

Palatable Mathematical Science in Schools?

Gary Boyd • Concordia University, Canada • boyd@education.concordia.ca

> **Upshot** • This is a book for thoughtful science and mathematics teachers and curriculum developers and educational philosophers. Quale helps us to challenge pernicious received “truths” and offers us intriguing perspectives, valuable discourse ventures and practical pedagogic strategies to engage the youth of today who are turning away from science in droves, to their and our cost.

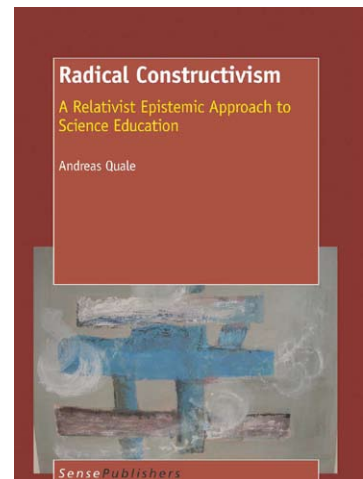
THIS BOOK IS MAINLY AN UNDERTAKING to promote moderately radical constructivism for the benefit of humankind via better science teaching. Quale promotes a moderate form of radical constructivism with the intention of making secondary school and college sciences and mathematics both more attractive and more readily co-constructable for and by today’s students.

The basic argument, as I read it, is that from the constructivist educator’s perspective taken here: “Science should be seen and presented as a particular *strategy of thinking* – a specific way of structuring and modeling whatever phenomena are chosen for examination.” For those who believe science to be what we actually do know about the *real* universe this may seem like a weak retreat, but actually it is a strong position. It is a strong position because it puts at the center the nature of the ability that the world community of scientists has developed to continually go on indefinitely improving our shared story, giving as coherent, explanatory and predictive an understanding of everything as is possible for us at the time.

Quale addresses three main problems. (1) The problem of continuing to propagate our beloved mathematical science “soul-stuff” in a society where it is perceived by youth to be difficult to learn and a source of our ecological difficulties rather than a resource for solutions. (2) The need for every citizen in any democracy in today’s globalized technologized world to have a good enough understanding of science to reject pseudo-science based, or anti-science cloaked political agendas. (3) How to at-

tract students to the study of the sciences, and how to retain them in, for example, science technology and society (STS) studies *long enough for their own good* and the good of society. He proposes as a solution a new approach to teaching mathematical science better in high schools and colleges by using a constructivist ontology and a constructivist epistemology.

The introduction to the book serves as a rather good “advance organizer”: the content and intention of each chapter is neatly explained. I paraphrase it here as follows: 1. *What is science* (versus non-science). 2. *The role of technology and mathematics* – It is advocated that technology be taught as an integral part of science. 3. *Constructivism a theory of learning and knowing* – Misunderstanding concerning what radical constructivism does or does not claim arises from the failure to distinguish between cognitive and non-cognitive knowledge. 4. *Reality, truth and viability* – Instead of “truth” to “reality,” “viability” should be the important descriptor of knowledge. 5. *The (very problematic) metaphor of Truth*. 6. *The story of science* – Implications of radical constructivism for educational practice and for teaching–learning conversations. 7. *The game of prediction and retrodiction* – An experiential conception of time to enable learners to appreciate the possibilities and limitations of prediction and retrodiction. 8. *Towards a radical constructivist philosophy of physics* – Reductionist strategy is only to be applied with the goal of constructing knowledge that is (hopefully) *viable* in historical progression for the knowers. 9. *Ontologi-*



Review of “Radical Constructivism. A Relativist Epistemic Approach to Science Education” by Andres Quale. Sense Publishers, Rotterdam, 2008. ISBN: 978-90-8790-611-5 217 pages.

cal aspects of radical constructivism – It has strong implications for ethics and religion, serving to elevate the individual learner into a position of inevitable personal responsibility. 10. *The what and why of science education* – What science curriculum is legitimate for universal public education and why; also the recommendation that science be taught in the mode of *telling a story*.

Among the most delightful aspects and greatest strengths of this book are its clear and illuminating discussions of the historical and philosophical interplay between mathematics and physics, and how a constructivist perspective can improve our understandings of both the conflicts and the advances that have occurred out of that interplay.

For instance, by starting from the contrast between the mathematical definition of a line as an infinity of points, one that

rules out any concept of truly adjacent points, Quale goes on to show how this made analytic-mathematics-based physics models blow up, necessitating such inventions as Paul Dirac's "delta function." And that this in turn forced mathematicians to invent a new definition of a "function" in terms of "distributions." From there, there is a very nice, easily followed explanation given of the problematic way in which realism prompted the introduction of "string theory" as a "Theory Of Everything" – which it isn't.

Quale is very much concerned with making science education more attractive and more accessible to the widest possible audience of young adults. Certainly he nicely shows how introducing constructivist perspectives can help do both. Unfortunately his prescriptions do not altogether manage to avoid the currently ubiquitous cop-out of substituting teachings which are merely about science, instead of those which are essential to enable the young to actually live as "personal scientists" (Kelly 1955). Teaching about the history of science, and STS studies from a radical constructivist perspective are very good strategies, both of which Quale ably advocates. However, even though his own background has obviously included it and even though practice in rigorous axiomatic-deductive reasoning really is needed for science, Quale seems to give

up on trying to provide it, except for those who are becoming professional scientists. But when is that decided?

There is a much larger societal problem which makes learning mathematics and science unappealing to the young, one which is being side-stepped by educators: the commercial media promote a misunderstanding of the good life as being all about consumption and amusement and winning power games, for which seriously demanding intellectual studies seem superfluous. Offering pleasant and interesting constructivist-framed studies about and in science may somewhat ameliorate massive commercial dis-education, but as responsible educators we should not avoid also trying to confront that larger challenge of our age by whatever democratic means we have at our disposal.

Quale's *Radical Constructivism* is a very good read for anyone concerned to find innovative practical approaches for attractively teaching science and mathematics to adolescents and young adults. I also commend Quale to philosophers and sociologists of education, because it nicely demolishes criticisms of radical constructivism for being solipsist or irresponsibly relativist.

Reference

- Kelly G. A. (1955) *The psychology of personal constructs*. W. W. Norton, New York.