An Overture

A Need for Caution in Use of Research Claims to Guide Biology Teaching

We should expect that biology teachers would evidence a commitment to rational inquiry as a method for creating new knowledge, not only in the life sciences but also in other fields of inquiry that are relevant to their work. I find it gratifying that hundreds of practicing biology teachers in both secondary schools and in tertiary education have been responsive to research findings in education, cognitive psychology, and neurobiology. As a biology educator with a principal commitment to cognitive learning studies, I wish to express a word of caution to teachers who seek to use research reports bearing on teaching/learning to guide their work or to justify their activities. It is important to look *critically* at the *primary* sources of evidence and to maintain a healthy skepticism toward those advocates who use principally secondary sources as the basis for their promulgations on teaching.

As a case in point, Barman's (1982) editorial in this journal suggested that we now have evidence that brain growth "spurts" account for Piagetian developmental stages, and these stages with the corresponding age norms can be used to plan curriculum according to Shayer and Adey (1981). In point of fact, Epstein's (1974) compilations of other researchers' studies of brain growth (see figure 1) show only very modest gains in brain weight during the years of primary and secondary schooling, and sex differences are larger than differences for various age groups. The work of Shayer and his colleagues has been the subject of considerable controversy (see Archenhold *et al.*, 1980). Even Piaget's monumental achievements are now regarded as seriously limited and, in his later years, Piaget modified his views in important ways (see Modgil and Modgil 1982).

My advice to teachers who wish to consider "research" claims as a basis for their practice is to try using these criteria: 1) What *events* were actually observed and recorded? 2) Are the records *valid* records of these events or are they biased in some systematic way? 3) Are the record *transformations* valid and appropriate? (Statistical transformations often violate or ignore underlying assumptions or limitations of these statistics.) 4) Do the *claims* reasonably follow from the data, or are they more likely a restatement of assumptions that guided the inquiry initially? If the answer to any of these four questions is "no" or "I'm not sure," I would be very cautious in using the claims in my own work.

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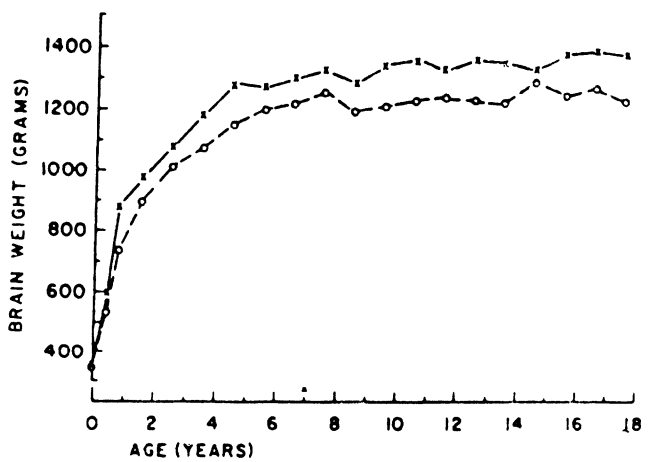

FIGURE 1. Average brain weight at various ages for males (x) and females (o) from Boyd, 1962, cited in Epstein, 1974.

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MacGINITIE, G.E., and MacGINITIE, N. 1968. *Natural history of marine animals.* 2nd ed. New York: McGraw-Hill.
MALLON, E.J. 1976. Cognitive development and processes: Review of the philosophy of Jean Piaget. *American Biology Teacher* 38(1):28.
MAREK, E.A., and RENNER, J.W. 1979. Intellectual development, IQ, achievement, and teaching methodology. *American Biology Teacher* 41(3):145.
MINSTRELL, J. 1980. Conceptual development of physics students and identification of influencing factors. Unpublished research report, Mercer Island School District, Wash.
PIAGET, J. 1929a. Les races lacustres de la *Limnaea stagnalis* and recherches sur la rapports de l'adaptation hereditaire avec la milieu. *Bulletin biologique de la France et de la Belgique* 62:424.
_____. 1929b. Adaptation de la *Limnaea stagnalis* aux milieux lacustres de la Suisse romande. *Revue Suisse de Zoologie* 36:263.
_____. 1952. *The origins of intelligence in children.* New York: International Universities Press.
_____. 1971a. *Biology and knowledge.* Chicago: University of Chicago Press.
_____. 1971b. Problems of equilibration. *In* Nodine, C.F., Gallagher, J.M., and Humphreys, R.H. (eds.) *Piaget and Inhelder: On equilibration.* Proceedings of the First Annual Symposium of the Jean Piaget Society, May.
_____. 1975. From noise to order: The psychological development of knowledge and phenocopy in biology. *The Urban Review* 8(3):209.
_____. 1976. Piaget's theory. *In* Inhelder, B., and Chipman, H.H. (eds.) *Piaget and his school.* New York: Springer-Verlag.
_____. 1978. *Behavior and evolution.* New York: Random House.
RENDEL, J.M. 1967. *Canalization and gene control.* London: Logos Press.
WADDINGTON, C.H. 1959. Canalization of development and genetic assimilation of acquired characters. *Nature* 183(4676):1654.
_____. 1960. Evolutionary adaptation. *In* Tax, S. (ed.) *Evolution after Darwin: Volume I, The evolution of life.* Chicago: University of Chicago Press.
_____. 1966. *Principles of development and differentiation.* New York: Macmillan.
_____. 1975. *The evolution of an evolutionist.* Ithaca, N.Y.: Cornell University Press.
WALKER, R.A., HENDRIX, J.R., and MERTENS, T.R. 1980. Sequenced instruction in genetics and Piagetian cognitive development. *American Biology Teacher* 42(2):104.
WOLLMAN, W.T., and LAWSON, A.E. 1978. The influence of instruction on proportional reasoning in seventh graders. *Journal of Research in Science Teaching* 15(3):227.

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References

ARCHENHOLD, W.F., DRIVER, R.H., ORTON, A., and WOOD-ROBINSON, C. 1980. *Cognitive development research in science and mathematics education.* Leeds, England: Center for Studies in Science Education, University of Leeds.
BARMAN, C.R. 1982. Science education for the 80s: Human brain research will make changes inevitable. *American Biology Teacher* 44(4):211.
BOYD, E. 1962. *In* Altman, P., and Dittman, D. *Growth.* Washington, D.C.: Federation of American Societies of Experimental Biology.
EPSTEIN, H.T. 1974. Phrenoblysis: Special brain and mind growth periods. I. Human brain and skull development. *Developmental Psychobiology* 7(3):207-216.
MODGIL, S., and MODGIL, C. 1982. *Jean Piaget: Consensus and controversy.* Eastbourne, England: Holt, Rinehart and Winston.
SHAYER, M., and ADEY, P. 1981. *Towards a science of science teaching.* London: Heinemann Educational Books.

Teaching Theories

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OVERTON, W.R. 1982. Creationism in schools: The decision in *McLean versus the Arkansas Board of Education.* [Text of 5 January 1982 Judgment]. *Science* 215:934-43.
PEACOCKE, A.R. 1979. *Creation and the world of science.* Oxford: The Clarendon Press.
PUPIN, M. (ed.) 1969. *Science and religion.* Freeport, N.Y.: Books for Libraries Press.
ROOT-BERNSTEIN, R.S. 1982. On defining a scientific theory: Creationism considered. *In* Montagu, A. (ed.) *Evolution and creationism.* Oxford: The University Press, in press.
_____. 1982. Ignorance versus knowledge in the evolutionist-creationist controversy. Paper presented June 22 at the symposium, "Evolutionists Confront Creationists," American Association for the Advancement of Science, Pacific Division, Santa Barbara, Calif.
RUSE, M. 1982. A philosopher at the monkey trial. *New Scientist* 317-319.
SKOOG, G. 1980. The textbook battle over creationism. *Christian Century* 97:974-76.
_____. 1982. We must not succumb to specious arguments for equal time. *Education Week* 1(18):19.
ZIMMERMAN, P.A. (ed.) 1970. *Rock strata and the Bible record.* St. Louis: Concordia Publishing House.

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