

Bibliography

- [1] Woo-kyoung Ahn and Charles W. Kalish. The Role of Mechanism Beliefs in Causal Reasoning. In Frank C. Keil and Robert A. Wilson, editors, *Explanation and Cognition*. The MIT Press, Cambridge, MA, 2000.
- [2] Rudolph V. Alvarado. *The Life and Work of Thomas Edison*. Alpha Books, Indianapolis, IN, 2002.
- [3] Geoffrey D. Austrian. *Herman Hollerith: Forgotten Giant of Information Processing*. Columbia University Press, New York, NY, 1982.
- [4] Christian Bailly. *Automata: The Golden Age, 1848–1914*. Robert Hale, London, UK, 2003.
- [5] Maria G. Bartolini Bussi, Mara Boni, Franca Ferri, and Rossela Garuti. Early Approach to Theoretical Thinking: Gears in Primary School. *Educational Studies in Mathematics*, 39:67–87, 1999.
- [6] Theodore Baumeister, editor. *Standard Handbook for Mechanical Engineers*. McGraw-Hill Book Company, New York, NY, seventh edition, 1967.
- [7] Silvio Bedini. The Role of Automata in the History of Technology. *Technology and Culture*, 5(4):24–42, Spring 1964.
- [8] Erwin H. Brinkmann. Programed Instruction as a Technique for Improving Spatial Visualization. *Journal of Applied Psychology*, 50(2):179–184, 1966.
- [9] William J. Broad. Top Advisory Panel Warns of an Erosion of the U.S. Competitive Edge in Science. *The New York Times*, Section A, Page 22, Column 1, October 13, 2005.
- [10] Norman Brosterman. *Inventing Kindergarten : Nineteenth Century Children*. Harry N. Abrams, New York, NY, 1997.
- [11] Earle Buckingham. *Manual of Gear Design: Section Two*. Machinery, New York, NY, 1935.
- [12] M. David Burghardt. Developing the Field of Children’s Engineering. In *Proceedings of the ASEE 2000 Annual Conference*, 2000.

- [13] Kirsten Butcher. *Effects of Diagram Complexity on Comprehension Processes and Learning Outcomes*. PhD thesis, Department of Psychology and Institute of Cognitive Science, University of Colorado at Boulder, 2003.
- [14] Cabaret Mechanical Theatre [online, cited 09 October 2005]. Available from: <http://www.cabaret.co.uk/>.
- [15] Cabaret Mechanical Theatre Stock Catalog, Winter 1998 [online, cited 09 October 2005]. Available from: <http://www.cabaret.co.uk/pdfs/stock.pdf>.
- [16] John B. Carrol. *Human Cognitive Abilities: A Survey of Factor-Analytic Studies*. Cambridge University Press, Cambridge, UK, 1993.
- [17] B. Chandrasekaran. Multimodal Perceptual Representations and Design Problem Solving. In John S. Gero and Barbara Tversky, editors, *Visual and Spatial Reasoning in Design '99*, 1999.
- [18] Alfred Chapuis and Edmond Droz. *Automata*. Éditions du Griffon, Neuchatel, Switzerland, 1958.
- [19] Highlights from John Drury Auction at Leslie Hindman's [online, cited 15 October 2005]. Available from: <http://chicagoantiquesguide.com/archives/20051014082916.php>.
- [20] Paul Cobb. Where is the Mind? A Coordination of Sociocultural and Cognitive Constructivist Perspectives. In Catherine Twomey Fosnot, editor, *Constructivism: Theory, Perspectives, and Practice*. Teachers College Press, New York, NY, 1996.
- [21] Colorado K-12 Student Assessment Index Page [online, cited 31 December 2005]. Available from: http://www.cde.state.co.us/index_assess.htm.
- [22] Colorado Model Content Standards for Science [online, cited 05 December 2005]. Available from: <http://www.cde.state.co.us/cdeassess/standards/pdf/science.pdf>.
- [23] John W. Cox. *Mechanical Aptitude: Its Existence, Nature, and Measurement*. Methuen & Company Ltd., London, UK, 1928.
- [24] LEGO CAD [online, cited 09 October 2005]. Available from: <http://www.workshop3d.com/cybertoy/legocad.htm>.
- [25] Unit 5C: Moving Toys [online, cited 10 October 2005]. Available from: <http://www.standards.dfes.gov.uk/schemes2/designtech/det5c/?view=get>.
- [26] Unit 6C: Fairground [online, cited 10 October 2005]. Available from: <http://www.standards.dfes.gov.uk/schemes2/designtech/det6c/?view=get>.

- [27] Josh Douglas, Eric Iversen, and Chitra Kalyandurg. Engineering in the K-12 Classroom: An Analysis of Current Practices & Guidelines for the Future. Technical report, The American Society for Engineering Education, November, 2004.
- [28] A.G. Drachmann. *The Mechanical Technology of Greek and Roman Antiquity*. The University of Wisconsin Press, Madison, WI, 1963.
- [29] Darle W. Dudley. *Practical Gear Design*. McGraw-Hill Book Company, New York, NY, 1954.
- [30] Richard T. Duesbury and Harold F. O'Neil, Jr. Effect of Type of Practice in a Computer-Aided Design Environment in Visualizing Three-Dimensional Objects From Two-Dimensional Orthographic Projections. *Journal of Applied Psychology*, 81(3):249–260, 1996.
- [31] Jacquelynne S. Eccles. The Development of Children Ages 6 to 14. *The Future of Children*, 9(2):30–44, 1999.
- [32] Ann Naomi Eisenberg. *An Educational Program for Paper Sculpture: A Case Study in the Design of Software to Enhance Children's Spatial Cognition*. PhD thesis, Department of Computer Science, University of Colorado at Boulder, 1999.
- [33] Michael Eisenberg. Mindstuff: Educational Technology Beyond the Computer. *Convergence*, 9(2):29–53, Summer 2003.
- [34] James Essinger. *Jacquard's Web: How a Hand-Loom Led to the Birth of the Information Age*. Oxford University Press, Oxford, UK, 2004.
- [35] Erika L. Ferguson and Mary Hegarty. Learning With Real Machines or Diagrams: Application of Knowledge to Real-World Problems. *Cognition and Instruction*, 13(1):129–160, 1995.
- [36] William Fitzgerald, Franklin Gracer, and Robert Wolfe. GRIN: Interactive Graphics for Modeling Solids. *IBM Journal of Research and Development*, 25(4):281–294, 1981.
- [37] Flying Pig Paper Animation Kits [online, cited 16 October 2005]. Available from: <http://www.flying-pig.co.uk/>.
- [38] Kenneth D. Forbus. Qualitative Reasoning About Space and Motion. In Dedre Gentner and Albert L. Stevens, editors, *Mental Models*. Lawrence Erlbaum Associates, Hillsdale, NJ, 1983.
- [39] Patrick N. Foster. The Heritage of Elementary School Technology Education in the U.S. *Journal of Vocational and Technical Education*, 15(2):28–43, 1999.
- [40] Patrick N. Foster and Michael D. Wright. How Children Think and Feel About Design and Technology: Two Case Studies. *Journal of Industrial Teacher Education*, 38(2), 2001.
- [41] Jeanette M. Gallagher and D. Kim Reid. *The Learning Theory of Piaget and Inhelder*. Brooks/Cole, Monterey, CA, 1981.

- [42] Martin Gardner. *aha! Insight*. Scientific American, Inc./W.H. Freeman and Company, New York, NY, 1978.
- [43] Girders and Gears [online, cited 13 October 2005]. Available from: <http://www.girdersandgears.com/>.
- [44] Vinod Goel. Cognitive Role of Ill-Structured Representations in Preliminary Design. In John S. Gero and Barbara Tversky, editors, *Visual and Spatial Reasoning in Design '99*, 1999.
- [45] Howard E. Gruber and J. Jacques Vonèche, editors. *The Essential Piaget*. Jason Aronson, Inc., Northvale, NJ, 1995.
- [46] Roland B. Guay. The Relationship Between Mathematics Achievement and Spatial Abilities Among Elementary School Children. *Journal for Research in Mathematics Education*, 8(3):211–215, 1977.
- [47] David Guile and Michael Young. Apprenticeship as a Conceptual Basis for a Social Theory of Learning. *Journal of Vocational Education and Training*, 50(2):173–192, 1998.
- [48] Mary Hegarty. Mental Animation: Inferring Motion From Static Displays of Mechanical Systems. *Journal of Experimental Psychology*, 18(5):1084–1102, 1992.
- [49] Mary Hegarty. Capacity Limits in Diagrammatic Reasoning. In Michael Anderson, Peter Cheng, and Volker Haarslev, editors, *Theory and Application of Diagrams: Proceedings of the First International Conference, Diagrams 2000*, pages 194–206, 2000.
- [50] Mary Hegarty and Marcel Adam Just. Constructing Mental Models of Machines from Text and Diagrams. *Journal of Memory and Language*, 32(6):717–742, 1993.
- [51] Mary Hegarty, Marcel Adam Just, and Ian R. Morrison. Mental Models of Mechanical Systems: Individual Differences in Qualitative and Quantitative Reasoning. *Cognitive Psychology*, 20(2):191–236, 1988.
- [52] Mary Hegarty and Maria Kozhevnikov. Spatial Abilities, Working Memory, and Mechanical Reasoning. In John S. Gero and Barbara Tversky, editors, *Visual and Spatial Reasoning in Design '99*, 1999.
- [53] Mary Hegarty, Sarah Kriz, and Christina Cate. The Roles of Mental Animations and External Animations in Understanding Mechanical Systems. *Cognition and Instruction*, 21(4):325–360, 2003.
- [54] Mary Hegarty and Valerie K. Sims. Individual Differences in Mental Animation During Mechanical Reasoning. *Memory & Cognition*, 22(4):411–430, 1994.
- [55] Mary Hegarty and Kathryn Steinhoff. Individual Differences in Use of Diagrams as External Memory in Mechanical Reasoning. *Learning and Individual Differences*, 9(1):19–42, 1997.

- [56] Mary Hegarty and David A. Waller. Individual Differences in Spatial Abilities. In Priti Shah and Akira Miyake, editors, *The Cambridge Handbook of Visuospatial Thinking*. Cambridge University Press, Cambridge, UK, 2005.
- [57] Julie Heiser and Barbara Tversky. Diagrams and Depictions in Acquiring Complex Systems. In Wayne D. Gray and Christian Schunn, editors, *Proceedings of the 24th Annual Meeting of the Cognitive Science Society*, 2002.
- [58] Susan L. Hendrix and Michael A. Eisenberg. Computer-Assisted Pop-up Design for Children: Computationally-Enriched Paper Engineering. In *Proceedings of the Eighth IASTED International Conference on Computers and Advanced Technology in Education*, 2005.
- [59] Ann Marie Hill. Problem Solving in Real-Life Contexts: An Alternative for Design in Technology Education. *International Journal of Technology and Design Education*, 8(3):203–220, 1998.
- [60] Mary Hillier. *Automata and Mechanical Toys: an Illustrated History*. Bloomsbury Books, London, UK, 1976.
- [61] Lloyd G. Humphries, David Lubinski, and Grace Yao. Utility of Predicting Group Membership and the Role of Spatial Visualization in Becoming an Engineer, Physical Scientist, or Artist. *Journal of Applied Psychology*, 78(2):250–261, 1993.
- [62] Ivan Illich. *Deschooling Society*. Harper & Row, New York, NY, 1971.
- [63] S. D. Johnson. The Heritage of Elementary School Technology Education in the U.S. *Journal of Vocational and Technical Education*, 52(8):29–30, 1993.
- [64] Allister Jones. The Development of a National Curriculum in Technology for New Zealand. *International Journal of Technology and Design Education*, 13(1):83–99, 2003.
- [65] Yasmin Kafai and Idit Harel. Children Learning Through Consulting: When Mathematical Ideas, Knowledge of Programming and Design, and Playful Discourse are Intertwined. In Idit Harel and Seymour Papert, editors, *Constructionism: Research Reports and Essays, 1985-1990*. Ablex Publishing, Norwood, NJ, 1991.
- [66] Sue Ann Kearns, Catherine Rogers, Judy Barosky, Merredith Portsmore, and Chris Rogers. Successful Methods for Introducing Engineering into the First Grade Classroom. In *Proceeding of the 2001 American Society of Engineering Education Annual Conference and Exhibition*, 2001.
- [67] The Central Site for the LDraw Family of LEGO CAD Software [online, cited 09 October 2005]. Available from: <http://www.ldraw.org/>.
- [68] Factory Homepage [online, cited 09 October 2005]. Available from: <http://www.lego.com/eng/factory/>.
- [69] Richard Lehrer and Leona Schauble. Reasoning about Structure and Function: Children's Conceptions of Gears. *Journal of Research in Science Teaching*, 35(1):3–25, 1998.

- [70] Clayton Lewis and John Rieman. *Task-Centered User Interface Design: A Practical Introduction*. Shareware, Boulder, CO, 1994.
- [71] Marcia C. Linn and Anne C. Petersen. A Meta-Analysis of Gender Differences in Spatial Ability: Implications for Mathematics and Science Achievement. In Janet Shibley Hyde and Marcia C. Linn, editors, *The Psychology of Gender: Advances Through Meta-Analysis*. Johns Hopkins University Press, Baltimore, MD, 1986.
- [72] The International LEGO Users Group Network [online, cited 09 October 2005]. Available from: <http://www.lugnet.com/>.
- [73] James G. Madison. *CNC Machining Handbook: Basic Theory, Production Data, and Machining Procedures*. Industrial Press, New York, NY, 1996.
- [74] Manolya Kavakli, Masaki Suwa, John Gero, and Terry Purcell. Sketching Interpretation in Novice and Expert Designers. In John S. Gero and Barbara Tversky, editors, *Visual and Spatial Reasoning in Design '99*, 1999.
- [75] Masaki Suwa, John Gero, and Terry Purcell. Unexpected Discoveries: How Designers Discover Hidden Features in Sketches. In John S. Gero and Barbara Tversky, editors, *Visual and Spatial Reasoning in Design '99*, 1999.
- [76] Juta McCord and Jim McCord. *Contemporary Automata: A Continuum*. MouseWorks Canada, Toronto, Ontario, Canada, 2004.
- [77] Malcolm McCullough. *Abstracting Craft: The Practiced Digital Hand*. MIT Press, Cambridge, MA, 1996.
- [78] Ann McKenna and Alice Agogino. Designing and Assessing a Learning Environment to Support Mechanical Reasoning. In *Proceedings of the 2002 American Society of Engineering Education Annual Conference & Exposition*, 2002.
- [79] Merriam-Webster. *Merriam-Webster's Collegiate Dictionary*. Merriam-Webster, Inc., Springfield, MA, second edition, 2000.
- [80] Heron of Alexandria [online, cited 09 October 2005]. Available from: <http://www.mlahanas.de/Greeks/HeronAlexandria.htm>.
- [81] George A. Miller. The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity to Process Information. *Psychological Review*, 63(2):81–87, 1956.
- [82] Joel Mokyr. *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton University Press, Princeton, NJ, 2002.
- [83] Barbara M. Moskal. Looking to the Future: Women in Science and Engineering. In *Proceedings of the 30th ASEE/IEEE Frontiers in Education Conference*, pages F1B–19–F1B–24, 2000.

- [84] The NASA SCI Files: The Case of the Powerful Pulleys [online, cited 11 December 2005]. Available from: http://whyfiles.larc.nasa.gov/docs/guides/guide1a_02.pdf.
- [85] Illuminations Lessons: Balance Beam Discoveries [online, cited 11 December 2005]. Available from: http://illuminations.nctm.org/index_d.aspx?id=319.
- [86] Design and Technology [online, cited 12 December 2005]. Available from: <http://www.nc.uk.net/webdav/servlet/XRM?Page/@id=6004&Subject/@id=3624>.
- [87] National Curriculum Online [online, cited 09 October 2005]. Available from: <http://www.nc.uk.net/webdav/servlet/XRM?Page/@id=6016>.
- [88] Division of Science Resources Statistics National Science Foundation. *Science and Engineering Indicators-2002*. National Science Foundation, Arlington, VA, 2002.
- [89] Division of Science Resources Statistics National Science Foundation. *Science and Engineering Indicators-2004*. National Science Foundation, Arlington, VA, 2004.
- [90] Aidan Lawrence Onn and Gary Alexander. *Cabaret Mechanical Movement: Understanding Movement and Making Automata*. Cabaret Mechanical Theatre, London, UK, 1998.
- [91] Seymour Papert. Situating Constructionism. In Idit Harel and Seymour Papert, editors, *Constructionism: Research Reports and Essays, 1985-1990*. Ablex Publishing, Norwood, NJ, 1991.
- [92] Seymour Papert. *Mindstorms: Children, Computers, and Powerful Ideas*. Basic Books, second edition, 1993.
- [93] Seymour Papert. A Word for Learning. In Yasmin Kafai, editor, *Constructionism in Practice: Designing, Thinking, and Learning in a Digital World*. Lawrence Erlbaum Associates, Mahwah, NJ, 1996.
- [94] Susan Pass. *Parallel Paths to Constructivism: Jean Piaget and Lev Vygotsky*. Information Age Publishing, Greenwich, CT, 2004.
- [95] Donald G. Paterson, Richard M. Elliott, Leo D. Anderson, Herbert A. Toops, and Edna Heidbreder. *Minnesota Mechanical Ability Tests: The Report of a Research Investigation Subsidized by the Committee on Human Migrations of the National Research Council and Conducted in the Department of Psychology of the University of Minnesota*. University of Minnesota Press, Minneapolis, MN, 1930.
- [96] Brief Outline of the History of I/O Psychology [online, cited 27 November 2005]. Available from: http://www.mtsu.edu/~pmccarth/io_hist.htm.
- [97] Rodney Peppé. *Automata and Mechanical Toys*. The Crowood Press, Ramsbury, UK, 2002.

- [98] Tillie Pine and Joseph Levine. *Simple Machines and How We Use Them*. McGraw-Hill Book Company, New York, NY, 1965.
- [99] Steven Pinker. *How the Mind Works*. W.W. Norton & Company, New York, NY, 1997.
- [100] Charles Poole and Gordon Stanley. A Factorial and Predictive Study of Spatial Abilities. *Australian Journal of Psychology*, 24(3):317–320, 1972.
- [101] Derek J. de Solla Price. Automata and the Origins of Mechanism and Mechanistic Philosophy. *Technology and Culture*, 5(4):9–23, Spring 1964.
- [102] Mitchel Resnick, Robbie Berg, and Michael Eisenberg. Beyond Black Boxes: Bringing Transparency and Aesthetics Back to Scientific Investigation. *The Journal of the Learning Sciences*, 9(1):7–30, January 2000.
- [103] Randy Sargent, Mitchel Resnick, Fred Martin, and Brian Silverman. Building and Learning With Programmable Bricks. In Yasmin Kafai, editor, *Constructionism in Practice: Designing, Thinking, and Learning in a Digital World*. Lawrence Erlbaum Associates, Mahwah, NJ, 1996.
- [104] Michael S. Shapiro. *Child's Garden: The Kindergarten Movement from Froebel to Dewey*. Pennsylvania State University Press, University Park, PA, 1983.
- [105] Francis T. Siemankowski and Franklin C. MacKnight. Spatial Cognition: Success Prognosticator in College Science Courses. *Journal of College Science Teaching*, 1(1):56–59, 1971.
- [106] Ian M. Smith. *Spatial Ability: Its Educational and Social Significance*. Robert R. Knapp, San Diego, CA, 1964.
- [107] Software 4 Teachers [online, cited 16 October 2005]. Available from: <http://www.software4teachers.org/>.
- [108] Charles E. Spearman. *The Nature of 'Intelligence' and the Principles of Cognition*. MacMillan, London, UK, 1923.
- [109] Guy L. Steele, Jr. *Common LISP: The Language*. Digital Press, Burlington, MA, 1984.
- [110] John L. Stenquist. *Measurements of Mechanical Ability*. Columbia University Teachers College, New York, NY, 1923.
- [111] Craig Strange. *Collectors Guide to Tinker Toys*. Collector Books, Paducah, KY, 1996.
- [112] Carol Strohecker. Elucidating Styles of Thinking about Topology through Thinking about Knots. In Idit Harel and Seymour Papert, editors, *Constructionism: Research Reports and Essays, 1985-1990*. Ablex Publishing, Norwood, NJ, 1991.
- [113] Donald E. Super and John O. Crites. *Appraising Vocational Fitness by Means of Psychological Tests*. Harper and Row, New York, NY, revised edition, 1962.

- [114] Masaki Suwa and Barbara Tversky. What do Architects and Students Perceive in Their Design Sketches?: A Protocol Analysis. *Design Studies*, 18(4):385–403, 1997.
- [115] Michael J. Tarr and Steven Pinker. Mental Rotation and Orientation-Dependence in Shape Recognition. *Cognitive Psychology*, 21(2):233–282, 1989.
- [116] Frederick W. Taylor. *The Principles of Scientific Management*. Harper & Brothers, New York, NY, 1911.
- [117] Ctesibius of Alexandria [online, cited 09 October 2005]. Available from: <http://www.tmath.edu.gr/en/aet/1/31.html>.
- [118] Hero of Alexandria [online, cited 09 October 2005]. Available from: <http://www.tmath.edu.gr/en/aet/1/55.html>.
- [119] Extensible Markup Language (XML) 1.0 (Second Edition) [online, cited 09 October 2005]. Available from: <http://www.w3.org/TR/REC-xml>.
- [120] Cabaret Mechanical Theatre. Cabaret Mechanical Video. Videotape, 1991.
- [121] Wendy Turnbull. The Place of Authenticity in Technology in the New Zealand Curriculum. *International Journal of Technology and Design Education*, 12(1):23–40, 2002.
- [122] Barbara Tversky. What Does Drawing Reveal About Thinking? In John S. Gero and Barbara Tversky, editors, *Visual and Spatial Reasoning in Design '99*, 1999.
- [123] Barbara Tversky. Visuospatial Reasoning. In Keith J. Holyoak and Robert G. Morrison, editors, *The Cambridge Handbook of Thinking and Reasoning*. Cambridge University Press, Cambridge, UK, 2005.
- [124] No Child Left Behind [online, cited 31 December 2005]. Available from: <http://www.ed.gov/nclb/landing.jhtml?src=pb>.
- [125] Philon of Byzantium [online, cited 09 October 2005]. Available from: <http://www-history.mcs.st-and.ac.uk/history/Mathematicians/Philon.html>.
- [126] Arthur J. Vidich and Stanford M. Lyman. Qualitative Methods: Their History in Sociology and Anthropology. In Norman K. Denzin and Yvonna S. Lincoln, editors, *Handbook of Qualitative Research*. Sage Publications, Thousand Oaks, CA, 2000.
- [127] Anthony F.C. Wallace. *Rockdale: The Growth of an American Village in the Early Industrial Revolution*. Alfred A. Knopf, New York, NY, 1978.
- [128] Bruce Watson. *The Man Who Changed How Boys and Toys Were Made*. Viking, New York, NY, 2002.
- [129] Judith Byrne Whyte. Starting Early: Girls and Engineering. *European Journal of Engineering Education*, 11(3):271–279, 1986.

- [130] CNC [online, cited 09 October 2005]. Available from: <http://en.wikipedia.org/wiki/Cnc>.
- [131] Denise Wilson, Tina Hudson, Susan Fletcher, Brannon Harris, Clinton Knight, Tonia Morris, Girish Patel, and Stephen DeWeerth. Establishing the Foundations for Engineering Education in K-5. In *Proceedings of the IEEE 1995 Frontiers in Education Conference*, pages 3b2.5–3b2.9, 1995.
- [132] Bennet Woodcroft. *The Pneumatics of Hero of Alexandria*. Taylor, Walton, and Maberly, London, UK, 1851.
- [133] Thomas E. Wensch. *Programming Computationally Enhanced Craft Items*. PhD thesis, Department of Computer Science, University of Colorado, Boulder, 2002.
- [134] Welcome to Zome!! [online, cited 30 December 2005]. Available from: <http://www.zometools.com/>.