

Steffe, L. P.; Gale, J.:

## Constructivism in Education

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### 1. The background to the book

As with many edited collections of academic papers, this collection originated in a conference: in this case, *Alternative Epistemologies in Education*, at the University of Georgia in February, 1992. The contributors presented key ideas from their work, followed by critiques from invited respondents and open discussion, in five panels. The panels addressed six “core paradigms”: social constructivism, radical constructivism, social constructionism, information processing constructivism, cybernetic systems and socio-cultural approaches to mediated action; as well as disciplines of clinical, language, mathematics and science education. An overall aim was to address *effective action* in education: what teacher education might look like from any of the alternative epistemological perspectives. Despite their individual differences, the six paradigms were seen to have a common theme in “differing from the Cartesian model in viewing knowledge in a non dualistic manner so as to avoid the mind-body split of endogenic (mind-centred) and exogenic (reality centred) knowledge” (Preface p. xiii).

Sections of the book offer papers from presenters and respondents, and from participants of the various panels at the conference. The overt inclusion of critique and counter critique is one of the strong features of the book. As the editors point out (p. xi), with reference to Spivey [16]<sup>1</sup>, “written texts only offer cues selected by the author that suggest configurations of meanings that the reader uses in constructing his or her own meaning”. The reader is drawn into the authors’ theses, and encouraged into the wider debate through various levels of commentary and critique – always scholarly, never bland, but in some cases more acerbic than others! I personally found it valuable to meet new paradigms and points of view, to start to recognise my own trajectories of meaning weaving through the writings of others, and to be challenged to rethink some positions.

### 2. The structure of the book

The book, with 27 chapters and over 500 pages, has a broad brief, dealing overtly with philosophical, psychological and sociological themes and their application to a variety of disciplines. The first 3 parts take up the six core paradigms in contrasting pairs. Debate within a pair is promoted explicitly through two key papers plus a number of responses. Thus we have:

Part I: Radical Constructivism (Ernst von Glasersfeld) and Social Constructionism (Kenneth Gergen),

with responses from John Shotter and John Richards

Part II: Information Processing (Frederick Steier) Constructivism and Cybernetic Systems (Rand Spiro et al.), with responses from Karl Tomm and Patrick Thompson

Part III: Social Constructivism (Heinrich Bauersfeld) and Sociocultural Approaches (James Wertsch & Chikako Toma) with responses from Clifford Konold and Jere Confrey.

At the end of these three parts an overview, Analysis and Synthesis I, is offered by Mark Bickhard. Following these are two more major parts:

Part IV: Alternative Epistemologies in Language, Mathematics and Science Education

Part V: Alternative Epistemologies in Clinical, Mathematics and Science Education.

These include papers, from a variety of authors, discussing explicit characteristics and issues in the named disciplines, relating also to the core paradigms, with three responses in each part. Analysis and Synthesis II, related to Parts IV and V is offered then by Paul Ernest, and finally Analysis and Synthesis III, from Les Steffe drawing on all the parts, completes the book.

It is hard to do justice to themes and issues which span over 500 pages. Necessarily I have selected from the 27 Chapters, and have followed themes which seem central to debates in mathematics education.

#### 2.1 Radical constructivism

It is unsurprising that a book on constructivism in education begins with a chapter from Ernst von Glasersfeld. In it he reminds us of radical constructivism, embedded in Piagetian theory and dealing with human adaptation of knowledge, viability, and the impossibility of knowing a real world outside of ourselves as experiencing thinkers (see, for example, von Glasersfeld, 1984). He acknowledges Noddings (1990) use of the term *postepistemological* to describe a theory of knowing which explicitly says or can say nothing about the status of knowledge. He offers a number of “real world” examples in terms of a subjective construction of perceived reality. He begins and ends with implications for the teacher of mathematics, recognising his own lack of experience where such teaching is concerned, but rooting his remarks in the differences between teaching and training in a cause-effect, behaviourist sense. His brief remarks in the direction of teaching are forerunners of a theme which permeates the book, that of educational action in terms of the advance of knowledge impinging on developments for teachers and learners.

Gergen [2], responding to von Glasersfeld, writes of constructivism positing a world independent of personal experience, quite contrary to much of what von Glasersfeld and others have written. He claims that *both* exogenic and endogenic traditions of knowledge are similar in their dualist foundations which assume “the mind and world are independent, and that knowledge is a mental state – an enhanced state of representation in the exogenic case and of reasoning in the endogenic.” (p. 18).

He presents radical constructivism as endogenic, implying

<sup>1</sup>A bracketed number in this form indicates the Chapter to which reference is made, in this case Chapter 16.

that “there is a real world separate from one’s experiences of it”.

## 2.2 Social constructionism

Gergen articulates his own position, *social constructionism*, which, he claims, represents a radical break with both the exogenic and endogenic traditions. Rather than a concern with an external world or an individual mind, it commences with *language*. Knowledge is seen to reside in a repository of linguistic artifacts, text, documents, journals, and to be communicated through lectures, discussions, overhead projections and the like, all of which depend on language. How language is used depends upon the processes of social interchange. Meaning is achieved through social interdependence – “the coordinated efforts of two or more persons”. Gergen writes

“It is thus that social constructionism seeks to replace the individualistic ideology of the traditional conceptions of knowledge with a communal concern. It is out of community that rational articulation is achieved, and without such articulation there is simply no means of presuming the individual self.” (p. 24)

He recognises some correspondence with Vygotskian formulations which focus on social interactions and cooperation, but rejects the psychological emphasis which, he claims, occupies the foreground of Vygotskian theory (p. 25). Social constructionism is about social relationships, being centrally concerned with “negotiation, cooperation, conflict, rhetoric, ritual, roles, social scenarios, and the like”. In this theory, meaning in language is context dependent. There are no generalities of a transcendent character. “Agreements are typically generated for local purposes, and there is no principled means of ensuring their generality outside such circumstances.”

Gergen begins articulation of the relationship of social constructionism to education with a disclaimer: that he approaches issues of pedagogy as a *social metatheorist*, (p. 29) that is, I presume, not as a practitioner (which is also von Glasersfeld’s position). Thus he can articulate a theory without any pretence of associated embedding in educational practice. He offers a rider which qualifies his position and which supports an argument to which I will return later about relationships between theory and practice.

“... there is no means by which practical derivatives can simply be squeezed from a theory of knowledge. As has been seen, theories can specify neither the particulars to which they must be applied nor the contexts in which they may be rendered intelligible. There are no actions which follow necessarily from a given theory.” (p. 30)

Despite such disclaimers, (and perhaps because a theory has to have consequences for practice – otherwise why, in constructionist terms, would it be worth stating?), Gergen offers a set of consequences of constructionism for learning and teaching. Through a consideration of the metaphor of the *dialogue* or *conversation*: “on the most abstract level, we might say that what we count as knowledge are temporary locations in dialogic space ...”. Thus, for example, the subject of a lesson would better arise from dialogue between its participants than from a predetermined, hidden from the student, agenda of the teacher. Individuals

are not possessors of contents or rationalities, but rather participate in them. Students would learn from dialogue within the learning environment rather than from teacher exposition. Education occurs primarily through mutual interchange – through the coordination of participants within the dialogue. Gergen asks in what ways students can be brought into planning of curricula and determine what parts of a subject are worth exploring.

I observe that, although these may be consequences of theory for practice, the realisation of such consequences raises deep issues which reflect profoundly on theory.

## 2.3 The way of theory

The chapters of critique which follow are helpful in presenting alternative perspectives of some of these ideas, through their elaboration by other authors, or in taking issue with what has been said. I shall leave it to the reader to explore this further. However, I want to offer one quotation from Shotter [3] who suggests that both Gergen and von Glasersfeld are in the thrall of “the way of theory”:

“That is, both exhibit in their writing the desire to survey a whole set of events retrospectively and reflectively – as if they were already made events – with an overall aim of bringing them all under an adequate conceptual scheme. Their project is to find a place for them all within a framework, thus creating a stable, coherent and intelligible unitary order among them that can be intelligently grasped by individual readers of their texts.” (p. 50)

It is Shotter’s view that such aims are impossible to fulfil, since there is no already made meaningful order to be found. Paul Ernest, in a later chapter, suggests that drawing educational implications from Gergen’s theory is problematic since Gergen is not an educationist. Those of us who see theory as a lens into educational practice might dream of some coherent, all embracing theory while, at the same time, recognising the ultimate absurdity of such a dream. However, it seems reasonable to seek *some* links between knowledge in educational practice and such theoretical perspectives.

## 2.4 Vygotskian theory

From his position of social constructionism Gergen sees Vygotskian theory as primarily psychological. Shotter disagrees, recognising its principally social nature (p. 51). It is in the chapter from Wertsch and Toma [10], in Part III, that Vygotskian theory is represented and analysed, drawing also on others of Wertsch’s writings where he talks about “a sociocultural approach to mediated action” (Wertsch, 1991). According to the authors, “a fundamental claim of this approach is that mental functioning is assumed to be inherently situated with regard to cultural, historical, and institutional contexts” (p. 159). The cultural psychology proposed is one which sees mental functioning as grounded in sociocultural settings which are given analytical priority. This seems not to deny the importance of individual mental functioning, but rather to see it as deriving from sociocultural fabric. Wertsch and Toma elaborate three general themes in Vygotsky’s theory: “the use of a genetic (developmental) method; the claim that essential aspects of mental functioning in the individual derive from social life; and the claim that a key to understanding human action, both on the social and individual

planes, is understanding the tools and signs that 'mediate' it" (p. 160). They include a cautionary note, as they put it "a shortcoming": notably that the equating, by Vygotsky, of social with *intermental* functioning, reducing the range of social phenomena addressed and "antithetical to the goals of a sociocultural approach to mediated action" (p. 164) contradicts some of Vygotsky's expressed aims.

With reference to dialogue from Japanese classrooms Wertsch and Toma provide examples of two forms of discourse, the *univocal* and the *dialogic*: respectively, transmitting given knowledge or meaning, and working towards new meanings through interaction. In emphasising the limitations and possibilities of these forms they point to the importance of the second in effective learning environments, and the scarcity of evidence of its functioning in American classrooms. The underlying social and cultural constraints are emphasised as needing more attention and research, as is the overt collaboration of teachers and researchers in enhancing classroom learning. These aspects of the Wertsch and Toma paper seem especially important as they start to take theory into a practical domain, emphasising the necessity of exploring characteristics of practice and of linking theory to practice through research.

### 2.5 Social constructivism

The move from radical to social constructivism is addressed explicitly, in Part III, by Heinrich Bauersfeld [9] who looks at the practice of mathematising in classrooms from a social and cultural perspective within a constructivist framework. Claiming that a critical examination of classroom processes from both psychological and sociological perspectives is underdeveloped, he offers an integrating theory. In doing so he addresses the differing dimensions of a (mathematics) classroom, and the nature of interactions within it. Drawing on sociological theory, and particular classroom examples, he emphasises the importance of recognising and understanding the various social forces, and the potential of interaction, for more effective mathematical and meta-mathematical construal of all participants, the teacher included. Although there is little reference here to Vygotsky, Bauersfeld's conclusions about the importance of classroom interaction and dialogue look remarkably similar to those of Wertsch and Toma. A challenge to the reader is to find some unifying path through the various theoretical influences these authors represent.

This is helped to some extent by Jere Confrey's [12] response to these two papers, taking as her task a detailed weaving of a route between Piaget and Vygotsky to unify psychological and sociological perspectives. While recognising the arguments for the strong influence of social forces and human interactions, it seems to be her view that both papers, albeit from differing theoretical positions, neglect the influences of individual experience on the construction of knowledge. She points to an irresolvable incompatibility between Piagetian and Vygotskian perspectives, in terms of their conceptualisations of the roots of knowledge, or coming to know. She too explores what an integrative theory might involve, offering her own set of characteristics.

### 2.6 The dilemma of practice

Education, as the book reminds us periodically, is fundamentally about students and teachers and processes of teaching and learning, most often in classrooms. As the book progresses, epistemologies become more overtly related to the practices of learning and teaching through alternative perspectives of the practice of education in a number of disciplines.

Reinders Duit and Rosalind Driver [14 & 21], writing of constructivism in science education, place strong emphasis on respect for students' personal conceptions, and their influence on the development of scientific conceptions. Duit draws attention to the dialectical relationship between conceptions and perceptions, "Conceptions guide perceptions, and perceptions develop conceptions" (p. 280). The point is made, with reference to Kuhn, that not only do students' conceptions "provide science instruction with information that is necessary to guide students to scientific conceptions" but they also "reveal important aspects of the nature of scientific knowledge" (p. 278). Thus the fallibility of scientific knowledge is emphasised, while simultaneously we have a recognition of particular scientific conceptions to which students need to be *guided*. A pedagogical process in such guiding involves the use of cognitive conflict. Duit emphasises both the aims and value of this "constructivist approach", and its failings. "Students often do not see the cognitive conflict, although it is obvious from the teacher's point of view" (p. 279). A 12-year old's investigation into the melting of ice illustrate his point. She believes that ice covered by wool will melt faster than ice covered by aluminium foil, since the wool will warm the ice. When she sees the ice in aluminium foil melting first she puts this down to conditions in the experiment, rather than being challenged by conflicting evidence. Her personal conceptions are too strong to be shaken by one conflicting experience.

Problematic here is the so-called scientific conception (in this case, that ice melts faster in aluminium foil) and the teacher's need to "guide" the student to this conception. Driver has written elsewhere (Driver, 1983) about the "intellectual dishonesty" of expecting that certain scientific principles will emerge from carefully constructed (by the teacher) classroom experiments. This results in what Edwards and Mercer (1987) refer to as "the teacher's dilemma", i.e. to have to inculcate knowledge while apparently eliciting it. The *problematic* nature of this emerges from close observations of classroom practice. My own research has revealed similar tensions in the teaching of mathematics (Jaworski, 1994).

While constructivism can highlight theoretical positions, like the fallibility of knowledge and the relation between personal *knowledge* and experience it cannot predict the fine complexity of interrelationship between learner, teacher and knowledge (mathematical, scientific, or other). Indeed the constructivist preference for speaking of "coming to know" rather than of "knowledge" per se is challenged by the requirement in classrooms that students come to know certain nuggets of knowledge articulated by a curriculum whose epistemological foundations often bear no relation to constructivism. I am worried by a

tendency to carry theory too far. While we might legitimately look at the consequences for learning and teaching of a constructivist perspective of knowledge and learning, defining the resulting teaching in terms of *constructivist pedagogy*, which is the case in a number of these writings, is to subscribe to a theoretical imperialism which is unhelpful in tackling the complexities of practice.

Edith Ackerman [18], critiquing papers in Part IV, speaks also of “the teacher’s dilemma”, recognising that “many teachers find their way out of the dilemma by guiding students into realising their limitations ‘from within’ or by themselves”, which seems to me to be what Driver referred to as intellectual dishonesty. Ackerman goes on to recognise what she calls the “designer’s dilemma” in another paper in this section, by Nancy Nelson Spivey [16] which addresses language education through a constructivist perspective on written discourse. Spivey focuses on social aspects of communication, particularly relationships between writers, the readers of their texts, and the associated meanings in what is written and understood. She highlights the process/product dialectic in classroom approaches to writing development, recognising a process-as-product pedagogical form which I recognise as an important feature of much mathematics teaching where *meaning-making*, by students and teacher alike, strongly directs pedagogy. This is exemplified in the negotiative processes described in the paper on mathematical education by Terry Wood and colleagues [22].

According to Ackerman, Spivey suggests that a “written text ‘exists’ only in so far as it carries clues for reconstruction or interpretation” which guides the reader’s construction of meaning. The designer’s dilemma, expressed by Ackerman, is “How can we come to a consensus about the qualities of a designed artifact ... if we do not endow it with an existence independent of a particular reader’s interpretations?” (p. 343). This question is particularly potent as I read this book and write this review. Necessarily, I treat what I read selectively through the lens of my own experience. My ability to make any sense at all of their writings (or them of mine), means that their (my) use of language, and the terms and expressions they (I) use, are sufficiently in the public domain which I (they) inhabit for me (them) to feel that I (they) “understand” points they are (I am) making. Whether this implies an existence independent of my interpretations is a question I want to go on thinking about. I apologise for the tortuous phraseology above!

Ackerman raises yet another dilemma related to the paper from Geoffrey Saxe [15], addressing mathematical understanding from cultural perspectives. In this case it is *the learners dilemma*: “How can learners build on their own limited knowledge as a means to access what is not yet understood?” (p. 344). Quoting Saxe, she asks, “How can learners use what they know in a given context as a way to make sense of another context which is not yet familiar?” Saxe’s main focus is cognitive goals which emerge as individuals participate in cultural practices, thus generating new knowledge linked to social and cultural life. Referring to his research in Papua New Guinea and in Brazil, he provides rich examples of such goals and their contribution

to knowledge. For example, he describes goals related to Oksapmin trading practices in New Guinea, which require some basic arithmetical processes. However, the idiosyncratic Oksapmin counting system, based on a correspondence of natural numbers with parts of the body, does not lend itself naturally to adding or subtracting of the numbers. Saxe highlights the cultural embeddedness in the development of mathematical forms and goes on to discuss problems in the *transfer* of these forms then to other social situations, perhaps those of learning mathematics in classrooms. In addressing the dilemma, Ackerman draws on Papert’s (elsewhere) suggestion that meaningful constructions require enabling tools and environments. Saxe’s work has involved developing such tools and environments and evaluating their use in the classroom relative to students’ own experiential worlds and personal needs.

I will end my comments in this section by reference to another dilemma, raised this time by Joe Becker and Maria Varelas [24], responding to papers in Part V. The dilemma is articulated as: “facilitating children’s entrance into our cultural enterprise and letting them be and become themselves” (p. 435). It bears many similarities to the teacher’s dilemma expressed above, but carries a greater cultural imperative. The authors largely contrast themes in the Driver paper [21] with those of Wood et al. [22]. They draw valuably on Piagetian and Vygotskian theory to highlight their analyses. Important to the project of Wood et al, was a pedagogical aim to avoid directing a pupil towards a solution to a problem, rather encouraging the pupils own conceptualisation of a solution. This is seen as following Piagetian admonitions regarding the dangers of directiveness in teaching. Teachers following this principle were guided by the project to submerge their own mathematical knowledge in the interests of facilitating pupils own constructions. Driver, on the other hand, recognised overtly the teachers’ own scientific knowledge, and was concerned to elaborate ways in which, through negotiation of contributions of *all* participants in the discourse, teacher included, established scientific principles were constructed. Thus the teacher’s knowledge was one of the elements of the classroom discourse, seen as following a Vygotskian view of teacher-learner interaction in the zone of proximal development. Becker and Varelas raise questions about the associated power relationships pertaining in classrooms, their influence on the establishment of classroom norms, and on ways in which students’ conceptualising was affected or conditioned by teachers’ inputs to the discourse, whether in terms of disciplinary knowledge or of social functioning.

### 3. Towards a conclusion

In dealing with various themes in this book I have aimed not only to provide insight into their content, but also a flavour of the discourses within which this book is situated.

My efforts in reading this book and writing a review have parallels with reporting the findings of a complex research project. Inevitably there are many wonderful ideas and episodes which have to be left out of the report because of limitations of size, space and reader’s time and

commitment. In looking back through the book I find very many passages highlighted as significant to which I have not made reference in this review and it is with some regret that I leave them unaddressed.

In a recent electronic communication to the mathematics education community in the UK, Tony Brown<sup>2</sup> suggested that “Constructivism is Dead”, premised on a view of the inadequate rooting in psychology of theories of practice in mathematics education. With reference to Lerman, 1996, he proposed that “the learning of individuals cannot be seen outside of a dynamic social frame”, and with reference to Apple, 1982, that mathematics education needs to attend more seriously to “social structure, the race, gender and class relations which form individuals”, and to a “wider social context that includes larger programmes for democratic education and a more democratic society”.

Electronic responses supporting or challenging this thesis emphasised the differing perspectives of constructivism itself, as well as perspectives which suggest constructivism is no longer adequate to address the greater needs of education. They perhaps highlight the growth of understanding about constructivism as a developing paradigm, as expressed by Paul Ernest in his analysis and synthesis of the second half of the book [26], although some would go far beyond this position:

“Radical constructivism is adapting to accommodate the criticism it has met, especially concerning its possible neglect of the sociocultural dimensions of learning and knowledge. This development removes much of the sting of the criticism. It also removes much of the difference between that position and social constructivism. Therefore perhaps a new unity is forming around radical constructivism.”

What strikes me in retrospect is that, given a little polish and editorial attention, the electronic contributions could well have a place in this book. Their epistemological diversity and the spirit of dialogue and debate which emerged through interaction over the internet are consistent with the style and aims of the book. The book has encouraged a *reflexivity* with its readers, expressed as a concept of theoretical significance to education by Frederick Steier in Part II [5], and carried in practice through most of the writings which address explicitly the meaning-making of their readers. The internet offers a more tangible form of reflexivity, which authors, editors and publishers need to address.

I hope this review has carried some clues to my own pleasure, stimulation and growth of knowledge which have emerged as a result of reading and rereading these writings. Mark Bickhard, in his analysis and synthesis of the first half of the book [13] said, “This volume is a very long conversation ... and it cannot be understood outside of the context of that conversation” (p. 229). Bickhard indicated that he saw “issues introduced here to be critical to the theory and practice of education” and “critical to the further development of both science and society” (p. 230).

It would be inappropriate to finish without a quotation from Les Steffe whose final chapter [27] offers an analysis and synthesis to the book as a whole. He says that his

goal is to produce a retrospective analysis which would “lessen, if not neutralise, some of the essential differences that have been identified and elaborated on”. He goes on: “This amounts to more than an academic exercise because there is a lot at stake here for the education of children and young adults, and for a role of constructivism in that education” (p. 489).

In encouraging advocates of psychological and sociological theories to devote more attention to the complementarity of these positions, he suggests that perhaps “models of teaching and models of learning can be formulated only from the point of view of a second-order observer – the professional teacher’s point of view”. Extending the dialectic to include practitioner theory seems to me to be essential to the theory-practice interface which has emerged so strongly from this book.

I feel it is in the spirit of debate encouraged here just to remark that the book is a product *mainly* of politically and economically developed western thought. A further challenge to many of these writings would be the question of what differences would arise in extending these debates to issues affecting the education of children and young adults in the “rest of the world”.

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