The Professional Life of Teachers

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At the Fifth International Congress of Mathematical Education in Adelaide, Australia, we conducted a session that addressed the following factors related to the professional life of teachers: research (Cooney), curriculum development (Goffree), and reform in mathematics education (Stephens). Marilyn Nickson provided concluding and summarizing remarks for the session. This article represents an overview of our presentations and provides a commentary on how the various factors mentioned are related to the professional life of teachers.

Metaphors and Their Implications for Research

THOMAS COONEY

Lakoff and Johnson [1980] have argued that metaphors play a pervasive role in the way we think and act in our daily lives. Consequently, we can argue that metaphors also play a pervasive role in the way we conceive research activities particularly research involving classroom teachers. Hence, it seems reasonable to assume that reflecting upon metaphors and how they potentially influence such research activities can increase our sensitivity to the possible roles researchers play.

Metaphors abound when the subjects of teaching and learning are discussed. References to medicine and coaching are made frequently in the contexts of talking about how the profession might better proceed. Clark [1978] has noted that references to the teacher as a clinical information processor, a decision maker, a diagnostician, and a problem solver exist in the literature. The use of terms such as "transmit mathematics" suggest a broadcasting metaphor where the role of the teacher is to provide as clear and distinct a message as possible, the assumption being that clarity is a virtue in the teaching of mathematics. When the metaphor of engineering is used to describe mathematics education, there is an implicit assumption that the field profits from a component analysis rather than a holistic one, that is, if we can "fix" the component parts, somehow the whole will necessarily improve. Such a metaphor is usually consistent with the notion of transmitting mathematics in that the goal of the "engineer" is to find better ways for teachers to transmit mathematics to students. Recently, the learning of mathematics has been described using computer metaphors, as suggested by Kilpatrick [1985].

Snow [1973] has argued that metaphors can play an important role in helping us envision what the field might be

> The development of metaphors can be an important form of theorizing, not to be ignored or criticized when used with a realistic perspective. (p. 82)

Hence it is argued that the use of metaphors to reveal issues related to the nature of the questions we ask and the methods we choose can be a fruitful and nontrivial activity.

To illustrate, consider the continuing problem in teacher education of trying to understand why we seem to be successful with some interns in influencing how they teach mathematics while others fail to assimilate whatever knowledge or beliefs we attempt to convey into any form of operational behavior. For example, in working with teachers in an extensive inservice program Good, Grouws, and Ebmeier [1983] found that

> most teachers who implemented the program obtained positive gains from students; however, *it is not clear why some teachers implemented the program better than others* (p. 196). (Authors' emphasis.)

The question raised is one with which teachers educators everywhere struggle. It is a question basic to our profession and deserves consideration just as we wonder why some students acquire certain mathematical knowledge and others do not.

Metaphors can help reveal approaches and alternatives to addressing the problem. Good, Grouws, and Ebmeier [1983] embrace a technological metaphor when they conclude that

> Only more research that involves the development of more advanced training procedures as well as alternative instructional procedures will clarify this issue. (p. 196)

The claim that research on more advanced training procedures is the ony way to clarify the question suggests that the question can be properly cast in a comparative form, i.e., more than, less than, or better than, and that the solution lies with the selection of paradigms suppportive of comparisons, paradigms that Mitroff and Kilmann [1978] term *analytic methodologies* which characterize much of the research in the "hard" sciences. Research which uses such

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methodologies finds strength in structure, an apparent freedom from bias, and the hope that replications will yield reliable generalizations. There is security in its use because of its proven record in so many disciplines, most notably the hard sciences.

Since the 1980 Berkeley Congress there has been an increased interest and use of humanistic methodologies as defined by Mitroff and Kilman [1978]. The most notable example is the rediscovery of ethnographies and the case study. The assumption seems to be that the more statistically oriented methodologies are lacking when problems involving the complexities of classroom life are considered. Yates [1983] emphasized that it is folly to feel comfort in reducing the multidimensionality of the classroom to an analysis of what appears to be key variables. What is not so clear is whether our metaphors have also changed, i.e., whether we have decided to adopt paradigms that generate different questions or whether we cling to the same metaphors, the same questions, and have changed only the means by which we study the questions.

The importance of considering alternate questions was echoed by Silberman [1970] who suggested that educators and especially teacher educators have suffered too long from a preoccupation with finding answers, usually to the question of how we can better train to competence, and consequently neglected the art of asking better questions. Recall that in the field of geometry a shift from the question of how the parallel postulate could be proved to whether it was provable at all led to dramatic progress in conceptualizing not ony the specifics of non-Euclidean geometry but also how axiomatic systems were viewed more generally. Given the highly eclectic nature of our field, it is unlikely that progress of such a dramatic sort will evolve from more imaginative questions but neither should we assume that reliance on existing questions and metaphors will result in improving the professional life of either teachers or teacher educators.

In search of new metaphors

Brown [1982] urges us to consider alternative metaphors

> There is an unwarranted feeling of optimism in the field of teacher education. I do not mean to imply a proposition of extreme arrogance but rather that we operate as if we believe that we are not far from the mark. More research may be needed and we may have to "tool up" on our techniques to improve our art a little but we seem to believe that at the very least we are headed in the right direction and are governed by the right set of paradigms.
>
> I believe that the misplaced optimism has its roots not only in the language we use explicitly (like teacher training) but in the implicit metaphors we hold as well (metaphors that derive from a technological view of the field) and in our consequent inability to even imagine alternatives. As a result our models of both research and practice tend to be limited in number, narrow in scope, and lacking in imagination. (p. 1)

Brown suggests the metaphor of therapy as one possible alternative. It is not that teacher educators should become therapists, argues Brown, but rather they should attempt to focus on reflective behavior, behavior so basic to much of therapy. Central are the activities of redefining problems and questions that enable people to understand themselves in new lights and to appreciate alternative orientations when pedagogical problems are encountered. The notion of finding solutions is replaced by the notion of making headway as problems are conceptualized and reconceptualized. Reflection, which is necessarily a humanistic process, suggests the use of humanistic methodologies with an emphasis on meanings and understandings and the elevation in importance of the individual as a research participant.

Whether one favors technological or humanistic metaphors depends, at least in part, on how one views progress in learning about the teaching and learning of mathematics. If importance is placed on the revelation of general truths and principles, then educational research is judged by the "power" of the resulting generalizations to yield predictions and useful prescriptions. Generality is the key if the goal is to have a sufficient knowledge base that most or at least many educational problems can be addressed substantively and successfully.

Research stemming from humanistic metaphors requires a different orientation, an orientation that emphasizes meanings individuals hold and consequently form the basis for what Stake [1978] calls "naturalistic generalization", that is, generalizations that are derived from tacit knowledge that is a composite of shared meanings, experiences and emotions among humankind. Such generalizations and their inherent meanings provide the basis for communication among people with diverse backgrounds, perhaps even without a common spoken language. Stake has argued that to generalize in a "natural" way is to be both intuitive and empirical. As Eisner [1981] put it, there is generality in the particular.

Our concept of generality and how we view progress is central to the means by which teachers are engaged in the research enterprise. If the researcher positions himself as an analytic scientist with all of its implicit meanings and beliefs, then he is obligated to distance himself from the teacher and to define the teacher's role accordingly so as to insure objectivity. A humanistic approach to the research enterprise necessitates the minimization of distance and requires a spirit of intimate collaboration in order to understand the meanings idiosyncratic to the individual teacher.

Most research publications in the United States reflect the more technological metaphors and use analytic methodologies as described by Mitroff and Kilman [1978]. Although humanistic methodologies, e.g. ethnographies and case studies, are becoming more popular or at least more discussed, they are but few in number in terms of published material. Is it the case that technological metaphors provide the context for progress but, as Burkhardt [1983] has suggested, we suffer from inadequate tools or conceptualizations to make more than crude approximations? Or is it the case as Brown [1982] has argued, that the tracks we ride are wrongheaded?

Each researcher has his or her own dispositions about

how and what kind of research should be conducted. But consideration of the metaphors we hold and of the way we envision our professional activities can reveal much of what is basic to what we believe. For as we would like teachers to reflect on their behavior and beliefs and consider the sometimes painful question of whether perceptions and ideals are harmonious, so also should we raise the question of whether the metaphors we hold are consistent with what we would like the profession to be. The experience might be no less painful but also no less rewarding than what we ask of the practitioner. By considering metaphors and their concomitant meanings and implications perhaps we can become more imaginative in constructing models for research and practice and in finding ways of improving the professional life of teachers.

The Teacher and Curriculum Development

FRED GOFFREE

In general we can say that curriculum developers used to be teachers who had distinguished themselves because of their *studious, reflective, and productive* atttitude. This attitude led to the development of certain subject material for the students, to reflection on the personal contributions of the student and to a continued review of related literature. After becoming professional curriculum developers, with more time available for reflection and study and less time for classroom teaching, they created, with new colleagues from various disciplines such as psychology, curriculum theory, and general education, new perspectives for considering curriculum development. As a result a real educational problem developed: the expertly-developed material did not always render the desired result.

Why are the desired results not always obtained? A contributing factor is the problem of curriculum implementation, usually considered only from the developer's point of view. What is needed is to take into account both the curriculum developer and the teacher as well. Because using new curriculum materials often requires radical changes in the practice of teaching and the philosophy of teaching, we should recall Freudenthal's tenth major problem of mathematics education concerning innovation.

> Curriculum development viewed as an innovation strategy is a wrong perspective. My own view, now shared by many people, is that educational development, so it was posed, is not more development on paper, but a matter of people. [Freudenthal, 1983, p. 6]

The teacher and the curriculum

If school mathematics textbooks are analyzed, various impressions of basic views on mathematics education can be recognized. Analyses of mathematics textbooks at the primary level reveal four different perspectives: the mechanistic view, the structuralistic view, the empirical view and the realistic view. However, as we know, textbooks alone do not reflect the reality of teaching and learning in classrooms. It is good to have in mind Robitaille's [1981] distinction between the "intended, implemented and realized" curriculum. What curriculum developers intend is not always consistent with what children learn. Thus the teacher's contribution to the teaching-learning process cannot be neglected if curriculum development is to have the desired classroom impact.

Related to the teacher's contributions are three different concepts of teacher use.

i. *Instrumental use* The textbook is followed to the letter; learning should occur along the presented sequence of learning tasks.
ii. *Subjective use* The teacher firstly makes a constructive analysis of the material and then elaborates on the material based on personal beliefs and knowledge.
iii. *Fundamental use* The curriculum material is constructively analysed, but now the underlining philosophical view of mathematics education is taken into account as well.

These concepts of teacher use combined with the four basic views on mathematics education can provide a basis for describing changes in teachers' behavior. A drastic change is required, for example, when an instrumental user of a mechanistic textbook series is asked to implement fundamentally realistic curriculum material. Such a change is much more dramatic than the changes expected during the so-called new math movement (which was strongly related to subject matter only) and even more dramatic than changes expected by researchers (of learning processes, developmental stages, social interaction etc.) in more recent times who advocate a teaching style based on a particular theoretical perspective. Consider the professional growth that would be required by most teachers if a constructivist paradigm were to be used as a primary instructional theme.

Several curriculum implementation projects within and outside the field of mathematics education concluded that "change" should be replaced by "professional growth", "implementation" by "adoption" and "using curriculum materials" by "investigating". It became clear in many projects that teachers and curriculum developers should be partners in teaching, developing and research.

The teacher as a "do-it-yourselfer" in curriculum development

A curriculum development project in a large primary school in a small Holland village involved teachers as participants in developing materials, partners in research and observers of the teaching of the materials. The project's title "From verbal problems to realistic mathematics" reveals some of the intended changes. Developments until now have resulted in a new series of primary school mathematics textbooks.

Children who became accustomed to the new textbooks had difficulty in handling the old test questions. They had trouble solving the "old" verbal problems, not being sure of how to get started. In general, motivation was a problem

when verbal problems were presented. While a few students did extremely well, most students did quite poorly. An analysis of tests and textbooks uncovered a number of causes. The language used in the textbooks emphasized processes rather than products, for example, working with charts and graphs and presenting situations that were realistic. The textbook problems were often open-ended and the children had longer to work on the problems. In contrast, the test problems were of eight different types and were to be solved in three quarters of an hour.

Subsequent analyses revealed even further complexity. In spite of the new textbooks and the fundamentally different approach, many teachers still lived in the "wondrous world" of traditionally-worded problems in which algorithms, not heuristics, are emphasized and the personal experience of students is minimized. Thus the difference between the intended curriculum and the realized curriculum (how the textbooks were used) was considerable.

This difference also became apparent to the teachers when the curriculum developer rewrote one of the problems from the (new) textbook as a sort of mathematical practical assignment. In it he expressed explicitly that which characterized the intended curriculum and that which had remained implicit throughout the book for the teachers to consider. While the basic concepts: "context", "meaning", "thinking model", "interaction", "informal mathematics", "activity" and "personal constructions", were meaningful and concrete to the curriculum developer, they were but abstractions to the teachers.

So there are two worlds, the world of the teacher and his standard-worded problems and the world of the curriculum developer with his rich mathematical problems. These two worlds became "one" in a school with 14 teachers and pupils aged 4 to 12. The first practical project (about fire) appeared to lead to some spectacular events in the classroom. The teachers worked the subject out first for themselves and then presented it to the class in a discussion format. Together with the curriculum developer they started working on the development of other "rich problems" and eventually tried the problems in class. The results were discussed with the students on a regular basis. Slowly but surely the personal theories of the teachers and the underlying concepts of the curriculum developer began to emerge. Sometimes the teachers asked for training sessions which included a 24 hour conference devoted to developmenmt and training.

The result for the school was a large number of packages with rich problems. This exceeded everyone's expectations. A number of teachers were reflective and became aware of the growth in their expertise. The curriculum developer described the course of events, the developed materials, the relevant didactics and the underlying philosophy in the form of a practice and study book for other school teams called "From Verbal Problems to Realistic Mathematics". Besides this information, the book also included problems that could be solved partly in class and partly by means of creative developmental activities.

This project also provided the impetus for extensive activity by the school team on its own. Like the original project, this one also had a realistic orientation in developing problems. For the teachers this curriculum activity provided additional insights as to the intentions of the curriculum developer. From that point on concepts such as context, meaning, thinking model, and interaction took on new, personal meanings.

Since the practice and study book has only just recently been made available, it is too soon to say anything about the transferability to other school teams. The basic question is whether the pertaining method of the active-constructive implementation can be realized by means of a "practice and study book".

Images of Reform

MAX STEPHENS

When considering reform in mathematics education, it is worth considering three models of curriculum development that give carriage to possible reform. The first model relies on the prescription of a common course of study for all schools. The second refrains from presenting schools with a common syllabus to be adopted and instead gives them the responsibility of interpreting and adapting an externally prepared set of curriculum guidelines. A third model attempts to foster school-based curriculum development with external advice and support but with as few prescriptions as possible.

The traditional and most common model has been through a centrally devised syllabus or course of study. This model is usually associated with changes determined by a central educational authority. Rarely do teachers themselves have much say in what constitutes the prescribed course of study. Frequently this course of study is linked to a set of approved textbooks or to a system of external examinations for which teachers are required to prepare their students. Within such a system, teachers' success tends to be measured by the ability to prepare candidates to do well in examinations or in national or statewide tests. This combination of an externally prescribed course of study, joined as it often is with a system of public testing, assumes that teachers work best when they have very clear directions about what to teach and how their success is to be measured.

Implicit in this first model is an assumption that there is an appropriate mathematics program for all schools. It assumes that textbooks and syllabi effectively transmit that program to schools and that these same means can ensure that the program is taught as intended. Within this model, curriculum change is seen to depend on the efficient transmission of information to schools.

Indeed, the metaphor of transmission is a key to understanding the role of teachers in this pattern of curriculum development and its communication to schools. Teachers are depicted as consumers of predefined mathematical knowledge. In turn, students are treated as consumers of what teachers have to pass on. It is no surprise, then, that when teachers are powerless to influence what mathematics is to be taught and how they are to teach it, young people in schools themselves experience a sense of power-

lessness in taking responsibility for and ownership of their own mathematical knowledge. From a teachers' perspective, curriculum change is seen as an updating of externally contrived knowledge.

The second model attempts to enhance the professional role of teachers through the use of guidelines for teaching mathematics. Guidelines can be used to communicate to teachers some of the insights and assumptions which have been used in constructing a school mathematics program. They need not incorporate a completely detailed course of study, being intended instead to leave schools and school districts with scope to develop their own courses of study, or to assist them in modifying and adapting current programs.

When this second model is used it is common to speak of "assisting schools and teachers" rather than telling them what to teach. There is an assumption that guidelines embody the collective wisdom of mathematics educators such that schools and school districts will choose to implement them rather than go their own way. It is assumed that teachers look for external support and direction in planning their mathematics programs while at the same time wishing to exercise a right to shape and adapt courses to suit local needs and conditions.

Implicit in this second model is a belief that guidelines can serve as a means of regulating the direction of reform and that national and local agencies, using the guidelines, can effectively support and monitor reform. Thus the use of guidelines cannot be separated from the expectation that teachers will become accountable, especially at a local level, for what they teach in their mathematics classrooms. As public enactments they serve to relate schools to a critical public and to project "images of efficiency, effectiveness and responsiveness demanded of public institutions" [Popkewitz, 1982, p. 13]. To the extent that teachers are seen to embody these qualities, their role as professionals is enhanced.

The language of guidelines is drawn from and serves to entrench publicly available forms of discourse about schooling and mathematics. Left unchallenged is that view of mathematics as a pre-ordained, sequential and discrete body of knowledge (content, skills, and attitudes) to be made available to children. Also unchallenged is the relationship between school mathematics and the social processes of classrooms and the institutional arrangements of schools. Indeed, consideration of these relationships may require the disclosure of one's primary values and interests. Such disclosure might unearth assumptions that define order, authority and value in schools and the recognition that these factors also play an implicit but powerful role in shaping conceptions of school mathematics.

In the third model there is an emphasis on making each school the primary focus for curriculum planning and implementation. This model has for its goal, school-based curriculum development. To support this goal, a set of principles for school-based curriculum development is often provided by a central educational authority. This set of principles may be incorporated into a framework or guidelines as identified in the second model. Hence it might be argued that this model is a variant of the second model rather than a distinct pattern of curriculum development by itself. Nevertheless I believe it deserves consideration in its own right.

This model assumes that teachers, working together in their own school, are the people best placed to give specific shape to a mathematics curriculum. It assumes that teachers have the time and ability to work within broad guidelines for the teaching and learning of mathematics, and so to devise their own solutions to specific problems of curriculum development. Implicit in this model is a willingness to allow, and indeed foster, local variations in mathematics curricula and a confidence that schools, supported by appropriate resources, will achieve this task with a likely measure of success. This model is not favoured by those who seek rapid change in one direction; or by those who prefer to concentrate resources on very specific projects for reform. It is also poorly suited to those locations where those who teach mathematics are inadequately qualified or have little time or opportunity to plan new courses.

This latter model requires the best features of the professional life of mathematics teachers — a high level of skill and expertise in executing tasks of one's own choosing, a strong sense of collaboration among peers, and an ability to determine the current and future directions of one's work. These features represent a formidable challenge for any group of teachers. However, studies by Stephens [1982] and Donovan [1983] demonstrate how difficult it is to reform school practices at a fundamental level. Both studies show the pervasive effects of curriculum and organizational fragmentation on the teaching of mathematics, thereby limiting the possibilities of reform. Donovan [1983] found that "mathematical knowledge is socially constructed, that its distribution in schools confers unequal benefits, and that these differential benefits are related to institutional arrangements and wider social-cultural conditions" (p. 215).

Donovan [1983] also argues that reform of institutional arrangements within schools cannot proceed without challenging assumptions of order, authority and value which underlie those arrangements. How teachers view their professional role is inextricably related to these same assumptions. In this respect, the beliefs, purposes and values which teachers attach to their professional role may limit attempts to reform schooling, and in particular, the teaching of mathematics.

It is easy to opt for one model of curriculum development and to argue that it holds the best prospects for reform of mathematics education. It is more difficult to uncover in each model assumptions about school mathematics and the role of mathematics teachers. These assumptions are potently linked to the social and institutional context of schooling. Their potency resides in a capacity to create images of school-worthy mathematical knowledge and how it should be taught and learned. These powerful images dull our senses and prevent us from asking, "Whose interests are being served by school arrangements for the teaching of mathematics; whose knowledge is being valued; what messages are given to those who are not enjoying success; and what roles are they prepared for in life after school?"

Aspects of the Professional Life of Teachers

MARILYN NICKSON

It is important to note that what we have been concerned with here is the teacher as an individual person involved in the educational process as opposed to describing teachers in terms of their skills or characteristics. Cooney raised our sensitivity to the metaphors we hold and suggested that metaphors which emphasize individuality can provide a contrast to the more technological metaphors and provide us with added insights on how we might proceed as a profession. Goffree focused upon the professional development of the teacher through interaction with a curriculum developer. Finally, Stephens is concerned with the broader social framework in which teachers work and the effects of the constraints imposed by that framework. What emerges is the notion that by studying the interaction of teachers of mathematics viewed within three different areas of activity, it is possible to gain insights into how they may increase their professional effectiveness as mathematics educators.

Presently, our profession appears to stress mathematics education more generally than just the teaching of mathematics (a view which has been supported in the U.K. by, for example, the Mathematical Association [1976] and Griffiths and Howson [1974]). Fundamental to this emphasis on mathematics education is that it leads to the development of the ability of pupils to interpret the environment in which they live in mathematical terms, and thus leads to the relevant uses of mathematics in their everyday lives. However, it is arguable that for this to happen it is necessary that the views of mathematics educators as to the nature of mathematics as a discipline need to be clarified. Otte [1979] suggests that the "controversy over the role content of teaching and the importance of the conception of mathematics for the organization of classes remains highly significant" (p. 120); our discussion here seems to highlight that significance. To suggest that views in mathematics education have changed begs the question of how many people in the field have taken the necessary step of articulating their personal view of the nature of mathematics. Is it perceived in terms of disembodied, abstract knowledge made up of facts, rules and algorithms? Or is it, perhaps, perceived as a kind of knowledge that has developed from everyday reality and as a result of different levels of social activity?

Clearly, whatever our perceptions may be, these will determine our beliefs and will provide a rationale for choices and actions and, ultimately, the kinds of teaching situations that are created in the classroom. If teachers are to meet curriculum developers on equal terms as suggested earlier, this step of identifying and clarifying beliefs and perceptions of their subject becomes even more important. Many benefits can follow from carrying out such a process, not the least of which will be the examination of constructs used which may freeze teachers in a particular stance in their approach to the teaching of mathematics.

Considerations of a similar kind are met on a broader scale when examining mathematics education in different cultures. Mellin-Olsen [1984] has identified factors that are particularly important when viewing related problems at this level. If curriculum development is to provide material relevant to the pupil's environment, then old and new knowledge must be reviewed and there should follow a general concern with context and meaning, as well as the different kind of interaction and activity that follow. Examination systems traditionally are the excuse for a lack of ability to bring about such change but there seems a possibility at least (within the U.K. for example) that there is a move towards advocating the construction of mathematics curricula from the "bottom up" as opposed to the "top down". The Cockcroft Committee [1982] has recognized the lack of reality in having a mathematics curriculum throughout all schools which is clearly out of touch with the everyday lives of the pupils for whom it is intended. A more general recognition of this factor could lead to more effective mathematical education for all pupils, wherever, and lead to the desired result of mathematically educated people, as well as to the production of some mathematicians en route.

The suggestion that what is needed is an orientation on the part of teachers towards teaching as a problematic and researchable activity seems a logical step that would follow. It would seem that if teachers are to reflect upon both their perceptions of mathematics and their role in teaching it, the metaphors adopted in so doing would dictate different methodologies. Reflection, in this context, would be expected to be a constructive activity leading to criticism and the exercising of judgment. As Popper [1974] suggests with respect to problems generally, we approach our situation "with an imaginative freedom that allows us to see so far unsuspected sources of error; possible prejudices in need of critical examination" (p. 37). In other words, following reflection, we must face the possibility that the metaphors we hold are not representative either of how we perceive mathematics or in turn of what we would like the profession to be, and take appropriate action.

The teaching of mathematics as with any other subject does, indeed, carry with it social messages which have considerable bearing on the pupils' interpretations of the world in which they live. It is when these social messages become removed from the pupil's world that concern is warranted. If our concern is deep-seated enough, then appropriate action to bring about change should follow. The constraints imposed on the teacher by certain features of school life in engaging in such changes have to be identified and dealt with. It has been suggested that as a result of these constraints, reform and innovation in schools tend to be confined to the superficial conditions of school life which present an image only of reality. The conflict between the professional maintaining institutional structures and the professional concerned with "educating mathematically" is real enough and clearly limits autonomy. However, if credibility in the goals of mathematics education is to be re-established or strengthened, then in the dialectic between institutional constraints on the one hand, and those imposed by a re-appraisal of the demands

of the nature of mathematics on the other, the professional as an individual as opposed to the professional as a member of an institution, must prevail. One way the teacher may develop sufficient professional autonomy to bring this about is by engaging in curriculum development with a curriculum developer on equal terms as suggested earlier. It may be that by coming together with other professionals and mutually sharing reflections on their work in an in-service situation, they may also gain clearer sight of the action to be taken.

With these thoughts in mind, it would seem that what is needed in mathematics education to add to the quality of the professional life of the mathematics teacher perhaps is not a new rhetoric of reform and change, but rather a clearly identified theoretical rationale for reform and change (which echoes Bauersfeld's [1980] plea for the need for a more theoretical orientation in mathematics education) It was suggested earlier that in attempting to bring about reform and innovation in school, a rhetoric of reform and change is adopted and, in the process, the rules and meanings that underlie institutional life are somehow filtered out leaving the impression that a consensus prevails. With a clearly articulated and well thought out rationale (relating to their perceptions of their subject, amongst other considerations), teachers may become more aware of what happens at this level and of how their intentions in bringing about change may be obstructed. The social and institutional context of schools does create powerful images that may "dull our senses" but the identification of such a rationale may, in turn, lead to the identification of strategies for the increased professionalism of teachers so that senses could become heightened rather than dulled.

What has emerged from our considerations here is a common basis that has to do with the notion of the social context in which mathematics education takes place, at three different levels. Firstly, examination of the part of the researcher studying classroom interaction has identified the importance of the different contexts produced by the adoption of different metaphors in how we approach our task as mathematics educators. Secondly, we have been concerned with the teacher and curriculum developer working side by side in the classroom to produce one kind of context. Finally, our attention has been drawn to the context of the institutional framework. What must not be neglected is the recognition that all three levels are contained in a particular cultural context which is the reality of the everyday life of our pupils. There has been some mention made not only of a degree of alienation of teachers from their profession but also of pupils from school and mathematics. The former might not occur to the degree that it does if we were to pay more attention to the latter. Mellin-Olsen [1984], in writing of pupils' perceptions of mathematics schooling, suggests that "In the case of cultures foreign to standard school cultures, it is vital to learn about not only the imagery and spatial systems of its members, but also of the kinds of contexts within which they are developed" (p. 157). This suggests reaching out to understand the reality of the pupil and, as teachers, creating contexts for the teaching and learning of mathematics that relate to that reality. It is possible, then, that the more humanistic approach advocated earlier with respect to research could pervade mathematics education more generally and lead to a concern for the social contexts created at a variety of levels. This could help to alleviate alienation by making our subject more accessible and meaningful to our pupils as well as to ourselves. What could better enhance our professional lives as teachers of mathematics?

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