique characteristics of each classroom community.

It was because of these considerations that I earlier doubted the appropriateness of talking about social constructivist teaching for, if the goal of teaching is to assist and guide learning, the form that teaching might ideally take on any particular occasion cannot be determined independently of the particular group of learners that it is intended to assist. Better, it seems to me, is to think of teaching within the theoretical framework provided by social constructivism – and particularly by the CHAT version of social constructivism – as being, not a set of methods, but rather an overall stance with respect to the two levels of responsibility that I proposed above.

# **DIALOGIC INQUIRY**

Seen in this light, I suggest, learning-and-teaching needs to be seen as essentially an enterprise of inquiry that is dialogically coconstructed by teacher and students together. This was the conclusion that was reached by the group of teacher researchers with whom I collaborated for nearly a decade at OISE/University of Toronto. While recognizing that our common 'vision' would be enacted in different practices by individual members, we agreed on the principles that would guide the learning and teaching for which we were responsible. The key components, we suggested, included:

- creating communities characterized by: inclusiveness, equity and caring, as well as by intellectual achievement;
- giving a high priority to knowledge building and understanding through inquiry, while not neglecting the routine processes and skills needed to engage in them;

- encouraging collaboration between teacher and students, as well as among students; valuing and building, whenever possible, on students' contributions to the activity in progress, so that knowledge is co-constructed, rather than unilaterally delivered;
- broadening participants' interests and recognizing and valuing the contributions of 'experts' beyond the classroom; bringing the classroom community into a two-way relationship with communities beyond the classroom (local/world-wide, practical/intellectual) by participating in their practices;
- acknowledging and taking into account that, whatever the activity, the whole person is always involved (body as well as mind, feelings and values as well as rational thinking);
- providing for the growth and self-determination of each individual as well as for the development of the classroom community as a whole.

As will be seen, we placed a strong theoretical emphasis on inquiry. The motivating force for learning that is generated by inquiry is developed at some length in the writings of Dewey (1974) and, while not made explicit in Vygotsky's theoretical work, it has become a key feature of many of the pedagogical developments of his work in recent years (Stetsenko & Arievich, in press).<sup>3</sup> An orientation toward inquiry also has advantages from an organizational point of view since, when students share the responsibility for selecting the topics to be investigated and the methods they will use to do so, the resulting sense of 'ownership' of their activities enables them to sustain their engagement and to develop strategies of responsible collaboration that lead to successful completion. Another important advantage of this approach is that it maximizes the opportunity for the teacher to provide individualized assistance, since less of her or his time and energy need to be given to matters of discipline and control.

In such an approach to the curriculum, language clearly plays a central role. Whether in group or whole class activities, provision is made for multiple occasions of goal-oriented dialogue, or what Bereiter (1994) has called "progressive discourse", in which participants propose, explore and evaluate alternative ideas, explanations and problem solutions and, together, construct the most satisfactory outcome of which they are capable. As he argues when likening classroom discussion to "the larger discourse of knowledge building communities" in the world beyond school:

<sup>...</sup> classroom discussions may be thought of as part of the larger ongoing discourse, not as preparation for it or as after-the-fact examination of the results of the larger discourse. The fact that classroom discourse is unlikely to come up with ideas that advance the larger

discourse in no way disqualifies it... The important thing is that the local discourses be progressive in the sense that understandings are being generated that are new to the local participants and that the participants recognize as superior to their previous understandings (1994, p. 9).

Approached in this way, teaching is no longer seen as transmitting the results of knowledge building activities already completed by distant experts, but as preparing for, encouraging, facilitating, and extending dialogue about curricular-related issues that are of personal interest and concern to the particular community for which the teacher is responsible.

However, it is not being suggested that such episodes of discussion are the only worthwhile learning activities. As will be exemplified below, there are occasions when teacher exposition or direct instruction is the most effective way of bringing relevant information into the arena (Bruner, 1990), and guided learning and practice of particular constituent procedures and skills may on occasion be a prerequisite for launching into some new domain of activity.<sup>4</sup> Furthermore, there needs to be opportunity for solo as well as group work. Not only are group or class discussions much more productive when individual participants have thought about, and prepared themselves to contribute to, the issues to be addressed, but it is in such 'dialogue with self' – often in the form of journal entries, written notes, or other permanent representations of their thinking – that they recognize the gaps in their own understanding and, at the same time, more fully appropriate the dialogic genres and strategies that they have encountered in interaction with others.

A third point also needs to be emphasized. While it is in dialogue with others that the significance of activities is made explicit, questioned and clarified, this does not in any way diminish the importance of action itself, as a site for putting understanding to use and for testing conjectures, hypotheses and problem solutions. Indeed, as I have argued elsewhere (Wells, 1999, 2001), the purpose of learning is not to amass knowledge, as in a bank account (Freire, 1970), but to be able to act effectively and responsibly in situations of personal and social import.

## UNDERSTANDING AND KNOWLEDGE BUILDING

I argued earlier that, because of the diversity of participants' cultural origins and individual life trajectories, there can be no universally appropriate method of teaching. It can nevertheless be plausibly argued that, at a rather abstract level, there is a universal sequence to the kind of learning that leads to increased understanding.<sup>5</sup> This I have attempted to represent in the 'spiral of knowing' (Fig. 1).



Fig. 1. The Spiral of Knowing (Adapted from Wells, 1999).

Learning is an inherent aspect of participation in almost all activities except the most routine (Lave & Wenger, 1991) and is continually extended and refined over the whole life-span through particular, situated occasions of knowledge building. Figure 1 is thus intended to represent a spiral progression through many cycles of 'coming to understand.' On each occasion, one starts with a personal resource of interpreted past experience that one uses to make sense of what is new. The new is encountered as 'information', either through feedback from action into the world (Freeman, 1995) or from reading, viewing and listening to representations of the experiences, explanations and reflections of others. However, for this information to lead to an enhancement of understanding – which is the goal of all useful learning – it must be actively transformed and articulated with personal experience through "knowledge building" (Bereiter & Scardamalia, 1996).

Knowledge building can take a variety of forms but all are essentially social and interactional in nature. The aim is to create a common, or shared, understanding to which all contribute, whether overtly or through responding internally to the contributions of others (Bakhtin, 1986). Most typically, this goal is attempted through face-to-face oral discourse (which may, of course, include reference to artifacts present in the situation, such as material tools, diagrams, graphs and quotations from written texts of present or absent authors). In Bereiter and Scardamalia's research, the discourse takes the form of messages written at a computer and posted to a central classroom computerized database,

to which other students are encouraged to respond with questions, objections or confirming evidence (Scardamalia et al., 1994). By contrast, in the Grades 6 and 7 class taught by Karen Hume, a DICEP teacher, the written dialogue is carried on in the medium of messages posted on the 'Knowledge Wall', a notice board that extends along one wall of the classroom (Hume, 2001). Another possibility that is being increasingly exploited is to carry on the dialogue via the internet.

A second desirable feature of knowledge building is that it occurs in relation to an object that the community, or some members of it, are trying to improve. Such an object can take many forms, ranging from a functioning model to a work of art (e.g. a drawing, a story or poem, a musical performance) and from a scientific explanation to a geometric proof, a map or diagram. Such an 'improvable object' provides a clear focus for discussion, particularly if it is a representation of its creators' current understanding and a rationale has to be given for proposing a change. It is also likely to motivate revision, since the effect of making a change can readily be judged for the improvement it brings or fails to bring about.

One question that is frequently asked about such student-led knowledge building is: What should the teacher do if the knowledge that is collaboratively constructed about a particular topic is at variance with the culturally sanctioned knowledge? This is certainly a serious issue, particularly if the students are to be assessed in terms of performance on tests that consider only whether answers are 'correct' or not and that ignore the processes involved in reaching them. One possible solution to this potential predicament is for the teacher to give a group of students the responsibility for ascertaining the points of view of particular experts who have contributed to the larger dialogue within the discipline and for introducing "what Newton (or some other authority) said" into the discussion as one perspective to be considered among others. Another possibility is for the teacher to suggest additional evidence (and where it could be found) that needs to be taken into account for the class to construct as complete an account or explanation of the topic or phenomenon as possible. To be avoided at all costs, on the other hand, is for the authorized version to be presented at the conclusion of the discussion as the 'correct' view, which should replace the collaboratively constructed one, simply because it is authorized.

Rather than teaching students to accept 'what is known' simply on the basis of authority, then, the aim of knowledge building is to help them to recognize that all knowledge of the world in which we live is tentative and open to improvement – that is to say, knowledge is simply the account that currently best fits the available evidence and has not been shown to be false in terms

either of internal inconsistency or of the consequences of actions that put it to the test. Furthermore, since advances in knowledge come from just the sorts of progressive discourse in which students are engaging, they should be encouraged to see that, by being apprenticed into this form of discourse, they can gradually take on the role of expert in their chosen field and contribute to the larger enterprise of creating knowledge that will have consequences for action and, hopefully, for improving the human condition. It is also important that they understand that, in some areas – for example, in relation to ethical and aesthetic judgements or in constructing explanations of complex events with multiple causal influences – there is no single 'right answer' since there are alternative points of view that are equally acceptable.

Finally, it is worth reemphasizing a point made earlier about the extent to which the whole person is involved in learning of the kind we have been discussing here. Learning through participation in collaborative knowledge building is not simply a matter of acquiring more knowledge. It also involves changes in attitudes and dispositions toward the topics investigated and in the knowledgeable skills that such investigations require. In other words, learning, seen as increasingly full and effective participation in activities of interest and concern to the learner, is also a major influence on the formation of his or her identity and self-image and, by the same token, of the ways in which he or she is regarded by others. For this reason, it is important that participation in dialogue be a positive experience for every student. With this in view, students should be encouraged to ensure that all contributions to the dialogue are both formulated as clearly and coherently as possible, and accepted and treated with respect – even if this takes the form of disagreement.

So far, drawing on cultural historical activity theory, I have argued for an approach to teaching that construes the teacher's role as essentially that of assisting learners in appropriating the knowledgeable skills necessary to develop and pursue interests and concerns that are both personally and socially valued. I have also suggested that this role involves two levels of responsibility: that of selecting, organizing and evaluating the activities in which students engage, and that of providing responsive guidance and assistance to enable them to complete tasks that they cannot yet manage on their own. In outlining this approach, I have also tried to explain why special emphasis should be given to dialogic inquiry as the means by which the goals of education can best be met. In the remainder of this chapter, I shall attempt to make these suggestions more concrete by describing particular activities in more detail and by presenting examples drawn from different areas of the curriculum, as these occurred in classrooms with which I am familiar.

# A TAXONOMY OF ACTIVITIES AND PARTICIPANT STRUCTURES

There are many types of classroom activities in which students can be occupied, some more obviously 'constructivist' than others. Rather than comment on each of them in turn, however, I want to sketch a framework that may be helpful to teachers when thinking about which activities to select on particular occasions and for particular purposes. The activities are arranged with respect to two dimensions: their relationship to the spiral of knowing introduced above, and to the participant structures in which they may be appropriately used (see Table 1). Not included, but also very important, are related activities in which students develop and refine the skills, such as observing, reading, writing, measuring, and so on, that are necessary for engaging in these activities. These are not included as separate activities because, in principle, they are best learned and practiced as they are used as means for achieving the goals of the activities in which they occur.

The participant structures in Table 1 will certainly be familiar; they range from a student working alone to the whole class functioning as a single group. The labels given to the types of activity are perhaps less self-explanatory; however, the activities themselves would be recognizable to almost every teacher, even though they themselves may rarely choose them. As mentioned above, they are arranged sequentially (from top to bottom) in relation to the four components in the spiral of knowing: experience, information, knowledge building and understanding. It must be emphasized, though, that it is not envisaged that they would necessarily all occur in any particular curricular unit, nor that those that were selected would occur in the order in which they are presented above. Furthermore, while each of the activities can, in principle, involve any of the participant structures, some of them seem likely to be more effectively carried out in some participant structures than others. With these provisos, I will start with descriptive definitions of the types of activity. Suggestions as to how they might be used with different participant structures will be considered in the section that follows.

# EXPERIENCE

It is a common practice to elicit students' prior knowledge of a curricular topic before introducing new information. Typically this happens in oral mode, with the teacher asking leading questions to the whole class. However, if we take

Type of Activity	Participant Structure				
	Individual Student (solo)	Student + Teacher	Group (2 or more students)	Group + Teacher	Whole Class
Experience					
Recap Relevant Knowledge					
Brainstorm Possible Questions, Approaches, Procedures, etc.					
Plan: Goals, Procedures, Materials, etc.					
Information					
Gather Information					
Obtain Evidence					
Observe, Experiment, etc.					
Knowledge Building		•			
Identify Patterns and Make Connections					
Evaluate Evidence					
Formulate Solution, Explanation, Conclusion, etc.					
Present Interim/Final Results + Receive Feedback					
Understanding					
Reflect on: Current Understanding, Strategies Used, What Next?					

Table 1. A Taxonomy of Curriculuar Activities.

seriously the constructivist principle that knowledge is built on the basis of what learners bring to the encounter with new material, it is important to give them the opportunity to reflect individually on what they already know and to communicate this to others. In the framework developed by the DICEP group, we typically start with a two part activity, which we refer to as 'launching' the unit (Wells, 2001). The aim is to capture the students' interest and to encourage them to make connections to their previous experience.

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## Recap Relevant Knowledge or Experience

In the first part, the teacher presents some form of aesthetic event to the whole class by, for example, reading or telling a story (Egan, 1988) or poem (Wells, 1990) or showing a videotape (Kowal, 2001). Such an event both connects to related events in students' lives and also provides an excellent basis for the forward-looking activities considered below that form the second part of the launch.

The aim of this 'recap' activity is to hear what ideas students spontaneously bring to the topic. Since personal experience tends to be emotionally charged, using it as a 'way in' is likely to provide positive motivation for further exploration of the topic. One possibility, which makes use of the 'solo' participant structure, is to ask students to jot down their ideas, including memories of actual events, in their journals or logbooks (D'Arcy, 1989). These can then be shared orally in small groups or in a whole class discussion. Another possibility is to ask students to work in small groups, listening to the contributions of all members and then preparing a list of key ideas generated within the group that will subsequently be presented to the whole class. An additional possibility that contributes further to student involvement is to designate a wall or table in the classroom on which students can display objects related to the topic that they bring from home, or pictures, books or writings of their own that they think will be of interest to their peers. These can then be referred to, as appropriate, as the unit progresses.

### Brainstorm Possible Questions, Approaches, Procedures

Once student interest has been aroused, it is very worthwhile, in the interests of developing student ownership of the work they are embarking on, to elicit their ideas about questions and issues that would be important to explore. Once these have been listed and refined, suggestions as to the procedures and materials to be used can also be elicited and discussed. On this basis, students can then choose the issues or questions for their individual or group inquiries.

## Plan: Goals, Procedures, Materials

Planning is a natural sequel to brainstorming, as it takes the outcomes of the latter and shapes them into a sequence of tasks to be carried out to reach the chosen goal(s). In part this will probably involve the whole class in deciding on how materials and equipment will be equitably shared and in setting

timelines for the different steps. Part of the necessary protocol for a classroom that works as a community is that groups be ready to report and discuss their own and their peers' investigations at times agreed in advance. Planning also needs to be conducted in relation to the specific issues selected by the individuals or groups who are going to pursue them and it is important that a record be made of the outcomes of this activity, whether by the teacher or a designated member of each group, in a form that can be referred back to as the unit proceeds.

In a unit on technology in a Grade 4 class, for example, one of the DICEP teachers encouraged her students to see themselves as scientists or engineers and, instead of simply engaging in the practical aspects of the activity, to keep a written record of their ideas as well as their actions and results to which they added while engaged in the activity. This proved very helpful to two students whom I observed, as the writing provided a strong incentive to think carefully about what they were doing and why, and enabled them to make a well considered decision about what to make and ultimately to produce an effective working model of a land yacht (Wells, in press). In similar vein, another DICEP teacher insisted that students should make and record predictions about the outcomes of their science experiments before actually embarking on them (Wells, 1997). In both cases, the teacher's intention was to ensure that 'hands-on' work was complemented and enriched by thoughtful 'minds-on' work as well.

## **INFORMATION**

Information is the basic material in relation to which the transactions of learning and teaching are organized. Information is not knowledge, however. Still less does the reception of information automatically lead to enhanced understanding. The problem with the traditional, 'delivery' model is that it tends to ignore – or at the very least to underestimate – the work needed to transform information into understanding. The activities to be described in this section are intended to prepare for, and encourage, this transformation.

#### Gather Information

Although by no means sufficient in itself, there are many occasions in the investigation of a topic when it is necessary to arrange for students to encounter substantial quantities of new information. The medium in which this occurs can vary from whole class presentations in the form of teacher exposition, through media presentation (video, audio) or visits to places of interest such as museums,

field sites and workplaces, to individual reading of printed material of various kinds. Two things are likely to enhance both the intelligibility and the memorability of the new information: the first is for the information to be selected so that it relates to the questions and issues that were proposed during the preceding brainstorming; and the second is for the receivers of the information to have prepared 'pegs' on which to hang it. These pegs can take the form of a list of questions developed from the brainstorming activity or as the nodes in a preliminary topic web which groups or the whole class prepare. As is frequently done in relation to literature, students can subsequently be asked to write a response to what they took from the 'presentation'. This allows the teacher to get a good idea of what was most salient to the students and, where necessary, to take contingent action to correct individuals' misapprehensions or to clarify areas of confusion.

## **Obtain Evidence**

Where curricular topics are approached through inquiry, students can be expected to take a more active role in searching out the information that they judge necessary to answer the questions they are researching, although they will probably need guidance in deciding where to look – which books, reference sources and internet sites to go to as being likely to provide the information they need in a form that they are able to deal with. While individual inquiries should not be ruled out, there are considerable advantages to students working in groups on the same, or related questions. First, when two or three students are searching for the same, or related, information, they can assist each other both in the more mechanical aspects of retrieving it and also in deciding which parts of what they find are most relevant to their purposes. Second, where there is a considerable amount of information to be sought out, the task can be divided among the members of the group, who will subsequently share what they have discovered with their peers.

Searching for information is only the first part of this activity, however. Making notes on the information found, or recording it in some other form, is absolutely essential. As with 'gathering information', it is important that students should prepare some kind of framework into which to fit the information they find; it is also beneficial if they respond to it in some form. (To carry out this phase successfully, students need to be helped to develop good note-taking and other study skills. This is an area in which direct instruction by the teacher may be very beneficial.)

In the Computer Supported Intentional Learning Environment (CSILE) project pioneered by Scardamalia, Bereiter and colleagues (1994), groups of

students select their own sub-topics to research within a broad class theme, such as the functions of different parts of the human body or the opening up of the West (Canada or U.S.A.), and then post contributions based on their research to a central computerized class database. These notes are thus available for all to read and other students are encouraged to respond to them with notes that query or add to those of their peers, or propose theories or evidence of their own <sup>6</sup> A further feature of CSILE is that students can 'rise above' the individual contributions to investigate connections across sub-topics. This form of dialogic writing constitutes a mode of knowledge building, which is what CSILE is designed to facilitate (see 'Knowledge Building' below). A somewhat similar collaborative form of research characterizes the Learning Communities pioneered by Brown and Campione (1994), though in their case without the networked computers. Although the means of evidence collection are very similar, students in classrooms associated with the 'Communities of Learners' project typically take part in 'jigsaw' activities which are designed to ensure that the findings of individual groups are made available to the class as a whole.

#### Observe, Experiment

In many forms of inquiry, the gathering of evidence can go beyond librarybased research. Most natural and social science topics, for example, lend themselves to investigations that involve empirical research. Such research can involve direct observation, as in the study of plants and other living organisms (see Gallas, 1995 for such investigations in Grade 1), experiments, as in chemistry or physics (see Van Tassell, 2001 for experiments in Grade 2), computer-based simulations, for example an investigation of gravity in Grade 6 (Cohen, 1995), or surveys of the experiences, beliefs or value judgments of others, as in the examples described by Roseberry et al. (1992).

As mentioned above, for information and evidence – however obtained – to lead to enhanced understanding, it needs to be transformed by being put to use in some way and the results evaluated and reflected on in relation to the question or issue that is motivating the investigation. This is the phase of Knowledge Building, to which we now turn.

# **KNOWLEDGE BUILDING**

Agreement on the centrality of dialogic knowledge building in intellectual development is one of the most characteristic features of studies of learning and teaching undertaken from a social constructivist perspective (Bereiter &

Scardamalia, 1996; Brown & Campione, 1994; Lampert et al., 1996; Mercer, 1995, in press; Nystrand, 1997; Palincsar et al., 1998; Resnick, 1987). This holds both across grade levels and across subject areas. Two main reasons are given for this emphasis. First, it is argued that it is in and through collaborative knowledge building that students advance their understanding of the topics they are studying. This occurs as they review and evaluate the evidence obtained through the various inquiries they have carried out and attempt to arrive at a consensual description, explanation or solution of the phenomena or issues under investigation. However, while consensus is the goal, it is worked for, not imposed, and the voicing of ideas or experiences that go against the majority or 'official' position is encouraged rather than being treated as disruptive. Both interpersonally and cognitively, it is considered important that students should feel able to voice disagreement, since it is the expression of doubts and differences that advances the understanding of the group as a whole by forcing contributors to reconsider and, if necessary, to modify their own positions with respect to the issue under discussion (Matusov, 1996).

The second reason put forward for the emphasis on such discussion is that it provides the most effective means for enabling students to appropriate the genres in which meaning is made in the different academic disciplines that underlie the subjects of the school curriculum. As Lemke (1990) argues, students can only really learn science by having the opportunity to 'talk science' around topics that really engage them. Here the role of the teacher as model and coach of the relevant genres is crucial; the task is to build bridges between 'everyday' and specialist, or 'scientific', concepts over which students can cross as they develop their identities as members of the relevant discourse communities (Wells, 1999).

These two reasons are not independent, of course; rather they are complementary aspects of the purposeful nature of this form of discourse which, as Bereiter (1994) puts it, to be 'progressive', must lead to understandings "that the participants recognize as superior to their previous understandings" (p. 9). A similar position is expressed by Cobb & McClain (in press) with respect to the learning and teaching of mathematics:

In our view, the value of such discussion is open to question unless mathematically significant issues that advance the instructional agenda become explicit topics of conversation. Conversely, students' participation in substantive discussions can serve as primary means of supporting their induction into the values, beliefs, and ways of knowing of the discipline.

The four activities in this group all contribute to these goals and, in a sense, they form a natural temporal progression. *Evaluate Evidence* and *Identify Patterns and Make Connections* would typically be activities carried out initially

by the students addressing the various sub-topics under investigation. These activities are aimed at sifting and evaluating the information gained through their inquiries with respect to its significance and relevance for the specific questions under investigation The remaining two activities, *Formulate Solution*, *Explanation, Conclusion*, and *Present Interim/Final Results+Receive Feedback*, bring the investigations to an interim or final conclusion in order for the results to be shared with the class as a whole and responded to in a critical but supportive manner. In some cases, the feedback received may lead a group to return to the preceding phases of obtaining and evaluating evidence in order to answer the questions or criticisms leveled at their first report.

So far, we have considered the knowledge building activities in which the groups investigating sub-topics might engage. However, when all the groups have reported, the same knowledge building activities can be conducted by the class as a whole in order to evaluate the degree of fit between the conclusions of the different groups, to determine what conclusions of a general nature can be drawn about the topic as a whole, and to consider what further questions still need to be investigated. This, in fact, constitutes the first part of the final stage in the spiral, which addresses the understanding developed over the course of the unit.

## **UNDERSTANDING**

By its nature, understanding is a criterion of learning that is extremely difficult to evaluate in any absolute manner. First, understanding is not an enduring state that can be reliably measured by decontextualized questions on a test. Understanding manifests itself in further action - in meeting a new challenge, whether in relation to a problem encountered in the world of material action or in the extension or modification of ideas in further dialogue. Perhaps the only clear evidence of an increase in understanding is the recognition that there are still further aspects of a situation or problem that one does not yet understand sufficiently clearly. The second feature of understanding is that it is only genuinely put to the test in specific situations. So, although one may think one understands such concepts as 'justice' or the principles of 'flotation', it is only when faced with a specific, situated problem to which one or more of these concepts seems to apply that one discovers the extent of one's understanding in terms of its utility as a tool in solving the problem. Thus, it is the participants rather than some external evaluator who can best decide whether they have increased their understanding of a topic and in what ways. Furthermore, the understandings achieved will almost certainly be different for different coparticipants in an activity, since individually they start from diverse

experiential bases. Nevertheless, this does not mean that understanding is not a valid aim for learning and teaching. Indeed, as I argued earlier, it is only when understanding has been enhanced that true learning can be said to have taken place.

Given that understanding is a mental action rather than a state of mind, it is to action that we must look to observe its growth. Clearly, it can occur in solo settings, such as when an individual succeeds in solving a problem and recognizes what she/he has learned in the process, or when engaged in dialogue with self or with a text that she/he is writing. However, the situation in which an increase in individual understanding is most likely to occur, particularly in educational settings, is in the course of collaborative knowledge building. Each of the activities already considered in relation to Knowledge Building can lead to increased understanding. However, there is one, in particular, that in my opinion is most likely to achieve this effect.

#### Reflection on: Current Knowledge, Strategies Used, What Next?

In the DICEP model of inquiry, this activity is undertaken to bring a curricular unit to conclusion; however, it can also prove valuable at the end of any of the major constituent parts of a unit. Solo or group work may be undertaken in preparation, but the essential component is the whole class discussion, usually chaired by the teacher, in which an attempt is made to reach a consensus – a common understanding – about what the class knows as a result of the various investigations in which they have been engaged in relation to the overarching theme or topic. It also provides an excellent opportunity for participants to consider the practical and ethical implications of what they have come to know – in what ways they will act differently in future situations to which this knowledge applies. This may also be an appropriate moment to consider how far the group has come to understand the 'culturally accepted' way of thinking about the topic and, if they are in disagreement with it, why that might be the case.

As with all such discussions, while consensus is the goal, it is important to listen to divergent – or even contradictory – points of view and to attempt to see why the differences occur and whether they can be resolved. A key feature of Piagetian theories of intellectual development is the role played by 'cognitive dissonance' in pushing individuals to try to reach a better understanding. The same argument figures in sociocultural theory, where cognitive dissonance is seen as externalized in conflicting claims and points of view. Attempting to resolve them, or at least to recognize when and why more than one position is tenable, is an excellent way of enabling both the individuals

involved and the class as a whole to achieve a better understanding of what is at issue.

A second purpose of this reflective activity is to "go meta", as Olson and Bruner (1996) call it – deliberately reflecting on the social and cognitive processes in which the group has been involved and on the status of the knowledge that has been jointly constructed. From a Vygotskyan perspective on intellectual development, this is the preeminent means whereby everyday ways of thinking are reconstructed in terms of "scientific concepts" (Vygotsky, 1987; Hasan, in press); it is also the means whereby advances in knowledge have been made and systematized in human history more generally (Dewey, 1974; Wartofsky, 1979).<sup>7</sup> Ironically, however, of all the activities identified in Table 1, this is the one that is least often observed in classroom practice (Nystrand et al., 2001). Yet, as I shall illustrate below, the benefits in terms of individual and community understanding can be very considerable.

# **PARTICIPANT STRUCTURES**

It would be a straightforward matter to spell out and illustrate all the intersections between types of activity and structures of participation that are implied in Table 1, but it would be space-consuming and tedious to do so. Instead, I will reiterate the principles on which I believe pedagogic decisions about participant structure should be based and then present some actual examples of social constructivism in practice.

In general terms, CHAT conceives of development as occurring through transactions between individual participants and other members of the communities in whose activities they engage. In educational settings, there are thus two significant communities to be considered – that of the classroom and that of the wider society – and it is one of the teacher's major tasks as 'curriculum manager' to mediate the relationships between them.

In this respect, one of his or her most important responsibilities is to help students to develop their sense of responsible agency as lifelong learners who can actively participate in the construction of knowledge and its critique, and contribute to the betterment of the world they inherit. This is the rationale that Dewey advanced for the adoption of an inquiry approach to curriculum; it is also the rationale for the framework for selecting activities that was outlined above. By making 'understanding' the goal of each cycle of the spiral of knowing the teacher tries to ensure that students recognize that learning involves much more than memorizing information and that it has implications for action now and in the future .... As Barnes emphasizes:

Learning is seldom a simple matter of adding bits of information to an existing store of knowledge ... Most of our important learning, in school or out, is a matter of constructing models of the world, finding how far they work by using them, and then reshaping them in the light of what happens. Each new model or scheme potentially changes how we experience some aspect of the world, and therefore how we act on it. Information that finds no place in our existing schemes is quickly forgotten. That is why some pupils seem to forget so easily from one lesson to the next: the material that was presented to them has made no connection with their pictures of the world (1992, p. ??).

Some of the most persuasive examples of adopting this approach can be found in reports, by the TERC group, of empirical investigations that have real life consequences carried out by English language learners in language minority classrooms. For example, one of their reports includes an account of a particularly successful investigation that centered around the quality of the water in various drinking fountains in the school (Roseberry et al., 1992). Other examples are described in the work of Brown and Campione (1994) with the Communities of Learners project, and in classrooms of 'at risk' students described by Dalton and Tharp (in press). As these authors show, emphasizing connections *between* curricular topics and the students' lives as members of communities beyond the school leads teachers to choose and organize the activities that make up the day by day life of the community *within* the classroom in such a way that they enact the relationship between learning and living that is one of the fundamental principles underlying the social constructivist conception of education.

The teacher's second major task is to organize the flow of activities so that, as well as participating as members of the classroom community – both contributing to and benefiting from joint activities in group and whole class structures – students have opportunities to engage in dialogue with self to clarify and develop their individual ideas, interests, and knowledgeable skills.

In introducing the different types of activity in the previous section, I placed the emphasis on joint activities of various kinds. However, there are also multiple opportunities for solo activities in relation to group and whole class activities. In particular, many teachers have discovered that starting in solo or small group participant structures both allows individuals the opportunity to put their thoughts into words and, thus prepared, enables them to contribute more fruitfully to the whole class discussion. For example, individual students can be asked to make entries in their journals or log-books on work in progress and on the tentative conclusions their group has reached. Alternatively, they can individually take responsibility for preparing reports of different aspects of their group's investigations in the form of brief texts in procedural or explanatory genres, or in tables, diagrams or three dimensional representations.

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A particular advantage of writing of this kind is that not only does its production serve as a "thinking device" for the writer (Lotman, 1987), but it also allows the teacher to monitor and, if necessary, to intervene to assist individual students with the meanings they are making of the activities in which they are engaged. This sort of responsive intervention is what I earlier called the second level of teaching. In transmissionary classrooms, there is rarely time for teachers to work with individual students, as they spend the majority of the time that they are not lecturing in supervising seat work in which all students are working individually on the same teacher-selected task. By contrast, when activities are jointly undertaken, with groups sharing with the teacher the responsibility for determining their work schedules, controlling student behavior requires much less time and energy and the teacher is freed to observe and respond to individual and group efforts and to provide guidance and direct instruction when it is most needed, that is to say, when students are encountering difficulties and need assistance in completing the tasks they have chosen to undertake.

In sum, an inquiry approach to the curriculum accords equal value to solo, group and whole class participant structures and also accords a significant role to teacher supportive interaction with individuals and groups in which s/he provides assistance with problems encountered, offers constructive suggestions and critical comments on work in progress, and generally challenges students to "go beyond themselves" (Vygotsky, 1978) by extending and deepening the investigations they have undertaken and mastering the knowledgeable skills that are required to do so.

By now, it should be clear why I earlier cast doubt on the appropriateness of talking of social constructivist pedagogical methods. Where the curriculum is genuinely coconstructed in action, teaching methods are selected according to the needs of the moment and no methods in the teacher's repertoire are assumed, a priori, to be good or bad. Nevertheless, overall, the teacher's choice of method is made in relation to the superordinate goal of increasing understanding of the topic(s) under investigation. However, since this formulation is necessarily rather abstract, I should like, in the following section, to give some examples of what it might look like in practice.

# APPLYING SOCIAL CONSTRUCTIVIST PRINCIPLES IN PRACTICE

Each of the following examples is taken from the collaborative action research database of the Developing Inquiring Communities in Education Project (DICEP) and in each case is based on videorecordings made by the author at

the teacher's request and on discussions between the author and the teacher(s) concerned, as they investigated some aspect of their practice.

# A GRADE TWO STUDY OF ENERGY

By the summer of 1995, Mary Ann Van Tassell and Barbara Galbraith had been coteaching Grade 2 science for a number of years. As they reflected on their experiences during the previous year, they recognized that, although they invited and recorded student questions about the topic at the beginning of each curricular unit, they were not using those questions in planning the sequence of activities through which the topic was subsequently studied. They therefore set this as a goal for the following year and decided to investigate their success in doing so during a unit on energy taught after the winter holiday.<sup>8</sup>

To launch the unit, the teachers first brainstormed with the whole class to discover what the children already understood about energy and they wrote this information on a large sheet of paper, which was hung on one of the classroom walls. They then proposed that they should start their investigation by making and testing elastic-powered rollers.<sup>9</sup> Each child was asked to bring from home a cylinder, such as a Coke tin or an empty plastic bottle; holes were then made in each end of the container, an elastic band threaded through the two holes, one end being secured to the exterior of the cylinder and the other threaded through a bead washer and then secured round one end of a length of dowel. As was explained, when the dowel was turned a number of times, the elastic inside the container became twisted and stretched and, when the roller was placed on a flat surface, the tension of the elastic would drive it for a considerable distance.

The children spontaneously – and competitively – became interested in how far their respective rollers would travel and some began to keep records of distance traveled for different numbers of turns of the dowel (Solo: Obtain Evidence). Unfortunately, though, a number of practical problems arose, the most frequent being the breaking of the elastic band when overenthusiastic children wound the elastic too tightly. These problems were reviewed in whole class discussions, in which not only did the class Recap Previous Experience and Brainstorm possible solutions, but they also began to develop explanations of underlying cause and effect relationships (Whole Class: Knowledge Building).

One of the most fruitful problems was presented by a child who had used an empty film canister for her roller. To her surprise, instead of travelling in a straight line, her roller persisted in following a circular trajectory. As this was demonstrated in a whole class meeting and possible explanations explored,

another child saw an analogy in the effect of turning the steering wheel of a car. Although this did not really explain the observed phenomenon of the circling roller, it did prompt the teachers to suggest extending the investigation to the making and testing of elastic-powered cars.

After a variety of practical problems – such as the wheels failing to grip on the polished wooden floor – had been overcome (Whole Class: Brainstorm), the question jointly constructed for further investigation was: How far would a car travel for a given number of turns of the elastic round the axle when the car was pushed backwards? Together, the children designed an appropriate operational method of counting the turns and devised a chart for recording the results of increasing the number of turns and, working in groups, they began to carry out the necessary tests (Group: Obtain Evidence). In practice, most groups had some difficulties in making accurate measurements and benefited from assistance from one of the teachers (Group + Teacher: Gather Information). Whitney was in such a group and obviously gained from the teacher scaffolding. At the end of the session she came to show me her group's results: "Look, it goes up nineteen each time."

The next session started with a whole class meeting at which Whitney reported her results, which were written on the blackboard (Present Interim Results). One of the teachers then asked for suggestions as to how to explain the observed pattern. This proved to be a difficult problem for this group of seven-yearolds and, when this became obvious, various analogies were enacted at the suggestion of one of the teachers: walking along a tape measure and noting the regular pattern of increase in distance with each step, then putting a drop of ink on the rim of one of the driving wheels of Whitney's car and pushing it across a sheet of butcher's paper so that it left an inkmark for each revolution of the wheel. When the distance between the inkmarks was measured and proved to be 19 cm., one could see and hear 'the penny dropping'. One boy made a large clockwise circular gesture and several children simultaneously offered verbal explanations. Summing up this Knowledge Building discussion, one of the teachers orchestrated the conclusion that each class member could measure the circumference of one of the driving wheels on their respective cars and they would then be able to predict the results of further trials (Whole Class: Reflect on Current Understanding - with implications for action).

The practical work just described was accompanied by written journal entries in which the children recorded and reflected on their experiences (Solo: Reflection). Here is an example from Alexandra's journal during the mechanical problem solving phase:

Today our group made sure we got acurat answers on how far our cars move. First we looked at Jansens car. After 2 minutes me and katie realizised that Jansons cars wheels

were rubbing against the box thats called friction. Then the car wouldent go very far because there was to much friction.

Entries such as these then provided material for whole class discussions. In the final discussion the value of this reflective writing was explicitly addressed (Whole Class: Reflect on Strategies Used) and this is what Alexandra had to say:

When you write stuff .... You can always remember it and then, when you share in groups you can write more stuff so ... so whatever you share you learn more.

The teachers also made a practice of recording ideas that emerged in whole class discussion on large sheets of chart paper, the exact formulation being negotiated in collaboration with the children (Whole Class: Formulate Explanation). Here, the process of composing the written text helped the children to focus on what was happening, and why. The resulting text also provided a collective record of the group's emerging understanding, to which individual children could refer as they made their own entries in their science journals.

Thus, as can be seen, this curriculum unit involved students and teachers in activities from almost all of the rows and columns in the matrix. In terms of sequence, the spiral of knowing occurred at two levels. First it was apparent in the way in which the unit as a whole developed from experiential knowing, as the children built and tested their vehicles, to a community effort to construct more theoretical explanations of the substantive knowledge gained in the process. Second, the same pattern tended to occur in each phase of the unit where, on the one hand, there was a strong emphasis on understanding arising from and oriented to action, and on the other, it was very clear that the teachers believed that this understanding would be greatly enhanced through the knowledge building discussions that were a feature of each lesson.

However, in arguing for the quality of the knowing together demonstrated in this class, I am not claiming that all the children had achieved the same understanding by the end of the unit. From a social constructivist perspective on knowing and learning, such an outcome would be most unlikely, since the development of each individual's understanding builds on his or her prior understanding, which itself depends on the range and nature of previous relevant experience. As classes of children are rarely, if ever, homogeneous with respect to prior understanding, identity of outcome is not to be expected. On the other hand, it is reasonable to expect that each individual will extend or deepen his or her own understanding through the interplay of solo, group and whole class activity and interaction. And this, in the teachers' view, could be observed, over the course of the unit, in the changes in the children's manner of participation and in the quality of their contributions to the discourse.

## RESOLVING CONFLICTING LAND CLAIMS IN WESTERN CANADA

My second example comes from a Grade 7 classroom in a multiethnic neighborhood in Toronto. Maria Kowal was the home-room teacher for this class and responsible for much of their program.<sup>10</sup> During the year she had engaged them in a number of social studies projects that took them out into various parts of the city, integrating first hand observation and data collection with library-based research, and concluding with presentations of the results of their inquiries using various modes of meaning making. In the last weeks of the year, she built on these earlier experiences with a short unit concerned with Native Land Claims in Canada, which was a prescribed social studies topic for this grade level. The outcomes specified for the course as a whole by the Toronto Board of Education required students to be able to: (a) outline different ways people are or have been involved in democratic process and change; (b) analyze relationships among bias, prejudice, stereotyping, discrimination and persecution; (c) analyze the struggle for basic human rights. Building on the class's previous work in social studies, Kowal decided to organize the unit around a simulation of a First Nations band's land claim. She also decided to invite the students to be coinvestigators with her of the manner in which the unit unfolded.

The unit started with two periods in which the students were introduced to the central issues through viewing a videotape and reading and discussing a text, both of which concerned the longstanding struggle between the Nisga'a band and the government of British Columbia, which had just become national news again. The teacher's purpose here was to ensure that the students became aware of and began to understand some of the key issues in these disputed land claims and, to this end, she stopped to ask questions about the material just viewed or read to ensure comprehension and to draw the students' attention to the subtlety of the points being made. At the most basic level, the activity was Guided Gather Information, but each discussion episode moved into Evaluate Evidence.

Kowal was a little concerned that this activity was painfully slow and might have been shutting down rather than arousing the students' interest. However, when asked later, the students validated her choice of a more direct form of instruction in this activity. As Jane, Keith and Richard said in the final joint interview I conducted with them:

Keith: . . . well, when you read it by yourself you might think you understand it, but you don't really, but unless you discuss it then you -

Richard: - never would know if you have understood it.

Keith: Yeah, if you don't understand a part of it or get what's going on, when you like discuss it in a group you sort of get an understanding of what's going on.

Jane: If you discuss it then you understand it more because you're actually talking, you're like reading it in your mind (Kowal, 2001, p. 125).

In the next lesson, the teacher divided the students into two heterogeneous groups and introduced the major activity for the unit: to prepare and enact a simulation of a land claim dispute between two fictitious entities – the Wishga'a First Nations band and the Government of Province West – which would be heard before two judges in the Supreme Court. Kowal describes the preparatory activities as follows:

Drawing on past experience, I decided to provide a structure for the students to work with. Their first task was to work individually to list points for each side to support the respective claims to ownership of the land, based on information that had been introduced in previous lessons (*Brainstorm, Obtain Evidence*). After this, they were invited to share their thoughts and decide which side they wished to represent at our court hearing. The element of choice at this point was important. The brainstorming they had completed individually would help them to decide as a group which side they felt they could support more strongly, and I did not want them to be forced to make an argument that they did not really believe in. The students were being drawn closer to the center of the issues: they were beginning to develop a personal affinity with the subject matter and were being asked to reinterpret the facts and arguments they had heard to support a position that they wanted to support. (Kowal, 2001, p. 126; material in italics added.)

While the groups worked at developing, refining and organizing their arguments, the teacher met with each group to help them by making connections with them to other oral and written work they had done during the year and by focusing on the appropriate court-room register in which to express their points (Evaluate Evidence; Formulate Presentation). In this Group + Teacher participant structure, she was able to provide assistance in their zones of proximal development in relation to the knowledge and skills that they needed in order to present the case for their side as effectively as possible. At this point, the teacher decided that the whole class would benefit from a review of the nature and purpose of the simulation (Recap Relevant Knowledge) and so she spent the first part of one lesson Brainstorming in more depth the sort of concerns that individuals on both sides might have – for example, a Wishga'a fisherman with a family to support or a non-Native person who owned a business and sent his children to school in a small town in the disputed land. The groups then had two lessons in which to finalize and rehearse their presentations.

Two teacher colleagues played the judges' roles at the Supreme Court hearing and both sides made effective presentations. The following are speeches made by representatives of the two sides:

Keith (Counsel for Province West): Good afternoon, your honors. My group and I are representing the Government of Province West. We feel strongly that the land that the Wishga'a are claiming to be theirs, although they FEEL that it is theirs, truly isn't. During this presentation, we'll, we will talk about economic issues, human rights issues, and other land claim issues....

Frank (Representative of the Washga'a Band): So in conclusion, I have to say that to me it is somewhat ridiculous that the government would even think that the land belongs to them. Our tradition has been broken, our bands have been separated, and our land has been taken... Having our own government is a necessity because many problems have been inflicted on us. We believe that if we govern ourselves, we could give help that we are not getting right now. We are prepared to sign a treaty saying that we wouldn't evacuate non-natives from our land. We KNOW the land is ours and will ALWAYS be (Kowal, 2001, pp. 118–119).

Following the hearing, I interviewed both groups, showing them extracts from the videorecordings I had made and inviting their reflections. From the students' comments, it was clear that they felt that the simulation had enabled them to gain a much deeper understanding of the viewpoints of the contending parties than they would have done from simply reading about the topic and writing an essay about it. Asked about the relative value of the different activities in which they had been engaged, those representing the government considered all the activities to have made important contributions to the understanding they developed. The First Nations group, on the other hand, felt that the opening video was the most important as it was from watching it that the group had been able to develop their case. However, despite the obvious success of the unit overall, Kowal was less than satisfied as she reflected on all the evidence. In particular, she regretted that, because of limitations of time, there had not been opportunity for the groups to deepen their understanding by carrying out their own research in relation to the positions they chose to represent. As she wrote:

I realize in retrospect that independent research is not something we do because it's a skill to be covered but because it is often an integral and motivating part of the learning process and, as such, should have been included in this unit... In truth, as I now see, I wanted the students to perform for me so that I could evaluate how well they understood the issues I had put before them. My goals limited the opportunities for the students to follow through on points of significance and interest for them... a potentially important opportunity for knowledge building had been omitted from the planning (2001, pp. 132–133).

Thus, not only did the students gain greater understanding of the complexity of resolving the claims of First Nations' groups through engaging in the

activities described, but they also increased their meta-understanding of the learning processes involved. Most importantly, however, through reflecting with the students and then later in her solo writing, the teacher also came to understand better how to organize both time and activities to maximize the students' learning and understanding.

# COLLABORATING ON A UNIT ON SOUND

The third example is based on a report of an inquiry undertaken by Zoe Donoahue (in press) in collaboration with Janna Adair, one of her teacher colleagues, in order to explore how a science unit from the new and much more closely specified Ontario curriculum could be organized in such a way as to allow the students to share in its planning and to initiate their own inquiries. The unit in question was on the topic of sound and took place in a grade four class in a suburban elementary school in Toronto. In order to include the students as partners in the inquiry, Donoahue interviewed them in groups of six before the unit and asked them to complete a questionnaire at the end; she also designed a protocol for their written reflections which the students were asked to complete at chosen moments during a number of different types of activity.

The teacher started the unit by focusing on the prescribed "learning outcomes" for the unit. As Donoahue notes, "The children needed to understand that these were non-negotiables, but that they could have input as to *how* they would learn." The six outcomes were written on sheets of chart paper and pinned up around the room and, after the students had taken some time for *solo written brainstorming*, they wrote their chosen questions on sticky notes and posted them on the outcomes for which they judged them to be most relevant. The next day, the whole class reviewed the results with their teacher and decided how they could best answer their questions (Whole Class: Plan Goals, Procedures, Materials, etc.). The activities that they considered would be most appropriate were:

- · doing experiments in groups
- studying books and other print resources (to find out what the ear looks like and how it works) and having a teacher guided lesson on the ear
- building a musical instrument
- researching a topic of interest relating to how we use sound in our everyday lives (Donoahue, op. cit.).

On the basis of this collaborative planning, the teacher decided to start with experiments and, specifically, with an experiment involving extending a ruler

over the edge of the desk and observing what happened when they struck or pressed down and then released the free end. Before starting, though, the students were asked to write down their predictions, as the teacher considered that this practice "helped the children to focus and gave them something to think about as they worked with the materials." When the students had had sufficient time to complete their experiments (Solo: Observe, Experiment), they were invited to report their findings to the class (Solo: Present Interim Results + Receive Feedback).

All had found the work interesting and several students were inspired to continue experimenting on their own, in class or at home, in some cases using ideas from books that the teacher had made available in the classroom. Some worked out how to play songs with their rulers and some even figured out a way to record their songs, as music, on paper. One student, at home, made a bass with a box, a string and a meter stick. By pressing the string against different points on the meter stick and strumming, he found that the instrument made different sounds. Further experiments then followed, based on ideas suggested by the telephones that two students had made at home with plastic or Styrofoam cups and string. The final practical activity was to design and make a musical instrument of their choice, using the principles that they had been learning.

During the course of these experiments, the students were asked to complete the protocol described above. From what they wrote, Donoahue observed that "there was a good match between what [the teacher] hoped the children would learn and what they felt they were learning . . . [They] seemed to be very aware of the concepts she had in mind (sound, vibration, frequency, how sound travels, music and sound, the ear, and communication)." Asked in the protocol whether they thought experiments were a good way to learn, the majority were enthusiastic. The reasons they gave included that when experimenting, they "get more ideas", "have examples to help me " and "actually get to make sound"; several thought that they learned more about a topic by "doing things" than by "just reading about it." They also appreciated the opportunity to work in groups, both for social reasons and for the intellectual benefits of collaborative thinking.

Another practical activity carried out in groups involved solving one of two problems in which a plastic cup containing 15 pennies was taped to an empty shoebox. Both problems required choosing objects/materials to tape inside the box, in the first case to amplify the sound produced by shaking the assembly and in the second to dampen it. The groups' solutions were ingenious and, on the whole, effective and, as several insightfully observed in their comments on the in-process protocol, the problems were a good way of showing what they had already learned and how they could use this knowledge in action. One

student commented "We must *know* how sound is amplified and absorbed" and another thought the task provided a "better way of using the words amplified and absorbed in a different way."

Many of the students continued their experiments at home and brought their work to show the class. Although this disrupted the teacher's planned schedule, she welcomed the evidence of their engagement with the topic of the unit and always made time for their efforts to be recognized and celebrated and to hear about what they had learned in the process.

Not all of the targeted outcomes were approached through group experiments, however. The concept of pitch was explored through a teacher demonstration that built on an activity that one student had initiated at home. Having filled a collection of bottles with differing amounts of water, the teacher showed the relationship between pitch and the volume of resonating air by blowing over the tops of the bottles. At the same time, the teacher encouraged discussion of the results, emphasizing the use of the register of scientific explanation, and taking the students' conjectures and hypothesis-based suggestions to guide how she proceeded with the demonstration.

Learning about the ear was also non-experimental, involving reading and a teacher 'lesson'. From their comments, it was clear that the students recognized the value of this approach, since, as one observed, "we can't look inside the ear"; another saw reading as a safer method of learning about the ear as "we can't do anything else without hurting ourselves." But they also recognized the value for their learning of being given information that was relevant to a topic of interest and importance to them (Solo and Whole Class: Gather Information), particularly when they had some input in the decision to learn in this way.

Toward the end of the unit, the students worked in pairs on a topic of their choice concerning sound in everyday life, researching their topic through reading, searching on the internet, and discussing what they were finding with others (Group: Obtain Evidence). Importantly, the goal of this activity was to present their findings to the rest of the class in whatever form they thought most appropriate. Once again, the element of choice added to their enthusiasm and a wide variety of modalities was drawn on, including speaking in role, demonstrating experiments and explaining displays mounted on bristol board (Group: Present Results + Receive Feedback). Of all the activities undertaken during the unit, presenting the results of their group's research on a self-chosen topic was rated most highly by the students, both as a mode of learning and for the pleasure and satisfaction of working toward the creation of their presentation.

In addition to what they learned about sound, much benefit accrued from the various forms of co-investigation that were included in the unit. A final

questionnaire and a follow-up discussion showed that the students had reflected on *how* as well as *what* they were learning. They made some insightful comments about the pros and cons of groupwork and on the basis on which groups were constructed; they also explained the advantages they perceived in sharing in the planning of the variety of activities through which they investigated and learned about the topic of sound. Perhaps most important was their appreciation of having ownership of and a degree of control over how they worked. As one of them noted, "If you get to pick your own topic you're into it . . . and you want to get starting right at it because it's what you want to do."

In her paper, Donoahue (op. cit.) offers extensive reflections on all these features of the approach that was adopted in this unit, and suggests several ways in which she and Adair thought it could be improved. As she explains:

A benefit of asking the children if they enjoyed and were learning from various activities is that they developed a meta-awareness of their own learning styles. They came away from the unit with a better sense of how and under what conditions they do their best learning. We found that a benefit of co-researching with the students is that we were more explicit with them about the decisions we, as teachers, make during a unit and about our reasons for choosing certain types of activities to meet specific learning goals . . . .

The teachers came away from this unit with knowledge that will help them to plan science units that better meet the needs and interests of children. The children acquired a greater metacognitive understanding of the conditions under which they can learn with richness, depth and joy (Donoahue, op. cit.).

# TEACHING ACCORDING TO SOCIAL CONSTRUCTIVIST PRINCIPLES: CLARIFICATIONS AND QUALIFICATIONS

The three examples just presented – and many more could have been included if space had permitted – reinforce some of the central points of the argument I have tried to develop in this chapter. In each case, it was various kinds of activity involving inquiry and exploratory talk that enabled students to become deeply engaged with the content of the unit and spurred them to learn the necessary skills and information. At the same time, these examples all illustrate the need for teachers to be flexibly responsive in selecting and organizing activities in the light of the affordances and constraints of their own specific situations: the characteristics of the students, the relationship of the current topic to the sequence of topics in the prescribed curriculum, the pressure of other, competing demands on the time available, and so on. In other

words, these examples make clear that, from a social constructivist perspective, effective pedagogy requires a framework of general principles within which decision making can be emergent and strategic in each specific situation.

It is important to make clear, therefore, that my purpose in this chapter is not to argue that it is necessary – or even optimal – for every topic to be approached through a particular model of inquiry. As emphasized above, rather than being a 'method' for teaching certain types of topic, we see inquiry as a stance toward experience and information – a willingness to wonder, to ask questions and to attempt to answer those questions through the collection of relevant evidence by various means, both empirical and library-based, and to present the findings to one's peers for critical review and improvement. Moreover, its ultimate aims are to foster in each student the lifelong dispositions to be agentive in learning and to collaborate with others in seeking for understanding that enables effective and responsible action.

These aims are inherently dialogic. They cannot, therefore, be achieved through rigid adherence to a predetermined sequence of activities, however coherent and theoretically principled the overall plan may seem to be 'on paper'.<sup>11</sup> To be sure, these dispositions can be powerfully fostered when students engage in the full cycle of activities described above but, once dialogue and inquiry have become established as the norm, they can continue to permeate the life of the classroom, even when less open-ended approaches to a topic or unit are deemed more appropriate. Furthermore, it is not the case that topics for inquiry have to originate with the students in order to secure their engagement. Good questions can originate from many sources, including the teacher, a book, the internet, or a member of the wider community. Who originally proposes the question for investigation is much less important than that students invest in and take ownership of it.

A second clarification also seems necessary. It sometimes seems to be implied that it is working on group projects that is the essence of a social constructivist approach to learning and teaching and that, if students are not involved in 'group work', they are not constructing knowledge in collaboration with others. But 'group work' is not the only participant structure that advances the goals of a community of inquiry. As I hope the preceding examples have made clear, solo and whole class participant structures are equally appropriate – and indeed necessary – for the classroom community to benefit from the contributions of all members and to attempt to reach a shared understanding of the topic that they are addressing.

Nor should it be thought that, within this approach, there is not an important role for instruction and information giving, both by the teacher and by experts in the field, through their writing and other modes of communication.

There are certainly occasions when 'direct instruction' is necessary and desirable, particularly when it provides assistance that an individual or many students need in order to complete the activity in which they are engaged (Wells, 1998). In launching a new topic, too, it is often desirable to start with some form of 'presentation' by the teacher, a reading of a poem or story, or a current event on television or a drama recorded on film or video (see the second example above). Visitors to the classroom from the local community can also make very significant contributions of various kinds (Rogoff et al., 2001). Likewise, the practice of the teacher regularly reading aloud to the whole class – a serialized story (Donoahue, 1998), or a non-fiction book that is relevant to work in progress – can enable students at all grade levels to make contact with the work of artists, storytellers, historians and scientists in the wider world beyond the school.<sup>12</sup>

Effective pedagogy, therefore, involves appropriate selection from all the possible participant structures and all the activities I described earlier. What varies is the balance between them. Where depth of understanding is the goal, and time permits, allowing students to negotiate the topics for individual or group investigation and including whole class time for presentation and discussion of their findings is probably the ideal course to take. DICEP teachers' experience suggests that at least one unit should be approached in this way as early as possible in the school year in order to develop the ethos of a classroom community of inquiry. Open-ended, 'hands on' inquiry is also desirable when embarking on a completely new field of study so that students gain some first hand experience as a basis for making sense of information that is subsequently encountered largely through symbolic representations of what others have done and the conclusions they have drawn as a result. However, when the topic builds on one that has already been explored in some depth, and particularly when the time allowed for the topic is limited, it may be appropriate to devote a greater proportion of the time available to various forms of 'gathering information'.

However, in the latter situation – as in all those discussed – three principles remain paramount. The first is that the information presented should be related as far as possible to the concerns and interests that students bring from the world beyond the classroom.

The second principle is that students' questions and ideas should be welcomed and taken seriously, and opportunities provided for their discussion. Whether in group or whole class settings, such focused discussion is one of the most significant means for students to extend and deepen their understanding as they try to formulate their thoughts in a form appropriate to the emerging exchange of ideas (Wells, 1999). As Vygotsky emphasized, "Speech does not merely serve as the expression of developed thought. Thought is restructured as it is

transformed into speech. *It is not expressed but completed in the word*" (1987, p. 251, emphasis added). If students raise more issues than there is time to take up during a particular lesson, one possibility is to invite them to post their questions or opinions on a 'knowledge wall' and to encourage written discussion of them by those who are interested (Hume, 2001, and above). Toward the end of the unit, a vote could be taken on which of these issues merited further whole class attention – perhaps as part of the final reflective discussion that, I would argue, should round off every unit, however short the time allotted to it.

But the most important principle is that of having a meaningful goal for the unit – an 'object' to be improved, both through and as a result of what is learned – whether this be the construction or modification of a material artifact, a problem to be solved pertaining to the students' own lives, a simulated situation in which they take on the roles of the participants, or the construction and public representation of their explanation of an event or phenomenon that is central to an understanding of the unit. As Vygotsky argued, it is in collaborative, goal-directed activity that knowledge has continually been created over the course of cultural history; and it is the same type of goal-directed activity that provides the most effective context for the creation of knowledge in each individual's development.

These principles were memorably captured by Ursula Franklin, a doyenne of Canadian science and an active feminist, when chairing a conference on the 'Ecology of Mind'. Knowledge, she argued, is created and recreated "in the discourse between people doing things together" (Franklin, 1996). In these words, she brought together three important features of the knowledge building that is the central concern of all communities of inquiry:

- it is an intrinsic part of "doing things"
- it is created between people
- it occurs in the collaborative meaning-making of their goal-directed discourse.

By the same token, therefore, in organizing the sequence of activities through which the members of the classroom community construct their understanding of the knowledge and skills involved in each curriculum unit, the teacher's prime aim should be to ensure that there is ample opportunity for this kind of dialogue of collaborative knowledge building.

# **CONCLUSION: MAKING IT HAPPEN**

As will be clear from the preceding sections of this chapter, a social constructivist approach to learning and teaching does not fit easily with the contemporary

emphasis on standardized outcomes and prespecified routes to their achievement. Truly to accept and welcome the diversity that exists in today's school population means abandoning the chimera of a universally effective way of teaching and, instead, encouraging teachers to take responsibility for negotiating with the students in their charge how best to address the curricular topics they must study in ways that engage the students in collaboratively constructing the relevant knowledge and skills in order to achieve goals that are of personal and social relevance to them as members of the communities to which they belong and to which they aspire to belong. It therefore follows that there can be no 'methods' that are universally suitable for all classrooms or for any particular curricular topic.

For those who seek to reduce teaching to 'delivery' of 'content' determined by others through the 'implementation' of a set of predetermined procedures, this must seem a very negative conclusion.. However, if – as Dalton & Tharp (in press) recommend – the standards are interpreted as a broadly-based "consensus about ideals and principles that must be enacted in local contexts through local participation," there is no fundamental incompatibility between goals to be aimed for and diversity in routes toward their attainment. Furthermore, it could very reasonably be argued that some variation in outcomes is unavoidable and, indeed, that it is a necessity if society as a whole is to retain the diversity that fosters creativity and originality in all fields of human endeavor (Lemke, in press).

On the other hand, for teachers who see learning as a lifelong endeavor – for themselves as much as for the students they teach – the challenge presented by the decision to organize their teaching according to social constructivist principles is both demanding and rewarding. It invites them, like other professionals, to be agents in determining, on the basis of their own experience and understanding, what courses of action are most appropriate in the situation and in the best interests of those for whose continued development they are responsible (Wells, 1999, Ch. 10).

There are many ways for teachers to meet this challenge of continuing to learn. Participating in supportive professional development activities and keeping abreast with relevant practice-oriented research are obviously important means. But, in line with the central arguments of this chapter, I should like to give particular emphasis to 'practitioner inquiry'. As is clear from the examples above, the inquiry approach that is so motivating for students can be equally energizing and productive for teachers. Since there are no universal solutions to the problem of how to effectively engage all students in learning what is specified in the prescribed curriculum, each class and each unit requires appropriate answers to be made as lessons and units are co-constructed

by teacher and students together. However, when these processes are systematically investigated in collaboration with colleagues through the collection and interrogation of evidence from their own classrooms, teachers both achieve improvement in action and understanding themselves and provide a powerful model of learning for their students. In so doing, they also effectively demonstrate what it means to apply social constructivist principles of learning and teaching in practice.

# NOTES

1. The research on which this chapter is based was largely carried out in conjunction with members of the 'Developing Inquiring Communities in Education Project' (DICEP). The group consisted of classroom teachers (Grades 1–8), two university teacher educators, a senior researcher, and a small number of graduate students. Between 1992 and 1998, with grants from the Spencer Foundation, the group attempted, through action research, to create communities of inquiry in their own classrooms, among colleagues in their schools, and in our own collaborative group, and to document the means that seemed most effective in achieving this goal. Accounts of some of their inquiries are collected in Wells (2001). Since I moved from Toronto, the group has been successful in obtaining a further grant from the Spencer Foundation to investigate the feasibility and benefits of involving their students as co-researchers.

2. A useful collection of articles that discuss this question is found in Guzzetti & Hynd (1998).

3. In a very interesting comparison of <u>Dewey and Vygotsky</u>, <u>Glassman</u> (2001) has recently shown that there are substantial similarities between the educational theories of these two writers, but also important differences. In the light of Glassman's argument, it is clear to me that, in the model presented here, I have modified the Marxist emphasis on cultural reproduction with a Deweyan emphasis on inquiry. From a classroom point of view, this leads to my advocacy for group inquiries on topics and issues that are negotiated between student(s) and teacher.

4. Mercer (in press) argues that discussion itself involves attitudes and skills that need independent attention and reports research that shows the improved quality and effectiveness of group discussion that resulted when preceded by a preparatory series of 'talk lessons'.

5. Although 'learning' is often treated as a unitary phenomenon, it seems clear that the term is habitually used to refer to the enhancement of relatively distinct forms of mental and physical activity. Most obvious is the distinction between 'knowing that' and 'knowing how to' (Ryle, 1949). While the sort of learning that I am concerned with combines both forms of knowing – hence the use of the phrase 'knowledgeable skills' – it is clear that much school learning has traditionally kept the two forms of knowing separate, both from each other and from situations of 'real-life' use. This is particularly apparent when the goal of learning is explicitly focused on being able to give correct answers to decontextualized items on tests.

6. Further information about CSILE can be found at the demonstration site: http://csile.oise.utoronto.ca/demo\_csile.html

7. This argument is developed in greater detail in Wells, 1999, 2000.

Author: Are these references OK?

8. A much fuller account of this investigation is included as Chapter 9 of Wells (1999). In addition to the teachers' focus on student questions, we were together also exploring what 'working in the zpd' might look like in contemporary classroom practice.

9. Instructions for making this elastic-powered roller can be found in Richards (1990).

10. For a much fuller account of this unit, viewed from the teacher's perspective, see Kowal (2001).

11. This argument is forcefully made in a recent case study by Christoph & Nystrand (2001), which traces the professional development of an experienced high school teacher of English as she attempted to become more 'dialogic' in her style of whole class interaction.

12. One of the most positive memories I retain of my own later years at school is of teachers of English and history who read aloud from works that they considered important for us to encounter.

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