

Section VII:

**Bibliography for the Review of Undergraduate Education
in Science, Mathematics, Engineering, and Technology**

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Bibliography for the Review of Undergraduate Education in Science, Mathematics, Engineering, and Technology

Clifford Adelman, *The Way We Are: The Community College as American Thermometer* (Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement, February, 1992, OR92-511).

_____, *The New College Course Map and Transcript Files: Changes in Course-Taking and Achievement, 1972-1993* (Draft Manuscript, Fall 1995)

Jeffrey C. Alexander, "The Irrational Disciplinarity of Undergraduate Education," *The Chronicle of Higher Education*, Vol. 40 (December 1, 1993) p. B3.

American Association for the Advancement of Science, *Project 2061, Science for All Americans* (James Rutherford and Andrew Ahlgren, principal authors) (New York, NY: Oxford University Press, 1989).

_____, *Update* (Washington, DC: AAAS, Inc., 1992).

_____, *Benchmarks for Science Literacy* (New York, NY: Oxford University Press, 1993).

American Association for Higher Education, *Forum on Faculty Roles and Rewards, and Teaching Effectiveness*, --- AAHE publications addressing the Forum's concerns include:

E. Anderson, *Campus Use of the Teaching Portfolio: Twenty-Five Profiles* (1993);

Jon Wergin, *The Collaborative Department: How Five Campuses Are Inching Toward Cultures of Collective Responsibility* (1994);

Ernest Lynton, *Making the Case for Professional Service* (1995);

Robert Diamond and Bronwyn Adam (editors), *The Disciplines Speak: Rewarding the Scholarly, Professional, and Creative Work of Faculty* (1995); and

P. Hutchings, *Peer Review of Teaching: A Project Workbook* (1995). (Washington, DC: AAHE, One Dupont Circle).

American Association of State Colleges and Universities, *Formula for Reform: The Role of the Comprehensive University in Undergraduate Science and Engineering Education* (Washington, DC: November, 1989).

American Council on Education, *Educating One-Third of a Nation: The Conference Report* (Washington DC: ACE, 1988).

_____, *Status Report on Minorities in Higher Education* (Washington D.C., ACE, annual volumes).

- American Geophysical Union, Chapman Conference, *Scrutiny of Undergraduate Geoscience Education: Is the Viability of the Geosciences in Jeopardy?* Conference Proceedings (Washington, DC: American Geophysical Union Chapman Conference, 1995)
- American Institute of Biological Sciences, *Report of the Workshop on Undergraduate Environmental Science Education*: Held in conjunction with the 42nd AIBS Annual Meeting of Scientific Societies, San Antonio, Texas, August 7-8, 1991 (Washington, DC: American Institute of Biological Sciences, 1991).
- American Mathematical Association of Two-Year Colleges, *Standards for Curriculum and Pedagogical Reform in Two-Year College and Lower Division Mathematics* (Cobleskill, New York: AMATYC, 1993).
-
- _____, *Standards for Introductory College Mathematics Before Calculus*, Revised Final Draft (February, 1995).
- American Psychological Association, *Handbook for Enhancing Undergraduate Education in Psychology*, Results of a National Conference held during June, 1991 at St Mary's City, MD, (Washington, DC: American Psychological Association, 1993).
- T.A. Angelo and K.P. Cross, *Classroom Assessment Techniques: A Handbook for College Teachers* (San Francisco: Jossey-Bass, 1993).
- Alexander W. Astin, *Undergraduate Science Education: The impact of different college environments on the educational pipeline in the sciences: Final Report* (Los Angeles, CA: Higher Education Research Institute, Graduate School of Education, University of California at Los Angeles, 1992).
- _____, *What Matters in College?* (Jossey-Bass, San Francisco, CA, 1993).
- J.C. Bailar, "First-Year College Chemistry Textbooks," *Journal of Chemical Education*, Vol. 70 (1993), pp. 695-698.
- Steven R. Barley, "The New Crafts: On the Technization of the Workforce and the Occupationalization of Firms," *Working Paper*, National Center for the Education of the Workforce (Philadelphia, PA: University of Pennsylvania, 1991).
- Robert Barr and John Tagg, "From Teaching to Learning - a New Paradigm for Undergraduate Education," *Change*, Vol. 27 (November/December, 1995) pp. 12-25.
- P.A. Basili and P.J. Sanford, "Conceptual Change Strategies and Cooperative Group Work in Chemistry," *Journal of Research in Science Teaching*, Vol. 28, No. 4 (1991), pp. 293-304.
- D.L. Benson, M.C. Wittrock, and M.E. Bauer, "Students Preconceptions on the Nature of Gases," *Journal of Research in Science Teaching*, Vol. 30, (1993), pp. 587-597.
- Tora K. Bikson and S.A. Law, *Global Preparedness and Human Resources, College and Corporate Perspectives*, RAND (Santa Monica, CA: RAND, 1994).
- J.P. Birk and J. Foster, "The Importance of Lecture in General Chemistry Course Performance," *Journal of Chemical Education*, Vol. 70 (1993), pp. 180-182.

- John Bishop, "Incentives and Disincentives for Studying in High School," *American Economic Review, Papers and Proceedings* (May 1995), paper presented at the American Economic Association national meetings, January 6, 1995.
- Debra E. Blum, "Colleges Urged to Make Radical Changes to Deal with National Crisis in Mathematics Education (Moving beyond Myths: Revitalizing Undergraduate Mathematics; Report by the National Research Council)," *The Chronicle of Higher Education*, Vol. 37 (April 17, 1991) pp. A15-16.
- Paul Von Blum, *Stillborn Education, A Critique of the American Research University* (Lanham, MD: University Press of America, 1986).
- J.V. Boettcher (editor), *101 Success Stories of Information Technology in Higher Education* (New York, NY: McGraw-Hill, 1993).
- C.C. Bonwell and J.A. Eison, *Active Learning: Creating Excitement in the Classroom*, ASHE-ERIC Higher Education Report 1 (Washington, DC: George Washington University, 1991).
- George Boggs, "The Learning Paradigm," *Community College Journal* (December/January, 1995/1996), pages 24-27.
- Derek Bok, *Higher Learning*, (Cambridge, MA: Harvard University Press, 1986).
- _____, *Universities and the Future of America* (Durham, NC: Duke University Press, 1990).
- _____, "What's Wrong with Our Universities?: Are they flunking out? or are the graders asking the wrong questions?" *Harvard Magazine* (Cambridge, MA: May-June, 1990) pp. 44-59.
- H.R. Bowen, *The Costs of Higher Education: How Much Do Colleges and Universities Spend per Student and How Much Should They Spend?* (San Francisco, CA: Jossey-Bass, 1980).
- Ernest L. Boyer, *College: The Undergraduate Experience in America* (New York: Harper and Row, 1987)
- _____, *The Condition of the Professoriate: Attitudes and Trends* (Princeton, NJ: Princeton University Press, Lawrenceville, NJ, 1989).
- _____, *Scholarship Reconsidered: Priorities of the Professoriate* (Princeton, NJ: Princeton University Press, Carnegie Foundation for the Advancement of Teaching, 1990).
- L. Braskamp and J. Ory, *Assessing Faculty Work: Enhancing Individual and Institutional Performance* (San Francisco, CA: Jossey-Bass, 1994).
- A. Brown, *Science Education in Private Colleges of Central Appalachia* (Lexington, KY: Faculty Scholars Program, University of Kentucky, October 22-24, 1989).
- S. Brush, *The History of Modern Science: A Guide to the Second Scientific Revolution, 1880-1950* (Ames, IA: Iowa State University Press, 1988).

- Lawrence Burton and Carin Celebuski, *Technical Education in 2-Year Colleges; HES 17* (Washington, DC: National Science Foundation, US Dept of Education, National Endowment for the Humanities, March 1995).
- Ann Bykerk-Kauffman, "Using Cooperative Learning in College Geology Classes, *Journal of Geology Education*, Vol. 43 (1995), pp. 308-316.
- A.F. Cabrera, M.B. Castaneda, & D.S. Hengstler, "The Convergence Between Two Theories of College Persistence," *Journal of Higher Education*, Vol. 63, No. 2 (1992) pp. 144-164.
- The Carnegie Foundation for the Advancement of Teaching, *A Classification of Institutions of Higher Education: A Technical Report, 1994 Edition* (Ewing, New Jersey: California / Princeton Fulfillment Services, 1445 Lower Ferry Road).
- Center for Instructional Study, Syracuse University, *A National Study of Research Universities on the Balance Between Research and Undergraduate Teaching*, Supported by a grant from the Lilly Endowment (Syracuse, NY: Center for Instructional Development, Office of Evaluation and Research, Syracuse University, 1992)
- C.S. Claxton and P.H. Murrell, *Learning Styles: Implications for Improving Educational Practices*, ASHE-ERIC Higher Education Report No. 4 (Washington, DC: Association for the Study of Higher Education, 1987).
- J. Clement, D.E. Brown, and A. Zietsman, "Not All Preconceptions are Misconceptions: Finding "Anchoring Conceptions" for Grounding Instruction on Students' Intuitions," *International Journal of Science Education*, Vol. 11 (1989), pp. 554-565.
- Council of Chief State School Officers, *State Indicators of Science and Mathematics Education 1993, State and National Trends: New Indicators from the 1991-92 School Year* (Washington, DC: Council of Chief State School Officers, 1993).
- Mary Crystal Cage, "A Struggle for Reform," (University of Minnesota's Plan Focuses on Undergraduate Education) *The Chronicle of Higher Education*, Vol. 40 (March 23, 1994) p. A41
- Carnegie Forum on Education and the Economy, Task Force on Teaching as a Profession, *A Nation Prepared: Teachers for the 21st Century* (New York, 1986).
- Audrey B. Champagne (editor), *Science Teaching: Making the System Work* (Washington DC: American Association for the Advancement of Science, 1988).
- Bradford Chaney, *Student Outcomes and the Professional Preparation of Eighth-grade Teachers in Science and Mathematics*, NSF/NELS:88 Teacher Transcript Analysis Prepared for the NSF (Washington, DC: Westat, Inc., May, 1995).
- Change Magazine, "Where's the Beef? College Seniors Evaluate Their Undergraduate Experience," *Change*, Vol. 26 (September/October, 1994) pp. 29-32.
- Lynne Cheney, *50 Hours: A Core Curriculum for College Students* (Washington, DC: National Endowment for the Humanities, 1989).

- A. W. Chickering and Z. F. Gamson (editors), "Applying the Seven Principles for Good Practice in Undergraduate Education (A Symposium), *New Directions for Teaching and Learning* (Fall, 1991) pp. 1-100. [Available at GWU and CU]
- Barry Cipra, "Calculus Reform Sparks a Backlash," *Science* (February 16, 1996), page 901.
- Charles Clotfelter, *Demand for Undergraduate Education*, Part I in *Economic Challenges in Higher Education*, A National Bureau of Economic Research Monograph (Chicago, IL: The University of Chicago Press, 1991) pp. 19-139.
- I.B. Cohen, *Birth of a New Physics* (Norton, New York, 1985).
- M. M. Cooper, "Cooperative Learning: An Approach for Large Enrollment Courses," *Journal of Chemical Education*, Vol. 72 (1995), pp. 162-64.
- Patricia Cuniff (Chair), Curtis Heiggelke (co-Chair), and Barbara Leigh Smith (co-Chair), *Putting the Pieces Together, A Guide Book for Leaders of Coalitions of Two- and Four-Year Colleges and Universities* (Largo, MD: The Science & Technology Resource Center, Prince George's Community College, 301 Largo Rd., October 14-15, 1993).
- Brian H. Denton, and Roger Bowers, "An innovation in Undergraduate Mathematics Courses," *Journal of Education for Teaching*, Vol. 19, No. 2 (1993) pp. 227-9.
- Mary E. Diez, *Setting Standards and Educating Teachers: a National Conversation: A Report from the Wingspread Conference*, November 1-4, 1993 (Washington, DC: American Association of Colleges for Teacher Education, 1994).
- James J. Duderstadt, *A Vision for the 21st Century: Beyond "The Leaders and Best."* President's Weekend Address (Ann Arbor, MI: The University of Michigan, September 29, 1995).
- R. Duit, F. Goldberg, and H. Niedderer (editors), *Research in Physics Learning: Theoretical Issues and Empirical Studies* (San Diego, CA: San Diego State University, 1991). In particular see: D. Brown and J. Clement, *Classroom Teaching Experiments in Mechanics*.
- Richard Duschl, *Restructuring Science Education; The Importance of Theories and Their Development* (New York, NY: Columbia University, Teachers College Press, 1990).
- Gordon P. Eaton, "Post Industrial Geological Education: What Curriculum Changes Might We Need at the Undergraduate and Graduate Level?," *Abstracts with Programs*, Geological Society of America, Vol. 26, No. 7 (1994), p. 154.
- Kenneth Eugene Eble, "The Degradation of Undergraduate Education," *New Directions for Teaching and Learning* (Winter, 1990) pp. 11-19.
- The Journal of Economic Education, "Undergraduate Economic Education (a Symposium)," *The Journal of Economic Education*, Vol. 22 (Summer, 1991) pp. 195-300.

- Russell Edgerton, P. Hutchings, and K. Quinlan, *The Teaching Portfolio: Capturing the Scholarship in Teaching* (Washington, DC: American Association of Higher Education, 1991).
- S.C. Ehrmann, "Asking the Right Question: What Does Research Tell Us About Technology and Higher Learning?" *Change Magazine* (March, 1995).
- The Engineering Foundation, *Innovation in Undergraduate Engineering Education* (New York, NY: United Engineering Trustees, August 6-11, 1989).
- B. L. Erickson and D.W. Strommer, *Teaching College Freshmen* (San Francisco, CA: Jossey-Bass, 1991).
- Edward W. Ernst, "Revitalizing Undergraduate Programs: Curriculum Development," *Engineering Education*, Vol. 79 (January/February, 1989) pp. 20-4.
- Engineering Foundation, *Innovation in Undergraduate Engineering Education*, Proceedings of a Conference held at Potosi, Missouri, August 5-10, 1990 (New York, NY: Engineering Foundation, 1991).
- Executive Office of the President, Office of Science and Technology Policy, *Science in the National Interest* (August 1994).
- Federal Coordinating Council for Science Engineering and Technology (FCCSET), *Pathways to Excellence: A Federal Strategy for Science, Mathematics, Engineering, and Technology Education* [A strategic plan for the years FY1994 - FY1998.] (Washington, DC: Committee on Education and Human Resources, FCCSET, 1992).
- The Five Colleges, *Conference on Cooperation in Undergraduate Science Education*, November 13-15, 1986 (Northampton, MA: The Five Colleges, Inc., 1986).
- Maura C. Flannery, "Problems in Beloit (BioQuest, a project for the improvement of undergraduate biology education)," *The American Biology Teacher*, Vol. 53 (November/December, 1991) pp. 500-3.
- Deborah C. Fort, "Top Federal Agencies Join Other Reformers to Focus on the Vital Undergraduate Years," *Journal of College Science Teaching*, Vol. 25 (September/October, 1995) pp. 26-31.
- D.L. Gabel and D.M. Bunce, "Research on Problem Solving: Chemistry," in D.L. Gabel (editor), *Handbook of Research on Science Teaching and Learning* (New York, NY: Macmillan, 1994).
- Zelda F. Gamson, "A brief History of the Seven Principles for Good Practice in Undergraduate Education," *New Directions for Teaching and Learning* (Fall, 1991) pp. 5-12.
- Malcolm Getz and John Siegfried, *Costs and Productivity in American Colleges and Universities*, Part III in *Economic Challenges in Higher Education*, A National Bureau of Economic Research Monograph (Chicago, IL: The University of Chicago Press, 1991) pp. 261-392.
- R. Giere, *Explaining Science: A Cognitive Approach* (Chicago, IL: University of Chicago Press, 1988).
- John I. Goodlad, *A Place Called School: Prospects for the Future* (New York, NY: McGraw-Hill, 1984).
- _____, *Teachers for Our Nation's Schools* (San Francisco, CA: Jossey-Bass Inc., 1990).

- A.S. Goodsell, M.R. Maher, V. Tinto, B.L. Smith, and J. MacGregor, *Collaborative Learning: A Sourcebook for Higher Education* (University Park, PA: National Center on Postsecondary Teaching, Learning, and Assessment, 1992).
- David Goodstein, "Scientific Elites and Scientific Illiterates," Sigma Xi, *Proceedings of a Forum on Ethics, Values, and the Promise of Science* (New Haven, CT: Sigma XI, February 25-26, 1993).
- Government-University-Industry Research Roundtable National Academy of Sciences, National Academy of Engineering, Institute of Medicine, *Stresses on Research and Education at Colleges and Universities: Institutional and Sponsoring Agency Responses* (Washington, DC: National Academy Press, 1994).
- M.F. Green (editor), *Minorities on Campus: A Handbook for Enhancing Diversity*, (Washington, DC: American Council on Education, 1989).
- Thomas J. Greenbowe, "An Interactive Multimedia Software Program for Exploring Electrochemical Cells," (Project supported by the NSF Division of Undergraduate Education), *Journal of Chemical Education*, Vol. 71 (July, 1994) pp. 555-7.
- Michael Henchman, "Developing a Science Course for Nonscientists on the Chemistry of Art," (Project supported by the NSF Division of Undergraduate Education) *Journal of Chemical Education*, Vol. 71 (August, 1994) p. 670.
- Susan T. Hill, *Blacks in Undergraduate Science and Engineering Education*, National Science Foundation Special Report (Washington DC: National Science Foundation, 1992, NSF92-305).
- Thomas L. Hilton and Valerie E. Lee, "Student Interest and Persistence in Science: Changes in the Educational Pipeline in the Last Decade," *Journal of Higher Education*, Vol. 59 (1988) pp. 510-526.
- Susan H. Hixson and Curtis T. Sears, "Instrumentation and laboratory improvement grants in Chemistry," (Projects supported by the NSF Division of Undergraduate Education), *Journal of Chemical Education*, Vol. 71 (October, 1994) pp. A244-5.
- Peter M. Hogan, "Vocational Preparation Within a Liberal Arts Framework: Suggested directions for undergraduate psychology programs," *Teaching of Psychology*, Vol. 18 (October, 1991) pp. 148-53.
- The Holmes Group, *Tomorrow's Teachers: A Report of the Holmes Group* (East Lansing MI, The Holmes Group, 1986).
- Gerald Holton, "A Nation at Risk, Revisited," *The Advancement of Science and its Burdens* (Cambridge, England: The Press Syndicate of the University of Cambridge, 1986).
- _____, *Science and Anti-Science* (Cambridge, MA: Harvard University Press, 1993).
- Howard Hughes Medical Institute, *Enriching the Undergraduate Laboratory Experience: 1992 Undergraduate Program Directors Meeting* (Bethesda, MD: HHMI, 1993).
- _____, *Institutional Strategies for Enhancing Undergraduate Science Education: 1993 Undergraduate Program Directors Meeting* (Bethesda, MD: HHMI, 1994).

- _____, *Expanding the Role of Science Departments: 1994 Undergraduate Program Directors Meeting* (Bethesda, MD: HHMI, 1995).
- G.A. Hutchings, W. Hall, and P. Thorogood, "Experiences with Hypermedia in Undergraduate Education," *Computers & Education*, Vol. 22 (January/February, 1994) pp. 39-44.
- Inverness Research Associates, *Science Education for the 1990s: Strategies for Change: Reflections on a 1991 Wingspread Conference* (held at Inverness, CA in 1991) sponsored by the Johnson Foundation (Inverness, CA: Inverness Research Associates, 1991).
- D.W. Johnson, R.T. Johnson, and K. A. Smith, *Active Learning: Cooperation in the College Chemistry Classroom* (Edina, MN: Interaction Book Co., 1991).
- Howard G. Johnson, "The National Geography Standards and Your Undergraduate Curriculum: The Opportunity that Knocks More than Once," *Journal of Geography*, Vol. 94 (September/October, 1995) pp. 534-7.
- William B. Johnson and Arnold Packer, *Workforce 2000: Work and Workers for the 21st Century* (Indianapolis, IN: Hudson Institute, 1987).
- Joint Policy Board for Mathematics, Committee on Professional Recognition and Rewards, *Recognition and Rewards in the Mathematics Sciences* (Washington, DC: Joint Policy Board for Mathematics, 1994), [Copies available from the American Mathematical Society.]
- Journal of Chemical Education, "Systemic Changes in the Undergraduate Chemistry Curriculum Program," (Project supported by the NSF Division of Undergraduate Education) *Journal of Chemical Education*, Vol. 71 (January, 1994) pp. 43-6.
- _____, "Projects supported by the NSF Division of Undergraduate Education," *Journal of Chemical Education*, Vol. 71 (June, 1994) pp. 506-8.
- Project Kaleidoscope, *What Works: Building Natural Science Communities, A Plan for Strengthening Undergraduate Science and Mathematics* (Washington, D.C.: Project Kaleidoscope, 1730 Rhode Island Avenue, NW, Suite 1205-ICO, 20036, 1991).
- L. Keig and M.D. Waggoner, *Collaborative Peer Review: The Role of Faculty in Improving College Teaching*, ASHE-ERIC Report No. 2 (Washington, DC: George Washington University, School of Education and Human Development, 1994).
- Donald Kennedy, "Another Century's End, Another Revolution for Higher Education," *Change* (May/June, 1995), pages 8-15.
- _____, *A Research-Rich Environment* (Washington, DC: Project Kaleidoscope, 1993).
- _____, *Leadership: Challenges for the Future* (Washington, DC: Project Kaleidoscope, 1994).
- _____, *Structures for Science: A Handbook on Planning Facilities for Undergraduate Natural Science Communities* (Washington DC: Project Kaleidoscope, 1995).

- Leslie Koltai & Michael Welding, Co-Chairs, *The Status of Science, Engineering, and Mathematics Education in Community, Technical, and Junior Colleges* (Washington, D.C.: American Association of Community and Junior Colleges, National Center for Higher Education, 1991).
- L. M. Lambert and S. L. Tice, *Preparing Graduate Students to Teach* (Washington, DC: American Association for Higher Education, 1993).
- Chen-Lin C. Kulik and J. A. Kulik, "Effectiveness of Computer-Based Instruction: An Updated Analysis," *Computers in Human Behavior* Vol. 7, Nos. 1 and 2 (1991) pp. 75-94.
- J. J. Lagowski, "The Condition of Undergraduate Science Education: the NSF Perspective," *Journal of Chemical Education*, Vol. 67 (January, 1990) p. 1.
- Ram S. Lamba, "Laboratory-driven Instruction in Chemistry," (Project supported by the NSF Division of Undergraduate Education), *Journal of Chemical Education*, Vol. 71 (December, 1994) pp.1073-4.
- Priscilla Laws, "Calculus Based Physics without Lectures," *Physics Today* (December 24-31, 1991).
- Rosarius Roy Leonardi, *Reflections: a Study of the Undergraduate Experience as it Relates to College Graduates in the Workplace* (University of Vermont, Doctoral Thesis, 1995).
- Nathan S. Lewis, "The Caltech Chemistry Animation Project," (Project Supported by the NSF Division of Undergraduate Education) *Journal of Chemical Education*, Vol. 70 (September, 1993) pp. 739-40.
- G. Lisensky, L. Parmentier, and B. Spencer, "Introductory Chemistry at Beloit College," *Leadership: Challenges for the Future*, Occasional Paper II (Washington, DC: Project Kaleidoscope, 1994).
- G. Loacker and M. Mentkowski, "Creating a Culture Where Assessment Improves Learning," in T. Banta (editor) *Making a Difference: Outcomes of a Decade of Assessment in Higher Education* (San Francisco: Jossey-Bass, 1993).
- Jack R. Lohmann & Angelica M. Stacy (co-Chairs), *America's Academic Future: A Report of the Presidential Young Investigator Colloquium on U.S. Engineering, Mathematics, and Science Education for the Year 2010 and Beyond*, Nov. 4-6, 1990, (Washington, DC: Division of Undergraduate Science, Engineering and Mathematics Education, National Science Foundation, 1992, NSF91-150).
- J. Lowman, *Mastering the Technique of Teaching*, 2nd Edition (San Francisco, CA: Jossey-Bass, 1995).
- Mathematical Sciences Education Board, *Measuring Counts, A Policy Brief* (Washington, DC: National Research Council, National Academy Press, 1993).
-
- _____, *Measuring Up, Prototypes for Mathematics Assessment* (Washington, DC: National Research Council, National Academy Press, 1993).
-
- _____, *The Preparation of Teachers of Mathematics: Considerations and Challenges*, A Letter Report (Washington, DC: National Research Council, National Academy Press, March 1996).

Marcia L. Matyas & Shirley M. Malcom (editors), *Investing in Human Potential: Science and Engineering at the Crossroads* (Washington, DC: American Association for the Advancement of Science, 1991).

R.A. Markwood and S.M. Johnstone (editors), *New Pathways to a Degree: Technology Opens the College* (Boulder, CO: Western Interstate Commission for Higher Education, 1994).

_____, *New Pathways to a Degree: Seven Technology Stories* (Boulder, CO: Western Interstate Commission for Higher Education, 1994).

William F. Massy and Robert Zemsky, *Using Information to Enhance Academic Productivity*, based on a meeting of an 18-member roundtable in June, 1995 at Wingspread (Washington, DC: Educom, 1995).

Lewis B. Mayhew, Patrick Ford, and Dean Hubbard, *The Quest for Quality: The Challenge for Undergraduate Education in the 1990s* (San Francisco, CA: Jossey-Bass, 1990).

Lillian C. McDermott, "A Perspective on Teacher Preparation in Physics and Other Sciences: The Need for Special Science Courses for Teachers," *The American Journal of Physics*, Vol.58 (1990), pp. 734-742.

_____, "What We Teach and What is Learned – Closing the Gap," *The American Journal of Physics*, Vol.59 (1991), pp. 701-315.

_____, P. Shaffer, and M. Somers, "Research as a Guide for Curriculum Development: An Illustration in the Context of the Atwood's Machine," *The American Journal of Physics*, Vol.62 (1994), pp. 46-55.

Wilbert J. McKeachie (editor), *Teaching Tips: Strategies, Research, and Theory for College and University Teachers*, 9th edition (Lexington, MA: D.C. Heath, 1994).

Dean McManus, "Some overlooked matters in undergraduate geoscience education," *Journal of College Science Teaching* Vol. 24 (March/April, 1995) pp. 316-21.

Dennis G. McMinn, Kay L. Nakamaye, and Joanne A. Smieja, "Enhancing Undergraduate Education: Curriculum Modification and Instrumentation," (at Gonzaga University) *Journal of Chemical Education*, Vol. 71 (September, 1994) pp. 755-8.

Ann P. Woodhull-McNeal, "Project Labs in Physiology," *Advances in Physiology Education*, Vol. 8 (1992) pp. 29-32.

_____ and Michelle Murrain, "Drugs in the Nervous System: a Course in Learning to Learn Science," *College Teaching* Vol. 42 (1994) pp. 47-50.

C. Meyers and T.B. Jones, *Promoting Active Learning: Strategies for the College Classroom* (San Francisco, CA: Jossey-Bass, 1993).

J. A. Moore, "Science as a Way of Knowing: Evolutionary Biology," *The American Zoologist*, Vol. 24 (1984), pp. 421-435.

P. Morris, S.C. Ehrmann, R. Goldsmith, K. Howat, and V. Kumar, *Valuable, Viable Software in Education: Cases and Analysis*, (New York, NY: Primis Division of McGraw-Hill, 1994).

Robert T. Morrison, "The Lecture System in Teaching Science," *Proceedings of the Chicago Conferences on Liberal Education*, Number 1, Undergraduate Education in Chemistry and Physics (edited by Marian Rice) (Chicago, IL: University of Chicago, The College Center for Curricular Thought, October 18-19, 1995).

S.L. Mow & M.T. Nettles, *Minority Access to, and Persistence and Performance in, College: A Review of the Trends and Research Literature*, in J.C. Smart (editor), *Higher Education: Handbook of Theory and Research*, Vol. VI (New York: Agathon Press, 1990).

Richard Murnane, John Willett, and Frank Levy, *The Growing Importance of Cognitive Skills in Wage Determination* (Cambridge, MA: NBER Working Paper No. 5076, March 1, 1995).

National Academy of Sciences, Committee on Science, Engineering, and Public Policy, *Reshaping the Graduate Education of Scientists and Engineers* (Washington, D.C.: National Academy Press, 1995).

_____, *Reinventing Schools: The Technology is Now!; A Model for Education*; A policy statement accessible through the NAS/NAE/IOM Internet Home Page ([HTTP://WWW.NAS.edu](http://WWW.NAS.edu), go to <http://www.nap.edu/nap/online/techgap/welcome.html> and choose *A Model for Education*; based on a May 1993 Convocation at the NAS).

The National Association of Scholars, *The Dissolution of General Education: 1914-1993* (Princeton, NJ: March 1996). An executive summary is available on the Internet at the NAS home page.

National Center on Education and the Economy, *America's Choice: High Skills or Low Wages, A Report of the Commission on the Skills of the American Workforce* (Rochester, NY: 1990).

National Commission on Excellence in Education, *A Nation at Risk* (Washington, DC: US Government Printing Office, 1983).

National Council of Teachers of Mathematics, *Curriculum and Evaluation Standards for School Mathematics* (Reston, Va: 1989).

_____, *Professional Standards for Teaching Mathematics* (Reston, VA: 1991).

_____, *Assessment Standards for School Mathematics*, Working Draft (October, 1993).

National Governors' Association, *Time for Results* (Washington, DC: National Governors' Association Publication Office, 1986).

_____, *Making America Work; Bringing Down the Barriers; Productive People Productive Policies* (Washington D.C., National Governors' Association Publication Office, 1987).

National Research Council, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*. A joint policy statement of the Mathematical Sciences Education Board, the Board on

Mathematical Sciences, and the Committee on Sciences in the Year 2000 (Washington DC: National Academy Press, 1989).

_____, Committee on the Mathematical Sciences in the Year 2000, *Moving Beyond Myths: Revitalizing Undergraduate Mathematics* (Washington, DC: National Academy Press, 1991).

_____, Board on Engineering Education, *Engineering Education: Designing an Adaptive System* (Washington, DC: National Academy Press, 1995).

_____, *From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology*, Challenge Paper for the NRC/NSF Convocation, April 9-11, 1995 (Washington, DC: National Academy of Sciences, 1995).

_____, Committee on Undergraduate Science Education, *Science Teaching Reconsidered: A Handbook* (Washington, DC: National Academy Press, Draft, 1995).

_____, National Committee on Science Education Standards and Assessments, *National Science Education Standards* (Washington, DC: National Academy Press, 1995).

_____, Center for Science Mathematics, and Engineering Education, *From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology*, Report of a Convocation (Washington, DC: National Academy Press, 1996).

National Science Board, Task Committee on Undergraduate Science and Engineering Education, Homer A. Neal (Chairman), *Undergraduate Science, Mathematics and Engineering Education; Role for the National Science Foundation and Recommendations for Action by Other Sectors to Strengthen Collegiate Education and Pursue Excellence in the Next Generation of U.S. Leadership in Science and Technology*, (Washington DC: National Science Foundation, 1986, NSB86-100).

National Science Foundation, *Changing America: The New Face of Science and Engineering, Interim Report of the Task Force on Women, Minorities, and the Handicapped in Science and Technology* (Washington DC: National Science Foundation, 1988).

_____, *Report on the National Science Foundation Disciplinary Workshops on Undergraduate Education: Recommendations of the disciplinary task forces concerning issues in U.S. undergraduate education in the Sciences, Mathematics and Engineering* (Washington, DC: Division of Undergraduate Science, Engineering, and Mathematics Education, National Science Foundation, 1989, NSF89-3).

_____, *Report on the National Science Foundation Workshop on Science, Engineering and Mathematics Education in Two-Year Colleges*, Robert E. Parilla (Chair) October 31 - November 1, 1988 (Washington, DC: Division of Undergraduate Science, Engineering, and Mathematics Education, National Science Foundation, 1989, NSF89-50).

_____, *Report on the National Science Foundation Undergraduate Curriculum Development Workshop in Materials*, October 11-13, 1989 (Washington, DC: National Science Foundation, 1989, NSF90-60)

_____, *The State of Academic Science and Engineering* (Washington, DC: National Science Foundation, Division of Policy Research & Analysis, 1990).

_____, *Report of the National Science Foundation Workshop on the Dissemination and Transfer of Innovation in Science, Mathematics, and Engineering Education*, Richard D. Breslin (Chair) May 1-3, 1990 (Washington, DC: Division of Undergraduate Science, Engineering, and Mathematics Education, National Science Foundation, 1990, NSF91-21).

_____, *Report of the National Science Foundation Workshop on Undergraduate Laboratory Development* Theodore Brown and Anton Lawson (co-Chairs) June 18-19, 1990 (Washington, DC: Division of Undergraduate Science, Engineering, and Mathematics Education, National Science Foundation, 1990, NSF91-26).

_____, *Matching Actions and Challenges: Report of a National Science Foundation Workshop on Science, Engineering, and Mathematics Education in Two-Year Colleges*, David Mertes & Dale Ewen (co-Chairs) May 13-14, 1991 (Washington, DC: Division of Undergraduate Science, Engineering and Mathematics Education, National Science Foundation, 1991, NSF91-111).

_____, *Gateway to Diversity in the Scientific and Technological Workforce* (Washington, DC: Directorate for Education and Human Resources, National Science Foundation, 1992, NSF 92-99).

_____, *Partners in Progress: Report of a National Science Foundation Workshop on the Role of Professional Societies in Science, Technology, Engineering, and Mathematics Education in Two-Year Colleges*, Susan Forman & James Stith (co-Chairs) October 29-30, 1992 (Washington, DC: Division of Undergraduate Science, Engineering and Mathematics Education, National Science Foundation, 1992, NSF93-64).

_____, Division of Research, Evaluation, and Dissemination, *Indicators of Science and Mathematics Education - 1992, First Edition* (Washington, DC: National Science Foundation, 1993, NSF93-95).

_____, *Proceedings of the National Science Foundation Workshop on The Role of Faculty from the Scientific Disciplines in the Undergraduate Education of Future Science and Mathematics Teachers* (Washington DC: Division of Undergraduate Education, 1993, NSF93-108).

_____, *Gaining the Competitive Edge: Critical Issues in Science and Engineering Technician Education*, Timothy Collins, Don Gentry, and Vernon Crawley (Co-Chairs), Workshop on Critical issues in Science and Engineering Technician Education (Washington, DC: National Science Foundation, 1993, NSF94-32).

_____, Expert Panel for the Review of Federal Education Programs in SMET, *The Federal Investment in Science, Mathematics, Engineering, and Technology Education: Where Now? What Next?* (Washington, DC: NSF, 1993).

_____, *Innovation and Change in the Chemistry Curriculum*, Seyhan Ege and Orville Chapman (Co-Chairs) (Washington, DC: Division of Undergraduate Education, National Science Foundation, 1993, NSF94-19).

- _____, *Foundation for the Future* (Arlington, VA: Directorate for Education and Human Resources, National Science Foundation, 1994, NSF94-65).
- _____, *Foundation for the Future: The Systemic Cornerstone* (Arlington, VA: Directorate for Education and Human Resources, National Science Foundation, 1994, NSF94-121).
- _____, *Federal Support to Universities, Colleges, and Nonprofit Institutions: Fiscal Year 1992* (Surveys of Science Resources Studies, Detailed Statistical Tables, NSF94-324).
- _____, *NSF in a Changing World, The National Science Foundation's Strategic Plan* (full text: NSF 95-24, executive summary: NSF 95-142).
- _____, *Foundation for the Future: Turning Points* (Arlington, VA: Directorate for Education and Human Resources, National Science Foundation, 1995, NSF95-36).
- _____, Division of Undergraduate Education, *Project Impact: Disseminating Innovation in Undergraduate Education, Abstracts of Projects: Things That Work* (Arlington, VA: National Science Foundation, 1995, NSF95-70).
- _____, *Teacher Preparation and NSF Collaboratives for Excellence in Teacher Preparation, FY93 and 94 Awards* (Washington, DC: National Science Foundation, Division of Undergraduate Education, 1995, NSF95-73).
- _____, *Restructuring Engineering Education: A Focus on Change*, Report of an NSF Workshop on Engineering Education (Washington, DC: Division of Undergraduate Education, National Science Foundation, 1995, NSF95-65).
- _____, Division of Undergraduate Education, Directorate for Education and Human Resources, *Undergraduate Education in Science, Mathematics, Engineering, and Technology; Program Announcement and Guidelines* (NSF 96-10).
- _____, *Contributions of the Social Sciences to the National Science Foundation Review of Undergraduate Education*, A Workshop, February 22, 1996. See Draft Report (March 6, 1996).
- Katherine J. Nevins, "Understanding Students as Learners: Using Student Development Models," SPECTRUM Program at Bethel College, St. Paul, MN [SPECTRUM = Scholars Pursuing Educational Competencies to Reach Undergraduate Maturity], *Liberal Education*, Vol. 78 (January/February, 1992) pp. 24-7.
- William H. Newell, "Academic Disciplines and Undergraduate Interdisciplinary Education: Lessons from the School of Interdisciplinary Studies at Miami University, Ohio," *European Journal of Education*, Vol. 27, No.3 (1992) pp. 211-21.
- Eli M. Noam, "Electronics and the Dim Future of the University," *Science*, (October 13, 1995), pages 247-249.
- J. D. Novak, and D. B. Gowin, *Learning How to Learn* (New York, Cambridge University Press, 1984).

- Lyman O'Neal and Jerry Skelton, "Teaching Undergraduate Ecology Through Adventure and Travel in the United States," *Journal of College Science Teaching*, Vol. 21 (December, 1991 /January, 1992) pp. 154-8.
- E. T. Pascarella, and P. T. Terenzini, *How College Affects Students. Findings and Insights from Twenty Years of Research* (San Francisco, CA: Jossey-Bass, 1991).
- _____, "Living with Myths: Undergraduate Education in America," *Change*, Vol. 26 (January/February, 1994) pp. 28-32.
- Physics Today, "Roundtable: Whither Now Our Research Universities?" *Physics Today* (March, 1995) pp. 42-51.
- Baron Perlman and Lee McCann, "The Place of Mathematics and Science in Undergraduate Psychology Education," *Teaching of Psychology*, Vol. 20 (December, 1993) pp. 205-8.
- The Pew Higher Education Roundtable, "To Dance with Change," *Policy Perspectives* (A Publication of the Pew Higher Education Roundtable), Vol. 5, No. 3, Section A (April, 1994), pp. 1-12.
- Karl S. Pister, *Report to the University-wide Task Force on Faculty Rewards* (Oakland, CA: Office of the President, University of California, 1991).
- _____, "Renewing the Research University," *University of California at Santa Cruz Review* (Winter 1996).
- H.B. Posner and J.A. Markstein, "Cooperative Learning in Introductory Cell and Molecular Biology," *Journal of College Science Teaching*, Vol.23 (1994), pp. 231-233.
- Anne Reynolds, "What is Competent Beginning Teaching? A Review of the Literature," *Review of Educational Research*, Vol. 62 (1992), pp. 1-36.
- S.A. Rice, *Report of the Symposium on Undergraduate Education in Chemistry and Physics* (Chicago, IL: Chemistry Department, University of Chicago, April, 1986).
- R.C. Richardson & L.W. Bender, *Fostering Minority Access and Achievement in Higher Education* (San Francisco, CA: Jossey-Bass, 1987).
- Robert W. Ricci, Mauri A. Ditzler, and Ronald M. Jarret, "The Holy Cross Discovery Chemistry Program," (Project supported by the NSF Division of Undergraduate Education) *Journal of Chemical Education*, Vol. 71 (May, 1994) pp. 404-5.
- V. Richardson, "Significant and Worthwhile Change in Teaching Practice," *Educational Researcher*, (October, 1990) pp. 10-17.
- Iris C. Rotberg, "Resources and Reality: The Participation of Minorities in Science and Engineering," *Phi Delta Kappan*, Vol. 71, No. 9, (1990) pp. 672-679.

- Inez Rovegno, "Content-knowledge Acquisition During Undergraduate Teacher Education: Overcoming Cultural Templates and Learning Through Practice," *American Educational Research Journal*, Vol. 30 (Fall, 1993) pp. 611-42. [Available at GWU]
- S.B. Sarason, K.S. Davidson, and B. Blatt, *The Preparation of Teachers: An Unstudied Problem in Education* (Cambridge, MA: Brookline Books, 1986).
- School Science and Mathematics Association, *National Science Foundation / School Science and Mathematics Association Wingspread Conference: A Network for Integrated Science and Mathematics Teaching and Learning* (Held at Racine, WI, 1991) (Bowling Green, OH: School Science and Mathematics Association, 1994).
- Arnold E. Seigel and Cynthia Davis, "Televising Undergraduate Engineering Courses: a Survey," *Engineering Education*, Vol. 81 (July/August, 1991) pp. 482-3.
- Elaine Seymour and Nancy Hewitt, *Talking About Leaving: Factors Contributing to High Attrition Rates Among Science, Mathematics, and Engineering Undergraduate Majors* (Boulder, CO: Bureau of Sociological Research, University of Colorado, 1994).
- Bonney H. Sheahan and John A. White, "Quo Vadis, Undergraduate Engineering Education?" *Engineering Education*, Vol. 80 (December, 1990) pp. 1017-22.
- Sigma Xi, *An Exploration of the Nature and Quality of Undergraduate Education in Science, Mathematics and Engineering*, A Report of the National Advisory Group of Sigma XI, The Scientific Research Society, sponsored by the National Science Foundation and the Johnson Foundation, The Wingspread Meeting [Racine, WI: January 23-26, 1989] (New Haven, CT: Sigma XI, 1989) [Address: 345 Whitney Avenue, New Haven, CT 06511].
- _____, *Entry-level Undergraduate Courses in Science, Mathematics and Engineering: An Investment in Human Resources*, An initiative of Sigma XI, The Scientific Research Society, Committee on Science, Mathematics and Engineering Education, supported by the National Science Foundation and The Johnson Foundation, June 21-24, 1990 (Research Triangle Park, NC: 1990).
- K.L. Smith, "Collaborative and Interactive Writing for Increasing Communication Skills," *Hispania*, Vol. 73, No. 1, (1990) pp. 77-87.
- R. Slavin, "Research on Cooperative Learning: Consensus and Controversy," *Educational leadership : Journal of the Department of Supervision and Curriculum Development, National Education Association*, Vol. 47 (1989), pp. 52-54.
- Page Smith, *Killing the Spirit, Higher Education in America*, (New York, NY: Viking Penguin, 1990).
- Timothy Stanton, "Liberal Arts, Experiential Learning and Public Service: Necessary Ingredients for Socially Responsible Undergraduate Education," *The Journal of Cooperative Education*, Vol. 27 (Fall, 1991) pp. 55-72.
- Lynn Arthur Steen, "Reaching for Science Literacy," *Change* (July/August, 1991), pages 11-19.

John Richard Tinker, Jr., "Undergraduate Education in Hydrogeology," *Journal of Geological Education*, Vol. 37 (January, 1989) pp. 20-3.

Shiela Tobias, *They're Not Dumb, They're Different* (Tucson, AZ: Research Corporation, 1990).

_____, *Stalking the Second Tier* (Tucson, AZ: Research Corporation, 1990).

_____, *Revitalizing Undergraduate Science: Why Some Things Work and Most Don't* (Tucson, AZ: Research Corporation, 1992).

K. Tobin, D.J. Tippins, and A. Gallard, "Research on Instructional Strategies for Teaching Science," in D.L. Gabel (editor), *Handbook of Research on Science Teaching and Learning* (New York, NY: Macmillan, 1994).

J. Trefil and R.M. Hazen, *The Sciences: An Integrated Approach* (New York, NY: John Wiley and Sons, 1995).

Alan C. Tucker and James R. Leitzel, *Assessing Calculus Reform Efforts, A Report to the Community* (Washington, DC: Mathematical Association of America, 1995).

Harriet Tyson, *Who Will Teach the Children? Progress and Resistance in Teacher Education* (San Francisco: Jossey-Bass, 1994).

U.S. Congress, House Committee on Science, Space, and Technology, Subcommittee on Science, *The Quality of Undergraduate Science Education: Hearing, One Hundred Second Congress, Second Session, March 31, 1992* (Washington D.C.: U.S. Government Printing Office, 1992, No. 105).

U.S. Department of Education, National Center for Education Statistics, *The Condition of Education: A Statistical Report* (Washington, DC: U.S. Dept of Education, NCES, 1987 through 1995).

U.S. Department of Energy, *Science and Engineering Research Semester for Undergraduate Students, Program Description and Application*, (Washington, DC: U.S. Department of Energy, Office of Energy Research, 1993).

U.S. Department of Labor, *What Work Requires of Schools* (Washington, DC: U.S. Government Printing Office, 1991).

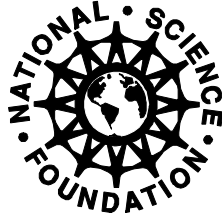
U.S. Department of Labor, Secretary's Commission on Achieving Necessary Skills (SCANS), *Learning A Living: A Blueprint for High Performance, A Scans Report for America 2000* (Washington, DC: U.S. Government Printing Office, April, 1992).

William E. Vandament, "Those Who Would Reform Undergraduate Education Must Recognize the Realities of Academic Governance," *The Chronicle of Higher Education*, Vol. 35 (November 30, 1988) p. A52.

Anne-Lee Verville, "What Business Needs form Higher Education," *Educational Record* (Fall, 1995), pp. 46-50.

Charles Vest, *The Massachusetts Institute of Technology Report of the President for the Academic Year 1994-1995* (Cambridge MA: MIT Press, Jan 6, 1996).

- S.B. Watson and J.E. Marshall, "Effects of Cooperative Incentives and Heterogeneous Arrangement on Achievement and Interaction of Cooperative Learning Groups in a College Life Science Course," *Journal of Research in Science Teaching*, Vol. 32 (1995), pp. 291-299.
- James C. Weisshaar, "Frontier Chemistry for Freshmen," (Project supported by the NSF Division of Undergraduate Education) *Journal of Chemical Education*, Vol. 71 (March, 1994) pp. 225-6.
- Kenneth G. Wilson and Bennett Daviss, *Redesigning Education*, (New York, NY: Henry Holt, 1994, 254 pages; and also <http://www.physics.ohio-state.edu/~kgw/RE.html>).
- W.R. Wineke & P. Certain, Co-Chairs, *The Freshman Year in Science and Engineering: Old Problems, New Perspectives for Research Universities*, April 6-7, 1990 (University Park, PA: The Alliance for Undergraduate Education, 1990). [Address: 405 Old Main, University Park, PA 16802.]
- Wingspread Conference on Teacher Preparation (at Racine, WI in 1984), *An Urgent Imperative: Proceedings of the Wingspread Conference on Teacher Preparation* (Washington, DC: American Association of State Colleges and Universities, 1986).
- Wingspread Conference (at Colorado Springs, CO during June 8-12, 1987), *Communication is Life: Essential College Sophomore Speaking and Listening Competencies* (Annandale, VA: Speech Communication Association, 1990).
- The Wingspread Conference, *National Life Science Education Summit - Report of the Wingspread Conference* [February 1-3, 1991, South Carolina] sponsored by the Johnson Foundation and the American Society for Microbiology, (Racine, WI: 1991).
- Wingspread Group on Higher Education, William E. Brock (Chair), *An American Imperative: Higher Expectations for Higher Education*, (Racine, WI: The Johnson Foundation, 1993).
- D.R. Woods, "Teaching and Learning: What Can Research Tell Us?" *Journal of College Science Teaching*, Vol. 25 (1995) pp. 229-232.
- Gene Wright, Andersen Consulting, in "Consulting Giant's Hot Offer: Jobs, Jobs, Jobs," *The Wall Street Journal* (March 16, 1996), page B6.
- William A. Wulf, "Warning: Information Technology Will Transform the University," *Issues in Science and Technology*, (Summer, 1995), pages 46-52.
- Shoshana Zuboff, *In the Age of the Smart Machine* (New York, NY: Basic Books, 1989).



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