

# Collaborative Inquiry and the Professional Development of Science Teachers

Gaalen L. Erickson  
*University of British Columbia*

In this article I argue that the nature and meaning of collaborative relationships are highly dependent upon the particular, practical settings in which they occur. To obtain a better understanding of a claim that a given project is collaborative, that claim must be examined in view of the specific purposes, processes, and relationships engendered by that project. To illustrate this argument I describe an on-going, science teacher development project and outline the fundamental postulates on which the project was based. Both a practical and a theoretical rationale are advanced to explain why a form of collaborative inquiry was essential to the project. A set of general principles linking the various types of collaborative relationships found in the project is identified and discussed.

Cet article a pour but d'élucider la nature des relations de collaboration telles qu'illustrées dans un projet de recherche. Ces relations interpersonnelles dépendent étroitement du contexte dans lequel s'inscrit le projet. La collaboration en recherche suppose des objectifs, des processus et des relations interpersonnelles spécifiques, parce que engendrées par le projet lui-même. C'est ce que démontre l'expérience d'une recherche de groupe visant au développement professionnel d'enseignants en sciences. La nature même de ce projet justifie les présupposés théoriques et pratiques qui en constituent le bien-fondé.

The term *collaboration* has appeared with increasing frequency in the education community. A cursory inspection of recent conference papers at educational conferences in a number of countries illustrates the extent to which this term has crept into the lexicon of educational research. Its use has not been limited to the research community; it is also widely used by educational practitioners as they discuss means to improve teaching practice. Given the diversity of situations and approaches that have been described as collaborative, it is appropriate for us to begin to take stock of this phenomenon. What are some of the factors that could account for this apparent interest in collaborative approaches in the educational community? Are there any common features or characteristics in these diverse projects which could be characterized as more general principles of

collaborative relationships? These are some of the questions that will be addressed in this paper.

Let me begin by examining the ordinary language meaning for the term collaboration. In the *Oxford English Dictionary* the term is defined quite simply: to work in conjunction with another or others; to co-operate. Clearly, the notion of working together in a cooperative manner captures some of the spirit of its use in educational settings. Beyond this, however, the basis for the additional meanings that have been attached to the term is less clear. Part of this diversity may stem from the recognition that any form of collaboration involves a working relationship between people for the purpose of reaching some agreed-upon goal. Given the many different educational contexts in which collaboration occurs, the potential for differences in the perceived purposes for collaboration, the varied forms of relationships between the participants, and the diverse goals, it is not surprising that considerable ambiguity exists surrounding the use of this term. This means that the onus is on the participants (or at least the chronicler) involved in a project to clarify the associated meanings of the term in that particular setting. Following the position taken by a number of contemporary philosophers, I would argue that the meaning of terms which refer to relationships among humans are often deeply ingrained in the practice of particular activities (Hirst, 1983; Morawetz, 1978). Thus, the nature of collaborative relationships is best examined in terms of the unique contexts of those practices. It is for this reason that I examine the nature of collaborative relationships as exemplified by our current research project of instructional practices in science teaching. I begin with a brief overview of this project and then discuss some of the questions and issues raised earlier.

### *An Overview of the (SI)<sup>2</sup> Project*

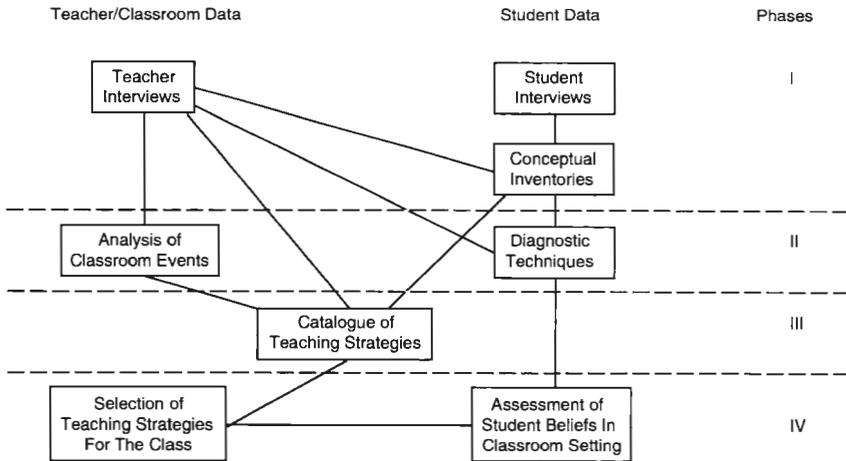
While the formal beginnings of the Students' Intuitions and Science Instruction group (the (SI)<sup>2</sup> Project) was formally initiated only six years ago (Erickson, 1984), its conceptual and empirical roots can be traced back to a number of studies over the past 12 years that have been conducted at the Science Education Department at the University of British Columbia. These studies consisted of two basic types. The first documented the nature of students' intuitions and thinking about a variety of concepts used to describe and explain physical and biological phenomena (e.g., heat and temperature, motion, forces, solution chemistry, inheritance, growth, and cells). The second type examined how students' intuitive knowledge might interact with classroom instruction. (See Erickson (1983) for a brief description of some of these studies.) In the early 1980s many researchers, including myself, were making conjectures about the value and even necessity of incorporating students' prior knowledge into classroom instruction. However, very few reports of systematic classroom practice incorporating this perspective had been published at the time, the exemplary work reported in many issues of the journal *Outlook*, edited by David

Hawkins, and that of Minstrell (1984) in the United States, Armstrong (1980) and Rowland (1984) in England, and Mitchell (1984) in Australia being notable exceptions. Thus, we decided to address this complex problem area by developing a collaborative research team consisting of three classroom teachers and three university-based team members. This project had three broad aims:

1. The establishment of a functional and genuinely cooperative research group with practising teachers and university educators.
2. The development and documentation of a constructivist teaching perspective in conventional classroom settings.
3. The development of strategies for communicating this perspective to pre-service and inservice teachers.

In an earlier paper (Erickson, 1988) I indicated how this classroom-based project differed significantly from my earlier conception of how the research findings we were generating might be utilized by teachers. Suffice it to say that our present view of the research-practice interface is almost diametrically opposite to that which I held, at least implicitly, ten years ago. Instead of university researchers generating “diagnostic techniques” and “catalogues of teaching strategies” (as displayed in Figure 1) to be implemented by the classroom teacher, we now view the teacher as playing a much more

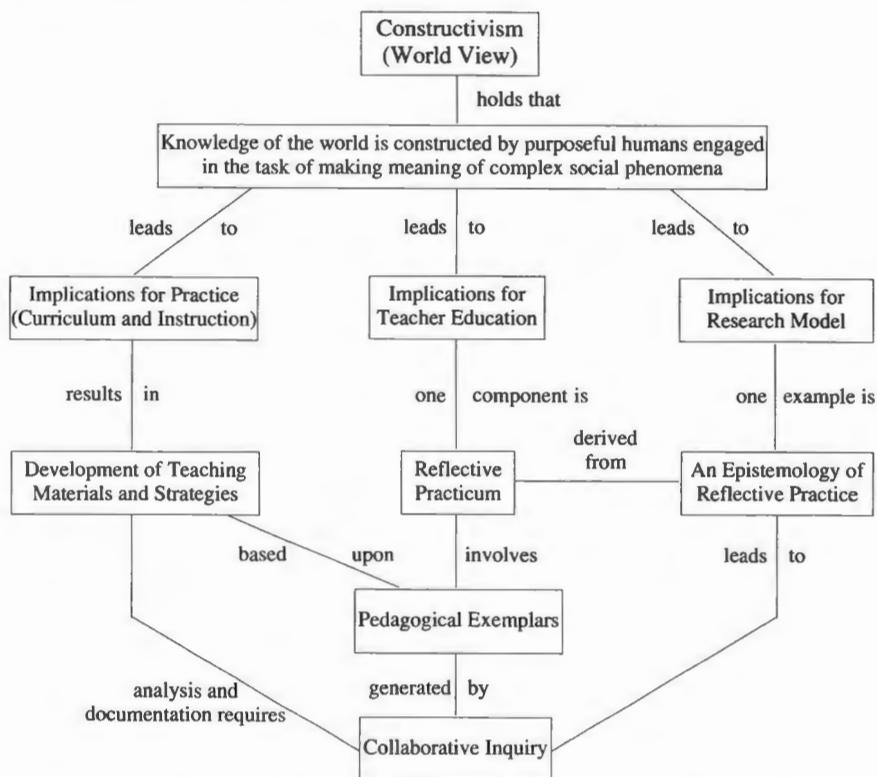
**Figure 1**  
**Flowchart of Project**



fundamental role in the development phase itself. In fact, we go so far as to argue that to some extent teachers must construct for themselves a repertoire of diagnostic techniques and teaching strategies that will allow them to respond to the uniqueness and complexity of their practice setting. In claiming this,

however, we are not suggesting that individual teachers cannot use or benefit from knowledge generated by researchers or from other teachers. In fact our present project is based on the premise that we will be able to develop suitable descriptions of teaching practices that will provide opportunities for others, both novice and experienced teachers, to reflect upon their present understanding of teaching and learning phenomena so that they might come to “see classrooms in a new way” (Erickson & MacKinnon, 1991). An outline of our current “research agenda” is given in Figure 2. What I have endeavored to portray in this schematic is the interdependence of our research settings and our conceptual and methodological commitments. These settings include the classrooms of our project teachers, the methods courses in our preservice program and the practicum in our preservice program.

**Figure 2**  
**Overview of the (SI)<sup>2</sup> Research Agenda**



The project was initiated early in the summer of 1985 by an intensive three day workshop and was then followed by a two day meeting at the end of the

summer just before the new school term was to begin. The intended purpose of the initial workshop was to develop an overall plan for the project and lay out some specific objectives for work in the first year. In reality much of the time was spent by the six participants discussing readings that were distributed earlier as background papers on the topics of professional knowledge and collaborative inquiry. These papers included some of Schön's writings on the nature of "reflective practice" along with theoretical and practical descriptions of what might entail a constructivist approach to science instruction (e.g., selections from Driver, Guesne & Tiberghien, 1985). The discussions on these general perspectives of teaching and learning were frequently interspersed with many specific anecdotes by the teachers about students' actions in particular classroom situations. Interestingly, this particular form of discourse — a dialectic between the theoretical and the practical — characterized many of the subsequent discussions held during regular project meetings.

I recall being somewhat concerned initially that we did not reach the objectives that I had in mind for the workshop. That is, we did not agree on a specific blueprint or action, nor was there much enthusiasm for developing detailed teaching strategies for the content areas that had been the subject of our earlier investigations into students' intuitive ideas. It became quite clear that, because the three teachers had different teaching responsibilities, such a standardized approach would be unrealistic and nonproductive. Nonetheless there was a feeling of optimism and excitement generated by the discussions, particularly when contact was made with classroom incidents with which all of the group members could identify. Rather than focus on specific content units at that time, a consensus was reached that we would attempt to identify and document more generalized teaching strategies and descriptions of teaching practice which illustrated our constructivist perspective. We conjectured that teachers could adapt these strategies to most content domains. In other words, they would permit teachers to identify students' common sense ideas and then validate these ideas by incorporating them in a fruitful way into an ongoing instructional program. A number of these general strategies were identified — some based upon the previous teaching experiences of the group members, and others based upon reports from the research literature (for example, the techniques of concept mapping, Vee mapping, and the Predict-Observe-Explain (POE) sequence).

During the first year of the project teachers experimented with different methods for identifying student ideas in a nonthreatening manner and evolved a number of different strategies for working with these ideas. The development of these strategies proceeded much like a cycle of inquiry in an action research study (Carr & Kemmis, 1986). That is, the initial actions by the teachers created both desired and some undesirable behavior on the part of the students. The strategy would subsequently be altered to achieve a more favorable balance between these two outcomes. The results of particular trials by the teachers were

discussed in the group meetings with the outcome resulting in some suggested follow-up activities.

Over a period of a year, our group slowly learned to explain to each other the insights, the frustrations, the highlights of selected vignettes of practice. In addition to these biweekly project meetings there were more formal inservice sessions where the team presented to other teachers condensed versions of the teaching strategies that were being developed. During these sessions we also attempted to discuss the constructivist rationale for the teaching strategies. In retrospect, it was evident that through the discussions and deliberations in these various informal and formal sessions the project team was slowly evolving a common language to communicate this perspective on practice initially to ourselves and subsequently to others. Now it seems clear that this time period of close to a year was necessary in order to negotiate among one another the unique personal meanings that underlie many of the terms that were used in these group meetings. At the beginning of the project, we shared many general ideas about what we saw as the most important outcomes (e.g., increased student understanding and the constitution of the most preferred educational environment). Nonetheless, considerable negotiation about the specific nature of these aims and methods was required among various group members. However, this negotiation process was rarely explicit; it most frequently occurred when we engaged in discussions about particular classroom events. Thus, we were slowly and quite unconsciously forging a set of shared commitments about how best to think and talk about the instances of classroom practice that the teachers in our group selected to discuss during our group meetings. Without realizing it, we were ourselves engaging in a form of constructivist learning as we grappled with the problems of initially communicating our thoughts and actions to each other and later to other educators who were not part of the project. This communication was accomplished through numerous presentations at teacher workshops as well as through research conferences and published papers (Aguirre & Kuhn, 1988; Erickson, 1987, 1988; Gurney, 1988; Kuhn & Aguirre, 1987; MacKinnon, 1988; Parsons-Chatman & Sieben, 1988; and Sieben, 1987).

Any attempt to reconstruct either the dynamics or the substance of these interactions among the group members must remain just that — a reconstruction. Nonetheless it seems reasonable to try to identify some of the significant features of the emerging consensus that developed among the project team. In Figure 3, I have identified those features in terms of a number of postulates that appeared to guide, in some way, the deliberations and the decisions made by the project team.

**Figure 3****Postulates of the (SI)<sup>2</sup> Program Pertaining to Teacher Development**

1. We believe that the constructivist principles of learning that guide our approach to understanding student learning also apply to the learning of teaching.
2. We view it as important to integrate all components of professional development into a coherent research agenda.
3. Our view of professional knowledge is that it is under continual development and primarily oriented around the practice setting.
4. We believe that an effective method for communicating professional knowledge to teachers is through the use of pedagogical exemplars.
5. We believe it is important to encourage a disposition for classroom-inquiry in teachers and to create appropriate climates for this to occur.
6. We believe it will be necessary to develop a language of professional knowledge and classroom inquiry that will encourage open communication and criticism among educators.
7. We believe that a model of collaborative inquiry is the best means for achieving our aims of professional growth and improved practice.

These postulates, then, form the conceptual and methodological bedrock of our project. I only deal briefly with these postulates in this paper since they have been discussed in more detail in other papers by our group members (Aguirre & Kuhn, 1988; Erickson, 1987, 1988; Gurney, 1988; Kuhn & Aguirre, 1987; MacKinnon, 1988, 1989; Parsons-Chatman & Sieben, 1988; Sieben, 1987).

In the first postulate we declare our commitment to a constructivist perspective of learning as described, for instance, by Driver and Oldham (1986), von Glasersfeld (1989), and White (1988). Moreover, we submit that this perspective is as relevant to our concerns about student learning of subject matter (the primary focus of the (SI)<sup>2</sup> Project) as it is to the learning of a complex practice such as teaching. For instance, the extensive negotiation process engaged in by our project team illustrates for us the face validity of this postulate in the context of teaching practice.

The second and third postulates emerge, in part, from this constructivist perspective and address our view that professional knowledge is in a state of continual growth and change. Hence, we think it is both important and informative to examine the nature of the problems of nurturing and enhancing the construction of knowledge at various stages and phases of professional development. Our concern for attempting to examine the issues and problems of professional growth in a coherent and integrated program is displayed in the schematic of our research agenda in Figure 2. As indicated in this Figure we have found Schön's writings on an "epistemology of reflective practice" to be both persuasive and fruitful in terms of the ways in which we conceptualize professional knowledge. While Schön's primary concern is to give an account of how a practitioner might construct practical knowledge in an action setting, his analysis of reflective practice in his most recent writings on the subject (Schön, 1983, 1987, 1988, 1991) provides a very generalized description of what this

knowledge might look like in the context of teaching. We have endeavored to make explicit some of the components of that knowledge base, or appreciative system as Schön calls it, in the more specific domain of science instruction (Erickson & MacKinnon, 1991; MacKinnon & Erickson 1988; Marin, 1988).

The technique, referred to in the fourth postulate as "pedagogical exemplars," was developed for the purpose of communicating aspects of our constructivist perspective on science instruction to other teachers. In brief, these exemplars consist of a series of videotaped excerpts of classroom episodes edited to illustrate particular features of some of the teaching strategies that our group has developed. Written materials and opportunities for discussion and reflection on these episodes accompany these videotapes. (See Erickson, 1987, for a discussion of the conceptual origins of this technique.)

In the fifth postulate we outline what we take to be a very basic disposition or stance that ought to characterize the practice of teaching throughout a teacher's professional career. We are persuaded by Schön's description of how novice teachers construct an ever increasing and more powerful repertoire of teaching moves and skills. One of the primary constructs used by Schön to provide an interpretation of this construction process is his conception of reflection. While part of this conception is captured by the ordinary meaning of the term, to pause and carefully consider the results of some action or situation (*reflection-on-action*), an equally important aspect is his emphasis upon *reflection-in-action*. This leads Schön to claim that an important component of teachers' knowledge resides in their actions in a practice setting. This claim is similar in nature to that made by other philosophers concerned with providing a description of practical or professional knowledge (Hirst, 1983; Morawetz, 1978). For instance Hirst puts the issue this way:

For practical knowledge is not simply some blind unstructured executive competence that applies rules and principles. ... Practical knowledge is acquired by *living within* the organised social world to which we belong, structured as it is by institutions and traditions of great variety. (Hirst, 1983, p. 11-12, italics his)

Thus, one response to the enormous problem of nurturing continuing professional development requires an examination of the appropriate personal and institutional conditions for encouraging teachers to engage in this type of reflection (or "classroom inquiry" as we have called it) throughout their professional lives. Unfortunately, it becomes very easy, once in possession of the necessary survival skills and a functional repertoire of teaching moves, to gradually shift teaching performances towards the aeronautical equivalent of an "autopilot." The concern for developing an appropriate language that will maintain and support a professional culture of classroom inquiry, as indicated in postulate six, is a natural outgrowth of the preceding postulates. Given our experiences, under close to ideal circumstances, this task will be neither

straightforward nor rapid. While there is clearly a growing interest in developing more of a professional ethos where teachers are recognized as among the key actors on the educational stage (Lieberman, 1988, 1990), the conceptual, organizational, and administrative problems in bringing about such a shift are immense.

The final postulate, in which we stipulate our position that a variety of forms of collaborative inquiry will be necessary to achieve our aims, takes us to the primary subject of this article. In looking back over the six years of the project it now seems clear that the rationale used to justify our collaborative model of inquiry has changed somewhat. In my initial grant proposal to the Social Sciences and Humanities Research Council (Erickson, 1984) I argued that teachers must be an integral part of the research team on primarily pragmatic grounds. A second, theoretically based argument was also advanced but not elaborated. Briefly stated, my original, pragmatic arguments were that teachers must be actively involved in the project because they had direct access to the classrooms where the teaching strategies were to be field tested. Hence, they were in a better position than university researchers to judge whether the strategies were effective and functional. Finally, they would have more credibility with their peers in terms of communicating our results to other teachers. The theoretical argument was based mostly on Schön's analysis of reflective practice — a position that the development of pedagogically functional knowledge must be constructed in the practice setting.

While I think that both of these arguments in favor of a collaborative model of inquiry still stand, I am now inclined to suggest that the theoretical argument is at least as compelling as the pragmatic one. As our group began to reflect upon some of the features that seemed to characterize our approach to classroom instruction, we gradually became aware of an internal consistency or coherence between the way that we thought about classroom experiences, about practicum experiences, and even the way that we interacted with each other. When these perceptions which were noted by all of the group members in various contexts were explicitly discussed, we attributed this convergence of thought to our commitment to a constructivist perspective (or "world view") of learning.

This perspective, which applies equally well to the grade nine student trying to understand electricity and to the teacher trying to understand the problems that students are experiencing in learning physics, leads us to argue that individual learners have the ultimate responsibility for constructing meaning out of the very complex learning environments in which they are located. However, the types of meaning that can be constructed to make sense out of these situations are powerfully constrained by a number of factors. Most notably, these constraints come from the learners' previous experiences and background knowledge, and the conceptual richness or paucity of the linguistic community in which they were raised. In some instances the phenomena themselves are

constrained by the natural laws of our physical world. What our group has come to realize is that in order to extend the students' thinking and understanding about a phenomenon (e.g., static electricity), we had to be in a relationship with students that would allow for a better understanding of their existing ideas about the topic, how those ideas were influencing the meaning they were making of the classroom situation at that point in time, and the effects of instructional strategies employed in particular situations. In other words, we realized that the students needed to be in a collaborative relationship with the teachers in much the same way as we endeavored to establish a collaborative relationship between the teachers and university educators in the project itself.

This coherence comes from a shared set of beliefs and values about how people learn. Since all of the contexts in which we were operating — various classroom settings and professional development activities — involved some aspect of learning, it would seem that these shared commitments provided the continuity and structure we had implicitly noticed. Furthermore, a form of collaboration appeared to be an integral part of the learning environments that we endeavored to establish in those contexts involving student learning as well as those involving teacher learning.

In summary, I am arguing that an unintended byproduct of our activities was the generation of a set of collaborative relationships among the various participants in the several different educational contexts in which we were acting. Given our approach to the problems and issues arising from these contexts, it seems that collaboration is a crucial condition for achieving the pedagogical aims we were seeking.

In the next section I explore the nature of collaborative relationships in some of these contexts. In the latter section of this paper I examine some of the general principles that would appear to underlie these relationships.

### *Contexts of Collaboration*

There seem to be three general educational settings or contexts in which it makes sense to talk about collaborative relationships. These contexts and their associated relationships are presented in Figure 4.

The setting around which most of the work in our project has centered is the classroom. The primary relationship in this setting obviously is that between the teacher and the students. However, there were three other relationships that were also of concern to our project — that of student/student, teacher/teacher, and teacher/university educator. While there could clearly be other types of collaborative relationships in a given classroom, such as principal/teacher or curriculum consultant/teacher, I have only mentioned those relationships that were exemplified in our project.

**Figure 4**  
**Contexts and Purposes of Collaborative Relationships**

Context	Type of Relationship	Purposes
Classroom	student-student	to enhance shared understanding (e.g., cooperative learning)
	student-teacher	to provide negotiated understanding (e.g., constructivist teaching)
	teacher-teacher	to promote reflection and shared language of teaching (e.g., peer coaching)
	teacher-consultant or university educator	to promote reflection and classroom-based inquiry
School	teacher-teacher	to develop shared culture of teaching (e.g., PEEL project)
	teacher-administrator	to implement school-wide changes (various implementation models)
	teacher-university educator	to promote school-based inquiry (e.g., PEEL)
District	school-school	to address system-wide issues and problems of educational practice through inquiry and
	district-district	to coordinate development activities (e.g., consortium concept and school-university partnerships)
	district-university	

Because our project teachers were from different schools, we were not able to move easily from the classroom context to school-level contexts. We think that ultimately this transition from the classroom to the school context is crucial in providing the psychological, intellectual, and institutional resources necessary for developing and sustaining a climate of collaborative inquiry. While the literature on professional development contains many accounts of collaborative projects, there is one such project that exemplifies, at the school-level, some of the principles that guide our work. This project, which was given the acronym of PEEL (Project to Enhance Effective Learning), originally involved 10 teachers in five different subject areas located in a secondary school in Melbourne, Australia. Fortunately, they documented their efforts to collaborate with each other and with their pupils in the form of a book (Baird & Mitchell, 1987). Most of the teachers involved in this project wrote straightforward yet eloquent accounts of their efforts to encourage their pupils to take more responsibility for their own learning. The book contains numerous accounts of the many problems

faced by these teachers and their conjectures about which of their actions were successful and which were not. As such, it contains a wealth of information on the conditions which they judged to be essential in establishing and nurturing the collaborative culture which they managed to establish with this project. The basic philosophy and collaborative model for PEEL has subsequently been adapted by 12 or more schools in the Melbourne area and the book is now cited extensively in the research literature on teacher development.

Another context in which collaborative relationships could be nurtured is at the district level. Here one might aim to coordinate work at several schools in an endeavor, for instance, to introduce new curricular, instructional, or organizational policies. As above, the educational literature (in this case on implementation) is filled with reports of collaborative projects which have been implemented at the district level. One of the most interesting developments at this level is the series of school-university partnerships that are affiliated with the Center for Educational Renewal established by Goodlad and Sirotnik. In addition to publishing books dealing with some of the practical, theoretical, and methodological issues of these partnerships (Goodlad, 1990; Sirotnik & Goodlad, 1987), they also distribute regular newsletters on recent developments and issues associated with these partnerships.

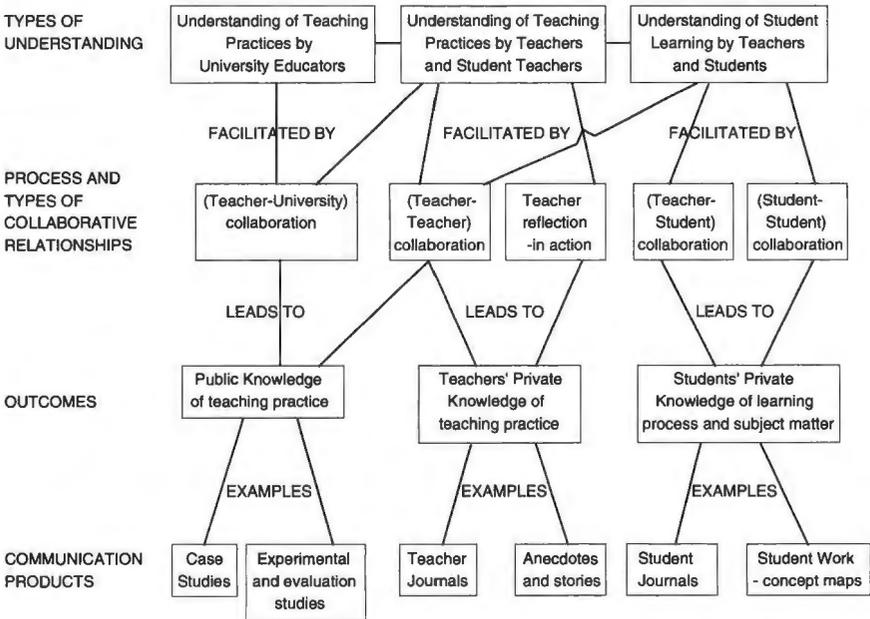
### *Principles of Collaboration*

As indicated in the introduction of this paper, the diversity of contexts and purposes in which collaborative relationships develop militates against the search for a *definitive* set of principles or values that would be shared by all projects. Nonetheless, it may be possible to generate some set of more generalized, underlying principles to characterize projects which display considerable overlap in their purposes. In particular, it is crucial when addressing the notion of underlying principles to identify the intended purposes for establishing a collaborative relationship. In the following discussion, these purposes are outlined as they pertain to the types of collaborative relationships that we established in the (SI)<sup>2</sup> Project.

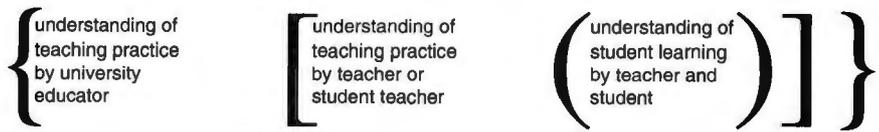
One of the underlying purposes of our project that was shared by all of the participants was that of understanding and improving the learning process as it was manifested in two areas — student learning and teacher learning. While these two areas can be separated for the purpose of analysis, in our project they were totally interconnected, or nested, when examined from the perspective of the classroom. However, it should be emphasized that even though our common purpose was that of understanding and improving learning, each of the group members brought to the project somewhat different concerns, understandings, and concepts. This is not surprising for several reasons. First, the teachers were dealing with students at different grade levels in different subject areas. Second, the specific reasons for seeking an understanding of the learning/teaching

environment differed among the project members. The primary purpose for the teachers was oriented toward the set of problems associated with conducting effective lessons with particular classes. The primary purpose for the university educators was to understand and write about the learning process as experienced through direct observation of lessons or vicariously through videotape or discussion. These differences in understanding the teaching and learning practices in our project are summarized in Figure 5. In this diagram I related the types of understanding associated with the various collaborative relationships in the project and indicated the primary outcome emanating from these relationships. While the terms *public* and *private knowledge* clearly require further elaboration, the only claim I wish to make at present is that one of the aims of university educators ought to be to make a public claim of their understanding of those teaching practices which enhance student learning. This is not to say that teachers or even students may not make public claims and that university educators do not construct private meanings; rather I am suggesting that the most common purpose of students' or teachers' understanding is generally that of increasing their own private knowledge base.

**Figure 5**  
**Collaborative Inquiry in the (SI)<sup>2</sup> Project**



In the context of our project these three types of understanding can be thought of as being nested as illustrated below:



The most nested or most basic form of understanding is that of student learning. The nature and substance of this understanding changes, however, as the focus of attention shifts from the students' understanding of their own learning, to the teachers' understanding of student learning, to the university educators' understanding of the teacher's practice and the way in which this practice influences student learning.

While recognizing the context-dependency of purposes and understanding, we may still ask whether it is possible to identify some underlying structure of beliefs and values that could be described in terms of a more generalized set of principles. Because we are concerned with collaborative relationships among people engaged in activities aimed at obtaining an improved understanding of learning and teaching, these principles will have an empirical and a moral (or normative) component. The former component results from our beliefs about teaching and learning and they are, for the most part, a product of our prior educational experiences. These beliefs, which influence our understanding of how we, or others, learn something, are primarily empirical in nature. They are continually being checked against the reality of specific learning situations to determine their viability. The latter, normative component results from the recognition that collaborative relationships, like teaching relationships, involve a significant interaction between two or more humans and these actions are always subject to scrutiny in terms of some set of moral standards (Goodlad, Soder, & Sirotnik, 1990).

In Figure 6 these two components are represented by a general set of empirical and normative statements which seem to characterize the nature of the collaborative relationships as they have been operative in our project. The empirical components focus primarily upon our experiential model of learning which draws extensively upon a type of neopragmatist account of knowledge construction such as that developed by Schön (1983, 1988) or Hirst (1983) in the context of professional knowledge. The notion of reflective inquiry into problematic situations is a very prominent feature of this position.

Other empirical commitments include the notion that the acquisition of knowledge is developmental in nature. This implies that we are dealing with

## **Figure 6** **Principles of Collaborative Relationships Aimed at Understanding and Improving Learning**

### **Empirical Propositions**

- Learning often involves a process of inquiry into problematic situations. Therefore, collaborative relationships must view teaching practice as being a form of reflective inquiry requiring both an open and a critical stance towards the problems of teaching.
- Learning involves a process of continual growth. Therefore, collaborative relationships must endeavor to promote a disposition for reflective thought and behavior.
- Learning is promoted when more responsibility and control (i.e., autonomy) is given to the learner. Therefore, collaborative relationships must result in endeavors to validate learners' existing knowledge and provide opportunities for them to extend it.

### **Normative Propositions**

- Teaching is a relationship involving mutual trust and inquiry. Therefore, collaborative relationships must foster an atmosphere of openness and the sharing of intentions and concerns, while still promoting critical comment.
- Teaching involves the taking of personal/professional risks. Therefore, collaborative relationships must acknowledge the nature of these risks and attempt to establish some degree of reciprocity among the partners in terms of risk-taking activities.
- Teaching should display both personal and intellectual respect for the learners. Therefore, collaborative relationships must be concerned with the giving of reasons for their actions.

lifelong learning; hence, our task is to try to develop dispositions which would enable this sort of learning to occur throughout a learner's (or a teacher's) life. Finally, our perspective also commits us to a view that we can promote learning by validating the learners' existing knowledge and encouraging them to take more responsibility and control over their own learning. That is, we are seeking to develop autonomous learners (Candy, 1991). I would argue that these are primarily empirical propositions because they are open to criticism and refinement on the basis of empirical evidence.

The other set of propositions listed in Figure 6 are primarily normative in nature since they entail a commitment to those moral principles which guided the conduct of the participants involved in the project. The first such proposition is the establishment of an atmosphere of mutual trust and openness that will permit individuals to voice their own intentions and concerns in teaching/learning situations. This proposition is related to the autonomy condition above since it would be difficult for a learner to become more autonomous unless this kind of mutual trust were present in the collaborative relationship.

A second related proposition involves the importance of recognizing that teaching and learning require some degree of risk and that there should be some degree of reciprocal sharing of these risks in collaborative relationships.

A final proposition that we think is fundamental to our notion of collaborative relationships is the importance that we attach to establishing personal and intellectual respect for the learner. Because we think of all the participants in our project as learners, this proposition applies to all three collaborative contexts.

In conclusion, I have argued that collaboration requires some form of working relationship toward a common goal or set of purposes. Thus, the contexts of these relationships, which determine the purposes of the activities, are critical in determining any specific meaning to be attributed to this term. This stance is not to deny the importance of obtaining some conceptual clarity for the use of these terms, but rather to examine the way in which the terms are used in a specific setting or project. A collaborative project with teachers, student teachers, and university educators directed towards the improvement of science learning was used as an example of such a specific setting. In analyzing the types of activities that we engaged in and the different types of understandings that we hoped to generate in the project, I claimed that one could differentiate between several kinds of collaborative relationships. Furthermore I argued that it was possible to articulate some general empirical and normative principles that characterized the nature of the collaborative relationships which evolved in our project. These principles followed from our commitment to a "constructivist perspective" on learning. They constitute, in my view, the most fruitful level of analysis for representing both the substance and the function of the collaborative relationships as experienced by the members of our project team.

---

The author would like to acknowledge the support from the Social Sciences and Humanities Research Council of Canada in funding the work which led to the preparation of this article.

## References

- Aguirre, J. & Kuhn, K. (1988, June). *An interpretive approach to learning science: The journal method*. Paper presented at the meeting of the Canadian Society for the Study of Education, Windsor, Ontario.
- Armstrong, M. (1980). *Closely observed children*. London: Writers & Readers.
- Baird, J. & Mitchell, I. (1987). *Improving the quality of teaching and learning: An Australian case study — the PEEL Project*. Melbourne: Monash University Press.
- Candy, P. (1991). *Self-direction for lifelong learning*. San Francisco: Jossey-Bass.
- Carr, W. & Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research*. London: Falmer Press.
- Driver, R., Guesne, E. & Tiberghien, A. (Eds.). (1985). *Children's ideas of science*. Milton Keynes, UK: Open University Press.
- Driver, R. & Oldham, V. (1986). A constructivist approach to curriculum development in science. *Studies in Science Education*, 13, 105-122.

- Erickson, G. (1983). Student frameworks in science instruction. In H. Helm & J. Novak (Eds.), *Proceedings of the international seminar on misconceptions in science and mathematics*. Ithaca, NY: Cornell University Press.
- Erickson, G. (1984). *Development of an instructional approach based upon a cognitive perspective*. Proposal submitted to the Social Sciences and Humanities Research Council of Canada.
- Erickson, G. (1987, April). *Constructivist epistemology and the professional development of teachers*. Paper presented at the meeting of the American Educational Research Association, Washington, D.C.
- Erickson, G. (1988, June). *Processes and products from the (SI)<sup>2</sup> Project: Anatomy of a collaborative approach*. Paper presented at the meeting of the Canadian Society for the Study of Education, Windsor, Ontario.
- Erickson, G. & MacKinnon, A. (1991). Seeing classrooms in new ways: On becoming a science teacher. In D. Schön (Ed.), *The reflective turn: Case studies of reflection in and on practice*. New York: Teachers College Press.
- Goodlad, J. (1990). *Teachers for our nation's schools*. San Francisco: Jossey-Bass.
- Goodlad, J., Soder, R., & Sirotnik, K. (Eds.). (1990). *The moral dimensions of teaching*. San Francisco: Jossey-Bass.
- Gurney, B. (1988, June). *Conceptual change through negotiation*. Paper presented at the meeting of the Canadian Society for the Study of Education, Windsor, Ontario.
- Hirst, P. (1983). Educational theory. In P. Hirst (Ed.), *Educational theory and its foundational disciplines*. London: Routledge and Kegan-Paul.
- Kuhn, K. & Aguirre, J. (1987). A case study of the "journal method": A method designed to enable the implementation of constructivist teaching in the classroom. In J. Novak (Ed.), *Proceedings of the 2nd international seminar on misconceptions and educational strategies in science and mathematics*. Ithaca, NY: Cornell University.
- Lieberman, A. (1986). Collaborative research: Working with, not working on .... *Educational Leadership*, 43(5), 28-32.
- Lieberman, A. (Ed.). (1988). *Building a professional culture in schools*. New York: Teachers College Press.
- Lieberman, A. (Ed.). (1990). *Schools as collaborative cultures: Creating the future now*. London: Falmer Press.
- MacKinnon, A. (1988, June). *Conceptualizing a science teaching practicum: "The hall of mirrors"*. Paper presented at the meeting of the Canadian Society for the Study of Education, Windsor, Ontario.
- MacKinnon, A. (1989). Conceptualizing a hall of mirrors in science teaching practicum. *Journal of Curriculum and Supervision*, 5 (1), 41-59.
- MacKinnon, A. & Erickson, G. (1988). Taking Schön's ideas to a science teaching practicum. In P. Grimmett & G. Erickson (Eds.), *Reflection in teacher education*. New York: Teacher's College Press.
- Marin, P. (1988). *Collaboration in elementary science teaching: Four cases*. Unpublished doctoral dissertation, University of British Columbia, Vancouver.
- Minstrell, J. (1984). Teaching for the development of understanding of ideas: Forces on moving objects. In C. Anderson (Ed.), *Observing science classrooms: Observing science perspectives from research and practice*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.
- Mitchell, I. (1984). *Instructional strategies for changing a student's world view*. Unpublished master's thesis, Monash University, Melbourne.
- Morawetz, T. (1978). *Wittgenstein and knowledge*. Amherst, MA: University of Massachusetts Press.
- Parsons-Chatman S. & Sieben, G. (1988, June). *A case study of concept mapping and other constructivist instructional strategies for teaching a unit on the environment*.

- Paper presented at the meeting of the Canadian Society for the Study of Education, Windsor, Ontario.
- Rowland, S. (1984). *The enquiring classroom: An approach to understanding children's learning*. London: Falmer Press.
- Schön, D. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.
- Schön, D. (1987). *Educating the reflective practitioner*. San Francisco: Jossey-Bass.
- Schön, D. (1988). Coaching reflective teaching. In P. Grimmett & G. Erickson (Eds.), *Reflection in teacher education*. New York: Teachers College Press.
- Schön, D. (Ed.). (1991). *The reflective turn: Case studies of reflection in and on practice*. New York: Teacher's College Press.
- Sieben, G. (1987). Introducing concept mapping in the day to day science curriculum. In J. Novak (Ed.), *Proceedings of the 2nd international seminar on misconceptions and educational strategies in science and mathematics*. Ithaca, NY: Cornell University.
- Sirotnik, K. & Goodlad, J. (Eds.). (1987). *School-university partnerships in action: Concepts, cases, and concerns*. New York: Teachers College Press.
- von Glasersfeld, E. (1989). Cognition, construction of knowledge, and teaching. *Synthese*, 80 (1) 121-140.
- White, R. (1988). *Learning science*. Oxford: Basil Blackwell.