

Pella, M.O., and Treisenberg, H.J., "Three levels of abstraction of the concept of equilibrium and its use as an advance organizer," *Journal of Research in Science Teaching*, 6 : 11-21 (1969).

Peterson, R.W., and Carlson, G.R., *A Summary of Research in Science Education -- 1977*, New York : John Wiley and Sons, 1979.

Pezaro, P.E., "Comments on 'The development and construct validation of a group-administered test of formal thought,'" *Journal of Research in Science Teaching*, 19(1) : 91-92 (1982).

Phillips, D.G., "The Karplus islands puzzle, volume with metal cylinders and other problems," *Journal of Research in Science Teaching*, 14(4) : 361-369 (1977).

Piaget, J., *The Child's Conception of the World*, New York : Harcourt, Brace and World, Inc., 1929.

Piaget, J., *The Language and Thought of the Child*, second edition, New York : Harcourt, Brace and World, Inc., 1932a.

Piaget, J., *The Child's Conception of Physical Causality*, New York : Harcourt, Brace and World, Inc., 1932b.

Piaget, J., *The Construction of Reality in the Child*, New York : Basic Books, 1954.

Piaget, J., "Les stades du développement intellectuel de l'enfant et de l'adolescent," in Osterrieth, P., et al., *Le Problème des Stades en Psychologie de L'Enfant*, Paris : Presses Universitaires de France, 1956.

Piaget, J., *Logic and Psychology*, New York : Basic Books, 1957.

Piaget, J., *The Psychology of Intelligence*, Totowa, New Jersey : Littlefield, Adams and Co., 1960.

Piaget, J., "Development and learning," *Journal of Research in Science Teaching*, 2(3) : 176-186 (1964a).

Piaget, J., "Development and Learning," in Ripple, R.E., and Rockcastle, V.N., (eds.), *Piaget Rediscovered*, Ithaca, New York : Cornell University, 1964b.

Piaget, J., *Sagesse et Illusions de la Philosophie*, Paris : Presses Universitaires de France, 1965a.

Piaget, J., *The Child's Conception of Number*, New York : Norton, 1965b.

Piaget, J., *Six Psychological Studies*, New York : Random House, Inc., 1967.

Piaget, J., "On the development of memory and identity," *Heinz Werner Lecture Series*, Vol. 2, Worcester, Mass. : Clark University Press, 1968.

Piaget, J., *The Science of Education and the Psychology of the Child*, New York : Orion Press, 1970a.

Piaget, J., "Piaget's theory," in Mussen, P.H., (ed.), *Carmichael's Manual of Child Psychology*, Vol. 1, New York : John Wiley and Sons, 1970b.

Piaget, J., *Biology and Knowledge*, Chicago : Chicago University Press, 1971.

Piaget, J., "Intellectual evolution from adolescence to adulthood," *Human Development*, 15 : 1-12 (1972).

Piaget, J., foreword, in Schwebel, M., and Ralph, J., (eds.), *Piaget in the Classroom*, London : Routledge and Kegan Paul, 1974.

Piaget, J., Inhelder, B., and Sinclair, H., *Mémoire et Intelligence*, Paris : Presses Universitaires de France, 1968.

Piburn, M.D., "Sex, field dependence and formal thought," paper presented at the annual convention of the National Association for Research in Science Teaching, Cincinnati, Ohio, 1977.

Pienaar, H.N., and Walters, S.W., *Senior Basic Physical Science 10*, 2nd ed. Cape Town : Maskew Miller, 1976.

Pines, A.L., "Scientific concept learning in children subsequent to A-T instruction : The effect of prior knowledge on resulting cognitive structure," paper presented at the annual meeting of the National Association for Research in Science Teaching, Toronto, Canada, March 31 - April 2, 1978.

Pines, A.L., Novak, J.D., Posner, G.J., and Van Kirk, J., *The Clinical Interview : A Method for Evaluating Cognitive Structure*, Department of Education, Curriculum Series No. 6. Ithaca, N.Y. : Cornell University, 1978.

Posner, G.J., and Gertzog, W.A., "The clinical interview and the measurement of conceptual change," *Science Education*, 66(2) : 195-209 (1982).

Posner, G.J., Strike, K.A., Hewson, P.W., and Gertzog, W.A., "Accommodation of a scientific conception : Toward a theory of conceptual change," *Science Education*, 66(2) : 211-227 (1982).

Power, C., "Competing paradigms in science education research," *Journal of Research in Science Teaching*, 13(6) : 579-587 (1976).

Randall, D.L., "Examination of the hereditary assumptions underlying Piaget's theory of the development of intellectual structure," doctor's thesis, Boulder, Colorado : University of Colorado, 1967.

Raven, R.J., "The development of a test of Piaget's logical operations," *Science Education*, 57 : 377-385 (1973).

Raven, R., "Programming Piaget's logical operations for science inquiry and concept attainment," *Journal of Research in Science Teaching*, 11(8) : 251-261 (1974).

Reed, J.L., "Children's explanations," in Lesser, G.S., (ed.), *Psychology and Educational Practice*, Glenview, Ill. : Scott, Foresman and Company, 1971.

Renner, J.W., "Evaluating intellectual development using written responses to selected science problems," report to The National Science Foundation on Grant No. EPP75-19596, Analysis of cognitive processes, The University of Oklahoma, 1977, p. 164.

- Renner, J.W., "The relationship between intellectual development and written responses to science questions," *Journal of Research in Science Teaching*, 16(4) : 279-299 (1979).
- Renner, J.W., "The power of purpose," *Science Education*, 66(5) : 709-716 (1982).
- Renner, J.W., and Lawson, A.E., "Promoting intellectual development through science teaching," *The Physics Teacher*, 11 : 273-276 (1973).
- Renner, J.W., Stafford, D.G., Lawson, A.E., McKinnon, J.W., Friot, F.E., and Kellog, D.H., *Research, Teaching and Learning with the Piaget Model*, Norman, Oklahoma : University of Oklahoma Press, 1976.
- Renner, J.W., Sutherland, J., Grant, R., and Lawson, A.E., "Displacement volume, an indicator of early formal thought : Developing a paper-and-pencil test," *School Science and Mathematics*, 78(4) : 297-303 (1978).
- Roberts, R.S., "Concurrent validity in tests of Piagetian developmental levels," *Journal of Research in Science Teaching*, 17(4) : 343-350 (1980).
- Roper, K.E., "Generation of subsumers for secondary science students with differing cognitive development using advance organizers," University of Kansas, 1980. *Dissertation Abstracts International*, 41(12) : 4964-A (1981).
- Rowell, J.A., and Hoffman, P.J., "Group tests for distinguishing formal thinkers from concrete thinkers," *Journal of Research in Science Teaching*, 12(2) : 157-164 (1975).
- Sayre, S.A., and Ball, D.W., "Piagetian cognitive development and achievement in science," *Journal of Research in Science Teaching*, 12(2) : 165-174 (1975).
- Scandura, J.M., and Wells, J.N., "Advance organizers in learning abstract mathematics," *American Educational Research Journal*, 4(3) : 295-301 (1967).
- Schwebel, M., "Logical thinking in college freshmen. Final report," U.S. Office of Education, Department of Health, Education and Welfare, Grant No. OEG-2-7-0039 (509). (ERIC No. ED 063 896, April 1972.)
- Shayer, M., "Has Piaget's construct of formal operational thinking any utility?," *British Journal of Educational Psychology*, 49 : 265-276 (1979).
- Shayer, M., and Adey, P., *Towards a Science of Science Teaching*, London : Heinemann, 1981.
- Shayer, M., Adey, P., and Wylam, H., "Group tests of cognitive development ideals and a realization," *Journal of Research in Science Teaching*, 18(2) : 157-168 (1981).
- Shayer, M., Küchemann, D.E., and Wylam, H., "The distribution of Piagetian stages of thinking in British middle and secondary school children," *British Journal of Educational Psychology*, 46 : 164-173 (1976).
- Shayer, M., and Wharry, O., "Piaget in the classroom, part I : Testing a whole class at the same time," *School Science Review*, 55 : 47-458 (1974).

Shayer, M., and Wylam, H., "The distribution of Piagetian stages of thinking in British middle and secondary school children," *British Journal of Educational Psychology*, 48 : 62-70 (1978).

Sheehan, D.J., "The effectiveness of concrete and formal instructional procedures with concrete operational and formal operational students" doctoral dissertation, University of New York at Albany, Ann Arbor, Mich., 1970. *Dissertation Abstracts International*, 31(6) : 2748-A (1970). (University Microfilm No. 70-25, 479).

Shyers, J., and Cox, D., "Training for the acquisition and transfer of the concept of proportionality in remedial and college students," *Journal of Research in Science Teaching*, 15(1) : 25-36 (1978).

Siegel, S., *Nonparametric Statistics for the Behavioral Sciences*, New York : McGraw-Hill Book Company, Inc., 1956.

Siegler, R.S., "Three aspects of cognitive development," *Cognitive Psychology*, 8 : 481-520 (1976).

Siegler, R.S., and Atlas, M.A., "Acquisition of formal scientific reasoning by 10- and 13-year-olds : Detecting interactive patterns in data," *Journal of Educational Psychology*, 68(3) : 360-370 (1976).

Siegler, R.S., Liebert, D.E., and Liebert, R.M., "Inhelder and Piaget's pendulum problem : Teaching preadolescents to act as scientists," *Developmental Psychology*, 9(1) : 97-101 (1973).

Siegler, R.S., and Liebert, R.M., "Acquisition of formal scientific reasoning by 10- and 13-year-olds : Designing a factorial experiment," *Developmental Psychology*, 11(3) : 401-402 (1975). Personal communication and further details on this study, 1978.

Sills, T.W., "Developmental and evaluative study of a group administered test of Piagetian formal operation," doctoral dissertation, Purdue University, 1977. (University Microfilms No. 77-30135).

Sills, T.W., and Herron, J.D., "Study of an electronic analog to the combinations of chemical bodies Piagetian task," *Journal of Genetic Psychology*, 129 : 267-272 (1976).

Sipe, H.C., and Farmer, W.A., "A summary of research in science education - 1980," *Science Education*, 66(3) : 305-493 (1982).

Sisler, H.H., Van der Werf, C.A., and Davidson, A.W., *College Chemistry*, 3rd ed. New York : The Macmillan Company, 1969.

Smedslund, J., "The acquisition of conservation of substance and weight in children : I," *Scandinavian Journal of Psychology*, 2(1) : 11-20 (1961).

Smith, C.D., "The effects of organizers and abstract reasoning levels on learning and retention of post-secondary mathematics students," *Dissertation Abstracts International*, 37(6) : 3482-A (1976).

Spiers, A., and Stebbens, D., *Chemistry by Concept*, London : Heinemann Educational Books, 1973.

Shayer, M., and Wylam, H., "The distribution of Piagetian stages of thinking in British middle and secondary school children," *British Journal of Educational Psychology*, 48 : 62-70 (1978).

Sheehan, D.J., "The effectiveness of concrete and formal instructional procedures with concrete operational and formal operational students" doctoral dissertation, University of New York at Albany, Ann Arbor, Mich., 1970. *Dissertation Abstracts International*, 31(6) : 2748-A (1970). (University Microfilm No. 70-25, 479).

Shyers, J., and Cox, D., "Training for the acquisition and transfer of the concept of proportionality in remedial and college students," *Journal of Research in Science Teaching*, 15(1) : 25-36 (1978).

Siegel, S., *Nonparametric Statistics for the Behavioral Sciences*, New York : McGraw-Hill Book Company, Inc., 1956.

Siegler, R.S., "Three aspects of cognitive development," *Cognitive Psychology*, 8 : 481-520 (1976).

Siegler, R.S., and Atlas, M.A., "Acquisition of formal scientific reasoning by 10- and 13-year-olds : Detecting interactive patterns in data," *Journal of Educational Psychology*, 68(3) : 360-370 (1976).

Siegler, R.S., Liebert, D.E., and Liebert, R.M., "Inhelder and Piaget's pendulum problem : Teaching preadolescents to act as scientists," *Developmental Psychology*, 9(1) : 97-101 (1973).

Siegler, R.S., and Liebert, R.M., "Acquisition of formal scientific reasoning by 10- and 13-year-olds : Designing a factorial experiment," *Developmental Psychology*, 11(3) : 401-402 (1975). Personal communication and further details on this study, 1978.

Sills, T.W., "Developmental and evaluative study of a group administered test of Piagetian formal operation," doctoral dissertation, Purdue University, 1977. (University Microfilms No. 77-30135).

Sills, T.W., and Herron, J.D., "Study of an electronic analog to the combinations of chemical bodies Piagetian task," *Journal of Genetic Psychology*, 129 : 267-272 (1976).

Sipe, H.C., and Farmer, W.A., "A summary of research in science education - 1980," *Science Education*, 66(3) : 305-493 (1982).

Sisler, H.H., Van der Werf, C.A., and Davidson, A.W., *College Chemistry*, 3rd ed. New York : The Macmillan Company, 1969.

Smedslund, J., "The acquisition of conservation of substance and weight in children : I," *Scandinavian Journal of Psychology*, 2(1) : 11-20 (1961).

Smith, C.D., "The effects of organizers and abstract reasoning levels on learning and retention of post-secondary mathematics students," *Dissertation Abstracts International*, 37(6) : 3482-A (1976).

Spiers, A., and Stebbens, D., *Chemistry by Concept*, London : Heinemann Educational Books, 1973.

Staver, J.R., and Gabel, D.L., "The development and construct validation of a group-administered test of formal thought," *Journal of Research in Science Teaching*, 16(6) : 535-544 (1979).

Staver, J.R., and Harty, H., "Validation of an instrument and testing protocol for measuring the combinatorial analysis schema," *Journal of Research in Science Teaching*, 16(1) : 53-59 (1979).

Stevens, S.S., "Measurement, statistics and the schemapiric view," *Science*, 161 : 849-856 (1968).

Stewart, J.H., and Atkin, J.A., "Information-processing psychology : A promising paradigm for research in science teaching," *Journal of Research in Science Teaching*, 19(4) : 321-332 (1982).

Strike, K.A., "On the expressive potential of behavioral language," *American Educational Research Journal*, 11(3) : 103-120 (1974).

Strike, K.A., and Posner, G.J., "Epistemological perspectives on conceptions of curriculum organization and learning," in Shulmann, L.S., (ed.), *Review of Research in Education*, 4, Itasca, Illinois : F.E. Peacock, 1976.

Sullivan, E.V., "Experiments in the acquisition of conservation of substance : An overview," in Brison, D.W., and Sullivan, E.V., (eds.), *Recent Research on the Acquisition of Conservation of Substance*, Education Monograph, Ontario Institute for Studies in Education, 1967.

Sullivan, E.V., "The role of inter- and intra-age individual differences in planning teacher training programs," an invited chapter for Teachers College, Columbia University. Supported by the United States Office of Education. RFP No. 68-4, June, 1968.

Swanepoel, C.H., Report 12, Work Committee on Instruction of Natural Sciences, Human Sciences Research Council, Pretoria, 1981.

Swanepoel, C.H., personal communication, 1983.

Szeminska, A., "The evolution of thought : Some applications of research findings to educational practice," in Mussen, P.H., (ed.), "European research in cognitive development," *Monograph of the Society for Research in Child Development*, No. 100, 30(2) : 46-57 (1965).

Talley, L.H., "The use of three-dimensional visualization as a moderator in higher cognitive learning concepts in college level chemistry," *Journal of Research in Science Teaching*, 10 : 263-269 (1973).

Tisher, R.P., "A Piagetian questionnaire applied to pupils in a secondary school," *Child Development*, 42 : 1633-1636 (1971).

Tisher, R.P., and Dale, L.G., *Understanding in Science Testing*, Hawthorn, Victoria : Australian Council for Educational Research, 1975.

Toon, E.R., and Ellis, G.L., *Foundations of Chemistry*, New York : Holt, Rinehart and Winston, 1973.

Treagust, D.F., "Comments on 'The acquisition of propositional logic and formal operational schemata during the secondary school years'," *Journal of Research in Science Teaching*, 16(4) : 363-367 (1979).

Tschopp, J.K., and Kurdek, L.A., "An assessment of the relation between traditional and paper-and-pencil formal operations tasks," *Journal of Research in Science Teaching*, 18(1) : 87-91 (1981).

Tyler, F.T., "Issues related to readiness," in *Theories of Learning and Instruction*, 63rd yearbook, Natl. Soc. Stud. Educ., Part II, Chicago : University of Chicago Press, 1964.

Van Kirk, J., "Limitations of Ausubel's theory of learning with regard to meaning and cognitive processing," paper presented at the annual meeting of the National Association of Research in Science Teaching, Toronto, Canada, 1978.

Varano, S.P., "The effects of advance organizers and behavioral objectives on the facilitation of learning and retention of a biology unit," The Pennsylvania State University, 1977. *Dissertation Abstracts International*, 38(12) : 7131-A (1978).

Vogel, A.I., *A Text-book of Macro and Semimicro Qualitative Inorganic Analysis*, 4th ed. London : Longmans, 1959.

Vygotsky, L.S., *Thought and Language*, Cambridge, Mass., : M.I.T. Press, 1962.

Walker, R.A., Hendrix, J.R., and Mertens, T.R., "Written Piagetian task instrument : Its development and use," *Science Education*, 63(2) : 211-220 (1979).

Ward, R.W., "A study of the development in fourth, fifth and sixth grade children of an understanding of a particulate model of matter," doctoral dissertation, Cornell University, 1972. *Dissertation Abstracts International*, 33(10) : 5579-A (1973) University Microfilm No. 73-10, 152.

Ward, C.R., and Herron, J.D., "Helping students understand formal chemical concepts," *Journal of Research in Science Teaching*, 17(5) : 387-400 (1980).

Ward, C.R., Nurrenbern, S.C., Lucas, C., and Herron, J.D., "Evaluation of the Longeot test of cognitive development," *Journal of Research in Science Teaching*, 18(2) : 123-130 (1981).

Wason, P.C., and Johnson-Laird, P.N., *Psychology of Reasoning : Structure and Content*, Cambridge, Mass. : Harvard University Press, 1972.

Weisberg, J.S., "The use of visual advance organizers for learning earth science concepts," paper presented at the meeting of the National Association for Research in Science Teaching, Minneapolis, March 1970. (ERIC Document Reproduction Service No. ED 040 054).

Wesney, J.C., "An analysis of the influence of prior cognitive development in physics and in mathematical reasoning on concept attainment in the study of mechanics in introductory college physics," Cornell University, 1977. *Dissertation Abstracts International*, 38(9) : 5379-A (1978).

West, L.H.T., and Fensham, P.J., "Prior knowledge and the learning of science -- a review of Ausubel's theory of the process," *Studies in Science Education*, 1 : 61-81 (1974).

West, L.H.T., and Fensham, P.J., "Prior knowledge or advance organizers as effective variables in chemical learning," *Journal of Research in Science Teaching*, 13 : 297-306 (1976).

West, L.T., and Kellett, N.C., "The meaningful learning of intellectual skills : An application of Ausubel's subsumption theory to the domain of intellectual skills learning," *Science Education*, 65(2) : 207-219 (1981).

Westmeyer, P.H., "Theories of education : An essay," *Journal of Research in Science Teaching*, 19(5) : 397-398 (1982).

Wheeler, A.E., and Kass, H., "Student misconception in chemical equilibrium as related to cognitive level and achievement," paper presented at the annual meeting of the National Association for Research in Science Teaching, Chicago, 1974.

White, R.T., "The validation of a learning hierarchy," *American Educational Research Journal*, 11 : 121-136 (1974).

Wilson, J.T., "Towards a disciplined study of testing in science education," *Science Education*, 65(3) : 259-270 (1981).

Wollman, W.T., "Form versus content in Piagetian testing," *Science Education*, 66(5) : 751-762 (1982).

Wollman, W.T., and Chen, B., "Effects of structured social interaction on learning to control variables : A classroom training study," *Science Education*, 66(5) : 717-730 (1982).

Yager, R.E., "Defining the discipline of science education," *Science Education*, 68(1) : 35-37 (1984).

Za'Rour, G.I., and Gholam, G.K., "Intellectual development of students at the secondary-college interface in Lebanon," *Science Education*, 65(3) : 285-290 (1981).

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