I had the great good fortune to study with Ernst von Glasersfeld while I was a doctoral student at the University of Georgia between 1978 and 1983. My purpose in this short essay is to share how, 27 years later, the experience of working with Ernst continues to influence my work as a mathematics education researcher.

Given my background as a high-school mathematics teacher, I intended to focus on the learning and teaching of algebra when I entered the doctoral program in mathematics education at the University of Georgia. However, that changed dramatically at the end of my first quarter in the program when a fellow graduate student gave me two theoretical papers on radical constructivism by Ernst von Glasersfeld. I found Ernst’s epistemological arguments about the relation between knowledge and reality to be both compelling and jaw dropping. I was also fascinated by the neo-Piagetian model of cognitive development that Ernst had developed, which holds that people reorganize their thinking in order to resolve perturbations or disruptions in the world of their personal experience. At that time, Ernst was collaborating with Leslie P. Steffe, a professor of mathematics education, on a research project in which they were investigating the development of young children’s arithmetical reasoning from a radical constructivist perspective. I asked Les to be my major professor so that I could work on this project as a research assistant. Les kindly agreed and so I quickly became immersed in the world of early number learning and left thoughts of algebra behind.

With hindsight, I regard this project as a near ideal learning environment for a novice researcher and consider myself to have been remarkably fortunate. I was involved in an investigation in which we taught six children one-on-one twice each week for two years in order to bring about and thus study the critical moments when cognitive restructuring occurs. As part of this work, I participated in project meetings in which exchanges were passionate but never personal, and where what counted was the substance of the argument rather than the formal position or role of the person making it. In addition, Ernst invited me to join an interdisciplinary faculty reading group. This group met once a month to discuss a paper selected by one of the members, whose fields included biology, philosophy and history of science, and literary criticism. The papers shared by this group proved to be a rich source of analogies and ideas for someone attempting to understand young children’s arithmetical learning.

In many respects, my experience as a graduate student was that of an apprentice whose induction into academia was supported at every step of the way. In the process, I learned much that is intangible from Ernst. A few years ago, Kenneth Tobin asked me to write a short reflection on Ernst’s contributions to science education for a paper that he was writing in honor of Ernst’s 90th birthday. In the paragraph that is reproduced below, I tried to convey...
both my intellectual debt to Ernst and my profound respect for his personal integrity.

“I had the great privilege of studying with Ernst as a graduate student. As has been the case for many others, learning about epistemology and cognition with him proved to be a life-changing experience. Most importantly, Ernst has provided us with a model of what it means to be a scholar. It is a form of scholarship that permeates the very essence of how one understands oneself, others, and the world. He has taught us many things. One of the simplest and yet most profound is that there is no substitute for sustained, first-hand engagement with the phenomena that we seek to understand. Ernst’s influence on research in science (and mathematics) education is far reaching and ranges from basic issues of epistemology, to the methodologies we use, to how we think about cognition and communication. In a very real sense, he has precipitated a change in the discourse of science education. For this, we are very much in his debt.” (Tobin 2007: 529)

In the intervening 27 years, the focus of my work has shifted from developing cognitive models of young children’s mathematical reasoning to attempting to understand what it might take to support improvements in the quality of mathematics teaching on a large scale. At first glance, research located at the intersection of mathematics education, educational policy, and educational leadership might seem far removed from the epistemological questions that Ernst addressed. However, a number of lessons learned from Ernst have shaped this current work. In the following paragraphs, I first provide background information on this research and then illustrate the influence of Ernst’s constructivist theory of cognition and communication.

Investigating and supporting large-scale instructional improvement

The notion of instructional improvement necessarily involves a position on what counts as high-quality teaching, and thus on what is worth knowing and doing mathematically. The perspective that my colleagues and I have adopted is broadly compatible with that outlined by Ernst over 20 years ago (Glasersfeld 1987, 1990a). Our intent is that students will develop a deep conceptual understanding of central mathematical ideas as well as procedural fluency, and that they will become increasingly autonomous intellectually as they do so. Research in mathematics education, the learning sciences, and related fields indicates that students’ development of these capabilities is best supported by inquiry-oriented forms of instruction in which teachers attempt to achieve a mathematical agenda by building on students’ solutions to cognitively-demanding tasks. The development of instructional practices of this type is challenging and requires significant learning for most US teachers. Large-scale instructional improvement therefore requires that schools and districts develop the capacity to support teachers’ (and others’) ongoing learning.

My colleagues and I are currently investigating this issue by collaborating with teachers, school leaders, and district leaders in four urban districts in the US that serve a total of 360,000 students. Like most urban districts, the collaborating districts have to cope with a number of challenges including limited financial resources and high teacher turnover. However, the collaborating districts are atypical in one respect: district leaders are responding to high-stakes accountability pressures that are prevalent in the US not by pushing teachers to “teach for the test,” but by supporting their development of inquiry-oriented instructional practices that aim at ambitious learning goals for students. Participants in each of the four districts include 30 middle-school (early secondary) mathematics teachers from between six and ten schools and 20 school and district leaders.

Thus far, we have completed three annual rounds of data collection and analysis. Each October, we interview district leaders to document their current strategies or policies for supporting the improvement of middle-school mathematics instruction. In January through March of each year, we document how these policies are actually playing out in schools and classrooms. The data we collect include: audio-recorded interviews conducted with the 200 participants that focus on the school and district settings in which the teachers and instructional leaders work (e.g., formal and informal sources of support, to whom they are accountable, and what they are accountable for); on-line surveys for teachers, coaches, and school leaders that focus on similar issues; video-recordings of two consecutive mathematics lessons conducted by each of the 120 participating teachers; assessments of teachers’ and mathematics coaches’ mathematics knowledge for teaching; video-recordings of selected district teacher professional development; audio-recordings of teacher collaborative planning meetings; and an on-line assessment of teachers’ professional networks completed by 300 mathematics teachers in the participating schools. In addition, the districts provide us access to mathematics and reading achievement data for students in the participating teachers’ classrooms.

Each February through May, we analyze transcripts of the 200 interviews to identify and explain gaps between each district’s intended and implemented instructional improvement policies. On this basis, we develop a detailed report for leaders in each district in which we share our findings and make actionable recommendations on how they might adjust their policies to make them more effective. Each May, we visit the districts to discuss our findings and recommendations with district leaders. Unsolicited, the leaders in all four districts have told us that this is the most valuable research in which they have participated. The interviews conducted in the following October reveal that the district leaders are indeed acting on our recommendations to a remarkable degree. As a consequence, we have become co-designers of the districts’ improvement policies with district leaders. Our long-term goal in conducting this work is to test, revise, and elaborate a comprehensive set of hypotheses about district and school supports for improving the quality of classroom instructional practice. These hypotheses encompass: district and school teacher professional development (including both on-the-job coaching for mathematics teachers and the development of productive teacher learning communities), curriculum frameworks and other district-developed tools, school instructional leadership, and district leadership.
Constructivism and instructional improvement

Ernst's influence on the work I have outlined is far reaching and, I contend, has contributed directly to our effectiveness in supporting the collaborating districts' improvement efforts. First, Ernst's constructivism emphasizes the importance of sustained engagement with the phenomenon under investigation. Given the focus of our work, we find it essential to participate in the process of attempting to support instructional improvement on a large scale. The approach we are taking is unusual in that research in educational policy and educational leadership is primarily observational rather than interventionist in nature. The reports we share with district leaders about how their improvement policies are actually playing out serve to complete a feedback loop. The reports are designed to problematize district leaders' current policies by documenting gaps between the intended or designed policies, and the implemented policies and their consequences. In Ernst's terms, the intent of our reports is to perturb district leaders' current suppositions and assumptions about the process of instructional improvement (Glasersfeld 1984). It is in this context that our feedback recommendations about how district policies might be adjusted to make them more effective have proved relevant to district leaders (Glasersfeld 1987). These recommendations are based on our current hypotheses about supports for instructional improvement. As a consequence, in acting on our recommendations, district leaders provide us with the opportunity to test those hypotheses and thus to advance our understanding of what it takes to support instructional improvement on a large scale.

Second, Ernst's constructivism emphasizes that people's actions are reasonable from their point of view. His goal when attempting to account for another person's actions was to infer the rationality that underpinned those actions, and he considered an analysis to be lacking in explanatory power if it portrayed people as less than rational given their personal histories and current circumstance (Glasersfeld 1989). This basic heuristic has served me well over the years and is fundamental to our current work. It is often the case that district and school policies either do not contribute to or are actually detrimental to the improvement of classroom instruction. Most mathematics educators are quick to condemn such policies and to portray school and district leaders as misinformed or obstructionist. Ernst's dictum has oriented my colleagues and me to suspend our judgments about such policies and to try to understand why district and school leaders' policymaking actions might be reasonable from their perspectives. In doing so, we find it essential to take account of their current visions of high-quality mathematics instruction, the support they receive to improve their practices, and to whom and for what they are accountable. We also take this approach when accounting for the practices of members of other role groups including teachers and mathematics coaches, and are therefore in a position to explain why district policies are playing out in particular ways and not others. In addition, our analyses of current instructional and leadership practices inform the policy adjustments that we recommend to support the learning of members of the different groups more effectively. More generally, a solid understanding of why people's current practices are reasonable from their perspective is a prerequisite for developing effective designs for supporting their learning.

Third, Ernst's constructivism emphasizes both that memory is reconstructive and that conceptual activity is grounded in sensory-motor action (Glasersfeld 1978). In the context of our current work, these basic principles imply that we should be cautious in taking teachers' and instructional leaders' descriptions of their current practices at face value. This concern is particularly pressing in the case of mathematics coaches and school leaders as we rely on interview and survey data to document their practices. We have therefore found it essential to include questions about the practices of members of other role groups in our interview protocols and surveys. For example, we ask teachers and mathematics coaches about key aspects of principals' practices. As Ernst would have predicted, the analysis of these data has revealed significant differences in responses across role groups on such basic issues as how frequently the principal visits classrooms to observe mathematics instruction. In resolving these differences, we find that the accounts of observers of others' practices are frequently more reliable than those of the actors themselves.

Fourth, Ernst's constructivism emphasizes that knowledge is constructed by internalizing and interiorizing action (Glasersfeld 1991). This insight has proved helpful as we have sought to clarify the relation between knowledge and practice. The default position in research on teaching and instructional leadership is that knowledge is prior to, drives, and is expressed in practice. We, in contrast, take practice - what teachers and instructional leaders do - as our starting point and attempt to delineate the types of knowing inherent in their observable actions without assuming that the knowing exists independently of action. As an illustration, we use a paper-and-pencil instrument developed by Hill and Ball (2004) to assess teachers' and coaches' mathematical knowledge that is specific to problems and decisions that arise while planning and conducting lessons. We selected this assessment because the items present specific problems of practice and were developed by analyzing instructional practice. However, we have noticed that it has nonetheless become common to treat mathematical knowledge for teaching (MKT) assessed by this instrument as though it exists prior to and apart from instructional practice. Our motivation for resisting this tendency is pragmatic as well as theoretical in nature. If one takes it for granted that MKT is prior to and drives practice, it is reasonable to design professional development that aims to deepen teachers' mathematical knowledge on the assumption that they will subsequently apply what they learn to practice. However, if one takes the view that MKT is an inherent aspect of instructional practice, then it becomes essential that teachers view themselves as working on practice when they engage in professional development and that they see the relevance of deepening their mathematical knowledge to the improvement of their practice. In other words, it is important that teachers become aware of the limitations of their current mathematical ways of knowing if the professional development is to support the improvement of practice. A number of recent studies of teacher professional development indicate the value of designs that explicitly situate
Fifth, Ernst’s constructivism characterizes communication as a process of ongoing negotiation in which people continually adjust their actions in response to their interpretations of others’ linguistic acts (Glasersfeld 1990b). Ernst emphasized both that intersubjectivity involves a fit rather than a match of the participants’ conceptual structures, and that intersubjectivity has to be assumed in order to be achieved. This perspective on communication comes to the fore in our work as we investigate whether and how members of different role groups have achieved a shared (or better, a taken-for-granted) vision of instructional improvement. Research in educational policy and leadership indicates that the development of a shared vision that can give direction and purpose to collaboration is strongly associated with school and district improvement. Ernst’s analysis of communication enabled us to anticipate that it would be difficult for school and district staff to achieve a shared vision given that the role groups differ in terms of their professional affiliations, responsibilities, and practices. In addition, it alerted us to the importance of ensuring that members of different role groups work together on concrete problems of practice so that fundamental differences in their taken-for-granted assumptions might become an explicit focus of negotiation. As a consequence, we frequently recommend to district leaders that principals participate in teacher professional development along with the teachers from their school, and that coaches participate in principal professional development.

Sixth, Ernst’s constructivism describes learning as a process of reorganizing sensorymotor and conceptual activity in order to resolve perturbations in the world of experience (Glasersfeld 1978). We have found this characterization helpful as we have sought to understand the process of policy implementation. Analyses of policy implementation are typically evaluative and assess whether the implementation of particular policies leads to the intended results or outcomes. The image that underpins analyses of this type is typically that of a policy traveling down through an educational system with varying degrees of fidelity. Although such analyses make an important contribution, they do not inform the improvement of policies that have proven ineffective. For our purposes, it has been critical to focus on the so-called targets of policies and, in particular, on how they reorganize their practices in response to their interpretations of others’ policymaking efforts. In developing this approach, we have found it essential to situate the reorganizations they make with respect to the school and district settings in which they work. The image of policy implementation as a process of travel is then displaced by the image of the reorganization of practice situated at multiple levels of an educational system. An advantage of approaches that are based on the latter image is that they relate the practices that targets are developing to the implemented supports for their learning. It is therefore a relatively straightforward matter to develop recommendations about how the policy might be adjusted to make it more effective. Our ongoing collaboration with the four districts indicates that this perspective on policy implementation holds considerable promise in supporting large-scale instructional improvement.

Conclusion

I consider it a privilege to have studied with Ernst. Although the focus of my work has changed over the years, basic precepts learned from Ernst continue to orient my research. For Ernst, the fundamental test of knowledge was its effectiveness in enabling us to achieve our goals (Glasersfeld & Cobb 1984). In this short essay, I have tried to illustrate that Ernst’s constructivism contributes to our effectiveness in supporting large-scale instructional improvement. For this, I am very much in his debt.

References


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OF RELATED INTEREST A JOURNEY IN MATHEMATICS EDUCATION RESEARCH

The objective of this book is laying out the theoretical constructs and research methodologies within mathematics education that have been developed by Paul Cobb and explaining the process of their development. It includes papers in which Cobb introduced new theoretical perspectives and methodologies into the literature, each preceded by a substantive accompanying introductory paper that explains the motivation/rationale for developing the new perspectives and/or methodologies and the processes through which they were developed, and Cobb’s own retrospective comments.

In this way the book provides the reader with heretofore unpublished material that lays out in considerable detail the issues and problems that Cobb has confronted in his work, that, from his viewpoint, required theoretical and methodological shifts/advances and provides insight into how he has achieved the shifts/advances. The result will be a volume that, in addition to explaining Cobb’s contributions to the field of mathematics education, also provides the reader with insight into what is involved in developing an aggressive and evolving research program.

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