# JOEL A. MICHAEL, PhD
# Educational Research and Development

*CURRICULUM VITAE*

## Work Address

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## Education

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| B.S. | Biology, California Institute of Technology, 1961 |
| M.Sc. | Physiology, McGill University, 1964 |
| Ph.D. | Physiology, Massachusetts Institute of Technology, 1965 |

## Present Position

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| 1990- | Professor<br>Department of Molecular Biophysics and Physiology<br>Rush Medical College<br>Rush University Medical Center<br>Chicago, Illinois |

## Past Positions

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| 2011- | Member of i-Human Advisory Board, Mammoth Lakes, CA |
| Summer, 2005 | Visiting Scholar, School of Nursing, University of Washington, Seattle, WA |
| 1991 – 1994 | Visiting Scholar, Northwestern University, Evanston, IL |
| 1989 - 1994 | Director of Research and Development, Office of the Alternative Curriculum<br>Rush Medical College |
| 1974 - 1989 | Associate Professor, Department of Physiology, Rush Medical College |
| Jan.-Aug. 1978 | Visiting Scholar, Department of Psychology, University of California,<br>Los Angeles, California |
| 1974 - 1976 | Acting Chairman, Department of Physiology<br>Rush Presbyterian-St. Luke's Medical Center |
| 1970 - 1977 | Associate Professor<br>Departments of Neurological Sciences and Biomedical Engineering<br>Rush Medical College |

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|---|---|
| 1972 - 1977 | Adjunct Associate Professor (The Graduate School)<br>Illinois Institute of Technology, Chicago, Illinois |
| 1972 - 1974 | Director, Section of Physiology<br>Department of Biomedical Engineering, Rush Medical College |
| 1970 - 1972 | Associate Attending Bioengineer and Associate Neurobiologist<br>Rush Presbyterian-St. Luke's Medical Center |
| 1968 - 1970 | Assistant Professor<br>Department of Physiology, University of Illinois at the Medical Center<br>Chicago, Illinois |
| 1967 - 1970 | Assistant Attending Bioengineer<br>Presbyterian-St. Luke's Hospital |
| 1966 - 1967 | Research Fellow<br>Psychiatric Research Laboratory<br>Massachusetts General Hospital and Harvard Medical School<br>Boston, Massachusetts |
| 1965 - 1966 | Carnegie Fellow<br>Autonomics Division, National Physical Laboratory<br>Teddington, England |

**Honors and Awards**

B.S. with Honors, California Institute of Technology, 1961
NSF Pre-Doctoral Fellowship, McGill University, 1961-62
Carnegie Institute of Washington Post-Doctoral Fellowship,
National Physical Laboratory, Teddington, England, 1965-66
Elected to membership in Sigma Xi
Selected to deliver the Claude Bernard Distinguished Lecture at the Experimental Biology meeting, 2001
Excellence in Education Award, Rush University, 2012

**Current Research Interests**

Conceptual assessment in biology/physiology
Use of simulated experiments and simulated patients in learning physiology
Faculty development
Research on, and promotion of, active learning
Uses of cases in learning physiology and other basic sciences
Studies of the processes involved in tutoring
Artificial intelligence applications in education (development of intelligent tutoring systems)

**Membership in Professional Societies**

American Education Research Association (AERA)
American Physiology Society (APS)
Cognitive Science Society
Human Anatomy and Physiology Society (HAPS)
Institute of Electrical and Electronics Engineering (IEEE)

International Association of Medical Science Educators (IAMSE)
National Association for Research in Science Teaching
National Science Teachers Association

**Membership on Committees: Education (RUMC)**

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| Served on the Committee on Educational Appraisal | 1976-1979 |
| Served on the Committee on Student Evaluation & Promotion | 1976-1979 |
| Served on Curriculum Committee | 1970-1975; 1983-1986; 1999-2002 |
| Served on Committee on Curriculum and Evaluation | 2005–2008 |
| M1 curriculum planning committee | 2008 - |

**Membership on Committees: Education (External)**

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| American Physiological Society: | |
| Education Committee | 1981-1884 |
| Committee on Committees | 1994-1996 |
| Program Advisory Committee Representative (Teaching of Physiology Section) | 1986-1989 |
| Teaching Section representative to the Joint Program Committee | 2000-2005 |
| International Union of Physiological Sciences Commission on the Teaching of Physiology | 1986 – 2005 |
| Program committee for Excellence in Teaching Mathematics and and Science: Research and Practice symposium series, organized by the Institute for Mathematics and Science Education, University of Illinois Chicago | 2000 - 2013 |

**Teaching Experience: Rush Medical College**

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| Course Director for core Medical Physiology course | 1971-1978, 1993- 2008 |
| Physiology resource person for Alternative (problem-based learning) Curriculum | 1983-1998 |
| Coordinator, Neurophysiology portion of Neuroscience course | 1971-1978 |
| Lectured on neurophysiology, special senses, homeostasis, temperature regulation, endocrine physiology, renal and acid/base physiology, muscle, CV physiology, respiration | 1971- |
| Physiology discipline director for GI/Metabolism block and Genitourinary block | 2010 – |
| Co-Block leader, Genitourinary block | 2011- |

**Current Education Related Research Funding**

Co-PI on an NSF grant “Defining and assessing the core principles for undergraduate physiology,” PI Dr. Jenny McFarland, Edmonds Community College, Lynnwood, WA. 6/1/2011 to 5/31/2013 (extended to 5/31/2014).

Co-PI on an NSF grant “Validating a pedagogy for conceptual learning: Application of internet delivered physiology experiments.” PI Dr. Harold Modell, PERC, Seattle, WA. 8/15/2011 to 8/14/2012.

Consultant on NSF SBIR Phase I grant “Internet application for authoring and playing case-based medical simulations which teach patient assessment and diagnostic reasoning skills.” PI Craig Knoche, Summit Performance Group, Mammoth Lakes, CA. June 1 – November 30, 2012.

**Past Education Related Research Funding**

Principal Investigator on a subcontract to Rush that was part of a grant from the Office of Naval Research to the Illinois Institute of Technology (Dr. M. Evens, PI) entitled "Computer Generation of a Tutorial Dialogue;" Rush budget was $105,000 for the period 6/1/89 to 5/31/91

Principal Investigator on a grant from the Office of Naval Research entitled "Computer Generation of a Complex Tutorial Dialogue;" $134,012 for period 6/1/91 to 11/14/93.

Principal Investigator on a grant from the Office of Naval Research entitled "Computer Dialogue Generation to Support Multiple, Sophisticated Tutoring Tactics;" $199,356 for period 11/15/93 to 11/14/96.

Co-Investigator on a grant from the National Science Foundation entitled “Efficacy of Active Learning in Remediating Misconceptions in Undergraduate Physiology.” $59,331 for the period May 1, 1997 to April 30, 1998.

Principal Investigator on a grant from the Office of Naval Research entitled "Language Understanding and Generation in Complex Tutorial Dialogues." $76,630 for the period November 15, 1996 to November 14, 1999.

Project leader on a grant from the National Science Foundation entitled " The Efficacy of Active Learning in Remediating Misconceptions in Undergraduate Physiology;" $59,331 for the period May 1, 1997 - April 30, 1998.

Co-Principal Investigator on a grant from the National Science Foundation entitled “Active Learning as the Basis for Reform of Undergraduate Life Science Education;” $458,422 for the period 2/1/00-1/31/03.

Co-Investigator on a grant from the National Science Foundation entitled “Physiology for the 21st Century: A Sourcebook of Effective and Economical Experiments.” October 1, 2004 to September 30, 2006.

**Participation in Faculty Development Activities** (organizer, presenter, participant)

1982 Co-Organizer and Co-Chairman of symposium on "Teaching Cardiovascular Physiology Outside the Lecture Hall," Fall Meeting of APS, San Diego, CA

1983 Co-Organizer and Chairman of a Workshop "Computers in the Teaching of Physiology: How Can APS Help?", FASEB meeting, Chicago, IL

1983 Invited participant, Workshop on the Teaching of Physiology, Jenolan Caves, NSW, Australia (satellite meeting to IXXX IUPS Congress)

1983 Participant in Workshop on "Application of Problem-Based Learning in the Pre-clinical Disciplines," Southern Illinois University, Carbondale, IL (Dr. Howard Barrows)

1984 Organizer and Chairman, Workshop on "Computer-Based Education," FASEB meeting, St. Louis, MO

1986 Organized and Chaired symposium "Computer-Assisted Learning in Physiology," XXX IUPS Congress, Vancouver, Canada

1986 Convener of "Workshop on the Teaching of Physiology - The Uses of Computers (Software Demonstration)," XXX IUPS Congress, Vancouver, Canada

1987 Co-Organizer and Co-Chairman of symposium "Approaches to the Teaching of Problem-Solving in Physiology," FASEB meeting, Washington, DC

1987 Co-Organizer and Co-Presenter, "Basic Science Faculty Development to Promote Self-Directed, Active Learning," Generalists in Medical Education Conference, Washington, DC

1988 Organizer and Co-Presenter at session "A Curriculum to Develop Problem Solving Skills," Generalists in Medical Education Conference, Chicago, IL

1989 Invited faculty participant in the Workshop "Teaching Physiology in Developing Countries," Kuopio, Finland (satellite meeting to XXXI IUPS Congress)

1989 Participant, GME Mini-Workshop, "Writing Cases for a Problem-Based Medical Curriculum," AAMC meeting, Washington, DC

1993 Organizing Committee Co-Chair, Workshop "Promoting Active Learning in the Life Science Classroom" (sponsored by the New York Academy of Sciences)

1994 Invited to present a workshop "Computer-Based Education in Physiology" at the 22nd Annual Congress of the Physiological Society of Southern Africa, Stellenbosch, South Africa

1995 Invited participant in workshop "Active Learning in Large Class Settings" at Experimental Biology '95, Atlanta, GA

1995 Invited to organize and present a workshop on "Active Learning" by the Educational Commission on Foreign Medical Graduates, Bethesda, MD

1995 Organized and chaired a workshop/discussion "Assessing Educational Quality in Problem-Based and Traditional Curricula" at the Spring Meeting of the Central Group on Educational Affairs, Columbus, OH

1997 Organizer and participant in panel discussion "Challenges Facing Undergraduate, Graduate and Medical Physiology Teachers: Are They the Same?" presented at Experiment Biology 97, New Orleans, LA

1997 Participant at the Workshop "What Do the Best Medical Educators Do?" put on by the Searle Center for Teaching Excellence and The Office of Medical Education, Northwestern University.

1997 Conducted faculty development workshop on “Promoting Active Learning in the Classroom” at Bastyr University, Seattle, WA

1998 Conducted workshop on “Active learning: what is it and how can I promote it in my classroom?” at HAPS 98, Fort Worth, TX.

1999 Organized and conducted workshop “Implementing Active Learning in Your SMET Classrooms” for the Maricopa County (AZ) Community College District, Phoenix, AZ.

1999 Conducted workshop “Creating an Active Learning Environment in the Lecture Hall” at the University of Kentucky Medical School, Lexington, KY

1999 Organized a faculty development program on “Active Learning” for the WISE Faculty Workshop, Chandler Gilbert Community College, Chandler, AZ

2000 Conducted workshop “Misconceptions about pressure and flow relationships: Uncovering and Remedying Them” at HAPS 2000, Charlotte, NC.

2000 Conducted (with H. Modell and M. Wenderoth) workshop “Physiology for Physiology Teachers” at HAPS 2000, Charlotte, NC.

2000 Presented a workshop “Small group, cooperative learning is the computer teaching lab” to the Division of Basic Biomedical Sciences, School of Medicine, University of South Dakota, Vermillion, SD.

2000 Presented two workshops “Creating an Active Learning Environment in the Life Science Classroom” and “Physiology for Physiology and Biology Teachers” (with H. Modell and M. Wenderoth) for the NSF National Chautauqua Workshop Program at the University of Washington, Seattle, WA.

2000 Organized and conducted workshop (with H. Modell and M. Wenderoth) “Teaching Physiology: Updating Pedagogy and Content,” Rush Medical College, Chicago, IL. (Sponsored by APS)

2000- Member of the Program Committee, Chicago Symposium Series on Excellence in Teaching Mathematics and Science: Research and Practice

2001 Conducted a workshop “Problem Solving in Physiology” at the HAPS/CAAPS Regional Conference, Triton College, River Grove, IL.

2001 Panelist for session “Perspectives on Problem-Based Learning: Thorns and Roses,” Experimental Biology, Orlando, FL.

2001 Conducted a workshop (with H. Modell) “Helping the Learner to Learn” at Indiana University College of Medicine, Indianapolis, IN.

2001 Conducted two workshops on “Probing Misconceptions,” Indiana University, Bloomington, IN.

2001 Participant and presenter at International Teaching Workshop (held in conjunction with the IUPS Congress), Lincoln University, New Zealand.

2002 Conducted workshop (with H. Modell) “Uncovering misconceptions can help you to help the learner to learn” at HAPS 2002, Phoenix, AZ.

2002 Conducted workshop (with H. Modell and M. P. Wenderoth) “Helping students understand physiology through the use of general models” at Experimental Biology 2002, New Orleans, LA.

2002 Contributor to workshop (organized by W. Cliff) “Incorporating case studies in the physiology classroom” at Experimental Biology 2002, New Orleans, LA.

2003 Co-organizer (with D. Silverthorn) and presenter at symposium “The teacher as educational researcher” at Experimental Biology 2003, San Diego, CA.

2003 Presenter at workshop “Is it the physiology, the students, or is it me? Reflections on the classroom,” Experimental Biology 2003, San Diego, CA.

2004 Presented a workshop “Active learning? OK, but . . . Breaking down the barriers” at Niagara University, Niagara University, NY.

2005 Co-chair for programming of the IUPS Teaching Workshop, Pali Mountain, CA

2005 Co-chair of Discussion Track I: The laboratory resource project at IUPS Teaching Workshop

2007 Invited participant at NSF sponsored meeting on Conceptual Assessment in Biology (CAB I), University of Colorado, Boulder, CO

2008 Invited participant at NSF sponsored CABII meeting, California Polytechnic University, Asilomar, CA

2011 Presented workshop "*Active Learning for any Discipline"* at Aurora University, Aurora, IL.

2014 Member of organizing team and presenter, The APS Institute on Teaching and Learning, June 23-27, 2014, Bar Harbor, ME

**Participation in Computer-Based Education and Medical Education Symposia**

1985 Organizer and Chairman, symposium "Computer-Based Education in the Biomedical Sciences," FASEB meeting, Anaheim, CA

1989 Panelist, GME Small Group Discussion Session, "Conflicts in the Prime Directive: Basic Science Faculty Research or Enhanced Medical Education," AAMC meeting, Washington, DC

1990 Participant, Panel Discussion, "A Hitch-hikers Guide to Problem Based Learning," Generalists In Medical Education Conference, San Francisco, CA

1990 Guest Critic, Cardiovascular Function Lab meeting (From the Heart Software, sponsored by NIH 2 R44 HL37790), Newport, OR

1991 Chair, Symposia "Reasoning in Medicine and Biology: Implications for Education" and "Applied Studies in Clinical Reasoning," American Educational Research Association annual meeting, Chicago, IL

1995 Moderator for two concurrent discussion groups at Second Biennial Conference of the Basic Science Education Forum, Lincolnshire, IL

2000 Invited lecturer at "International Workshop on Modern Approaches to Teaching and Learning Physiology," San Jose, Costa Rica.

2001 Co-Chair and participant in symposium "Matching technology to education: how to choose the right technology to meet your educational needs," Experimental Biology, Orlando, FL.

2003 Plenary lecturer and workshop presenter, International Association of Medical Science Educators, Georgetown University, Washington, DC.

2003 Invited education symposium speaker and workshop presenter, Australian Physiological and Pharmacological Society meeting, Sydney, Australia.

**Editorial and Review Experience**

1983-1985 Chairman, Editorial Board, American Physiological Soc.-AV/MD Audiocassette Program in Continuing Medical Education

1988-1994 Associate Editor, *American Journal of Physiology: Advances in Physiology Education*

1994- Editorial Board, *Advances in Physiology Education*

1995-1998 Editor, *The Basic Science Teacher*, published by the Educational Commission on Foreign Medical Graduates

2001-2005 Associate Editor, *Advances in Physiology Education*

2005- Editorial Board, *Advances in Physiology Education*

1990-1993 Editorial Board, *Computers in Life Science Education*

2005 - Editorial Review Board, Elsevier Integrated Series.

**BIBLIOGRAPHY**

***Medical & Science Education/Computer Based Education/AI in Education: 1980-present***

PUBLICATIONS: Books and Book Chapters

1. **Michael, J. A.**, & Rovick, A. A. (1999). *Problem Solving in Physiology*. Englewood Cliffs, NJ: Prentice Hall.

2. **Michael, J. A.** and Modell, H. I. (2003). *Active learning in secondary and college science classrooms: A working model for helping the learner to learn*. Mahwah, NJ: Erlbaum Associates.

3. Evens, M. and **Michael, J.** (2006). *One-on-one tutoring by human and computer tutors*. Mahwah, NJ: Erlbaum Associates.

4. **Michael, J**. (Editor). (2011). *Fundamentals of Medical Physiology*. Thieme: New York, NY.

5. **Michael, J.** (2012). Challenges and responses: My evolution from research scientist to teacher, educator, and educational researcher. In J, K. Dorsey and P. K. Rangachari (editors), *Students matter: The rewards of university teaching*. Carbondale, IL: Southern Illinois University Press.

PUBLICATIONS: Journal articles (Peer-reviewed)

1. **Michael, J. A.**, & Rovick, A. A. (Eds). (1983). Proceedings of the symposium"Teaching Cardiovascular Physiology Outside of the Lecture Hall". *The Physiologist*, **26**, 207-240.

2. **Michael, J. A.**, & Rovick, A. A. (1983). Teaching cardiovascular physiology outside the lecture hall: introduction. *The Physiologist*, **26**, 209.

3. **Michael, J. A.**, & Rovick, A. A. (1983). CV pathophysiology problems in small group tutorials. *The Physiologist*, **26**, 225-228.

4. **Michael, J. A.**, & Rovick, A. A. (1983). What are we doing outside the lecture hall and why are we doing it: a summary. *The Physiologist*, **26**, 240.

5. **Michael, J. A.** (1983). Computers in physiology teaching: how can APS help? *The Physiologist*, **26**, 323-325.

6. Rovick, A. A., & **Michael, J. A.** (1984). The computer lesson. *Computers in Life Science Education*, **1**, 6-7.

7. **Michael, J. A.** (1984). Workshop on computer-based education. *The Physiologist*, **27**, 358-359.

8. **Michael, J. A.** (1984). Computer-simulated physiology experiments. Where are we coming from and where might we go? *The Physiologist*, **27**, 434-436.

9. **Michael, J. A.** (Ed). (1985). "Computer-Based Education in the Biomedical Sciences Symposium". *The Physiologist*, **28**, 417-459.

10. **Michael, J. A.** (1985). Computer-based education in the biomedical sciences - introduction. *The Physiologist*, **28**, 418.

11. Rovick, A. A., & **Michael, J. A.** (1985). Teaching problem-solving in physiology with CBE. *The Physiologist*, **28**, 435-438.

12. **Michael, J. A.**, & Rovick, A. A. (1986). Problem-solving in the pre-clinical curriculum: the uses of computer simulations. *Medical Teacher*, **8**, 19-25.

13. **Michael, J. A.** (1986). Making CBE programs "smart": one goal of artificial intelligence research. *Computers in Life Science Education*, **3**, 19-22.

14. **Michael, J. A.**, & Rovick, A. A. (1986). Simulations used in teaching: how to generate them. *Collegiate Microcomputer*, **4**, 201-207.

15. **Michael, J. A.**, & Modell, H. L. (1986). Computer simulations in life science education: some design issues. *Computers in Life Science Education*, **3**, 73-76.

16. **Michael, J. A.** (1987). Comment on peer review or peer critique of software (Letter to the Editor). *Computers in Life Science Education*, **4**, 91-92.

17. **Michael, J. A.** (1987). On teaching physiology to medical students: a reply (Letter to the Editor). *The Physiologist*, **30**, 13.

18. **Michael, J. A.** (1989). An agenda for research on teaching physiology. *American Journal of Physiology*, **256** (*Advances in Physiology Education*, **1**), S14-S17.

19. **Michael, J. A.** (1989). If we're going to teach graduate students how to teach . . . (Editorial). *American Journal of Physiology,* **257** (*Advances in Physiology Education*, **2**), S1-S2.

20. Blumberg, P., **Michael, J. A**., & Zeitz, H. (1990). The roles of student generated learning issues in problem-based learning. *Teaching and Learning in Medicine*, **2**, 149-154.

21. **Michael, J. A.** (1991). Too little attention paid to teaching techniques (Letter to the Editor). *The Chronicle of Higher Education*, **37**(18), B4.

22. Blumberg, P., & **Michael, J. A.** (1992). The development of self-directed behaviors in a partially teacher-directed problem-based learning curriculum. *Teaching and Learning in Medicine,* **4**, 3-8.

23. Li, J., Seu, J., Evens, M., **Michael, J.**, & Rovick, A. (1992). Computer dialogue system (CDS): A system for capturing computer-mediated dialogue. *Behavior Research Methods, Instruments, & Computers*, **24**, 535-540.

24. Rovick, A. A., & **Michael, J. A.** (1992). The prediction table: a tool for assessing students' knowledge. *American Journal of Physiology,* **263** (*Advances in Physiology Education*, **8**), S33-S36.

25. Modell, H., & **Michael, J. A.** (Eds.) (1993). "Promoting Active Learning in the Life Science Classroom". *Annals of the New York Academy of Sciences*, **701,** 1 - 151.

26. Modell, H., & **Michael, J. A.** (1993). Promoting active learning in the life science classroom: defining the issues. *Annals of the New York Academy of Sciences*, **701**, 1-7.

27. **Michael, J. A.** (1993). Teaching problem solving in small groups. *Annals of the New York Academy of Sciences* , **701**, 37-48.

28. **Michael, J. A.**, & Modell, H. (1993). Life science education: reflections on some challenges facing us. *Annals of the New York Academy of Sciences*, **701**, 83-90.

29. **Michael, J. A.** (1993). Where to find the literature: an annotated bibliography of source for life science education. *Annals of the New York Academy of Sciences* , **701**, 91-94.

30. Rovick, A., **Michael, J.**, & Li, J. (1993). ABASE: A multi-component computer program to teach acid-base regulation. *Annals of the New York Academy of Sciences* , **701**, 136-138.

31. **Michael, J.**, & Modell, H. (1995). Understanding the concepts of physiology. (Letter to the Editor). *American Journal of Physiology,* **268** (*Advances in Physiology Education,* **13**), S81-S82.

32. Hume, G., **Michael, J.**, Rovick, A., & Evens, M. (1996). Hinting as a tactic in one-on-one tutoring. *Journal of the Learning Sciences*, **5**(1), 23-47.

33. **Michael, J. A.** (1998). Students= misconceptions about perceived physiological responses. *American Journal of Physiology,* **274***,* (*Advances in Physiology Education,* **19**), S90-S98.

34. Rovick, A. A., **Michael, J. A.** et al. (1999). How accurate are our assumptions about our students= background knowledge? *American Journal of Physiology,* **276** (*Advances in Physiology Education*, **21**), S93-S101.

35. **Michael, J. A.** et al. (1999). Undergraduate students= misconceptions about respiratory physiology. *American Journal of Physiology,* **277** (*Advances in Physiology Education,* **22**), S127-S135.

36. Modell, H. I., **Michael, J. A**. et al. (2000). Helping undergraduate repair faulty mental models in the student laboratory. *Advances in Physiology Education*, **23**, 82-90.

37. **Michael, J. A.** (2001). In pursuit of meaningful learning. *Advances in Physiology Education,* **25**: 145-158.

38. Shah, F., Evens, M., **Michael, J.** and Rovick, A. (2002). Classifying student initiatives and tutor responses in human keyboard-to-keyboard tutoring sessions. *Discourse Processes*, **33**, 23-52.

39. **Michael, J. A.** et al. (2002). Undergraduates understanding of cardiovascular phenomena. *Advances in Physiology Education*, 26, 72-84.

40. **Michael, J.** (2002). Misconceptions - what students think they know. *Advances in Physiology Education,* **26,** 5-6.

41. **Michael, J.**, Rovick, A., Glass, M., Zhou, Y. and Evens, M. (2003). Learning from a computer tutor with natural language capabilities. *Interactive Learning Environments,* **11**, 233-262.

42. **Michael, J. A**. (2004). Mental models and meaningful learning. *Journal of Veterinary Medical Education* , **31**, 1-5.

43. Modell, H. I., **Michael, J. A**., Adamson, T., and Horwitz, B. (2004). Enhancing active learning in the student laboratory. *Advances in Physiology Education*, **28**, 107-111.

44. Modell, H., **Michael, J.**, and Wenderoth, M. P. (2005). Helping the learner to learn: The role of uncovering misconceptions. *American Biology Teacher*, **67**, 20-26.

45. **Michael, J.** (2005). "Big science" and interdisciplinary science (Editorial). *Advances in Physiology Education*, **29**, 55.

46. **Michael, J.** (2006). Doing and reporting educational research (Editorial). *Advances in Physiology Education*, **30**, 99.

47. **Michael, J.** (2006). Where's the evidence that active learning works? *Advances in Physiology Education,* **30**, 159-167.

48. Woo, C. W., Evens, M. E., Freedman, R., Glass, M. Shim, L. S., Zhang, Y., Zhou, Y., & **Michael**, **J.** (2006). An intelligent tutoring system that generates a natural language dialogue using dynamic multi-level planning. *Artificial Intelligence in Medicine*, **38**(1), 25-46.

49. **Michael, J.** Faculty perceptions about barriers to active learning. (2007). *College Teaching,* **55**(2), 42-47.

50. Kim, Y. C., Evens, M, and **Michael, J**. (submitted). Diagrammatic reasoning with a concept mapper in medical education. *Cognition and Instruction*.

51. Lulis, E., Evens. M., and **Michael, J**. (2007). The use of analogies by expert and novice human tutors. Submitted to *Discourse Processes*.

52. **Michael, J.** (2007). What makes physiology hard for students to learn? Results of a faculty survey. *Advances in Physiology Education*, **31**, 34-40.

53. **Michael, J.** (2007). Conceptual assessment in the biological sciences: A National Science Foundation-sponsored workshop. *Advances in Physiology Education*, **31**, 389-391.

54. **Michael, J**., McFarland, J., and Wright, A. (2008). The second Conceptual Assessment in the Biological Sciences workshop. Advances in Physiological Education, **32**, 248-251.

55. **Michael, J**., Modell, H., McFarland, J., and Cliff, W. (2009). The "core principles" of physiology: What should students understand? *Advances in Physiology Education*, **33**, 10-16.

56. **Michael, J.** and McFarland, J. (2011). The core principles ("big ideas") of physiology: results of faculty surveys. *Advances in Physiology Education*, **35**, 336-341.

57. Silverthorn, D. U. and **Michael, J.** (2013). Cold stress and the cold pressor test. *Advances in Physiology Education,* **37**, 93-96.

PUBLICATIONS: Conference Proceedings (Peer-reviewed)

1. **Michael, J. A.**, & Rovick, A. A. (1984). Computer simulated experiments in the teaching of physiology. *Proceedings of the 6th Annual National Educational Computing Conference*. Dayton, OH. pp. 20-24.

2. **Michael, J. A.**, & Rovick, A. A. (1986). The uses of CBE in teaching the functions of complex systems. *Proceedings of the 27th International Association for the Development of Computer-based Instructional Systems Meeting*. New Orleans, LA. pp. 43-48.

3. Zhang, Y., Evens, M., **Michael, J. A.**, & Rovick, A. A. (1987). Knowledge compiler for an expert physiology tutor. *Proceedings of the ESD/SMI 1st Annual Expert Systems Conference*. Dearborn, MI. pp. 245-259.

4. Haque, M. M., Evens, M., **Michael, J. A.** & Rovick, A. A. (1987). A physiology tutor based on an expert system. *Proceedings of the ESD/SMI 1st Annual Expert Systems Conference*. Dearborn, MI. pp. 423-436.

5. **Michael, J. A.**, Rovick, A. A., Evens, M., Kim, N., & Haque, M. M. (1988). From CAI to ICAI: Two examples along the way. *Proceedings of the 30th International Conference of the Association for the Development of Computer-Based Instructional Systems*. Philadelphia, PA. pp. 268-273.

6. Kim, N., Evens, M., **Michael, J. A.**, & Rovick, A. A. (1989). CIRCSIM-TUTOR: An intelligent tutoring system for circulatory physiology. In H. Maurer (Ed), *Computer Assisted Learning (Proceedings of the International Conference on Computer-Assisted Learning*. Dallas, TX). Berlin: Springer-Verlag. pp. 254-266.

7. **Michael, J. A.**, Haque, M. M., Rovick, A. A., & Evens, M. (1989). The Pathophysiology Tutor: A first step towards a smart tutor. In H. Maurer (Ed), *Computer Assisted Learning (Proceedings of the International Conference on Computer-Assisted Learning*. Dallas, TX). Berlin: Springer-Verlag. pp. 390-399.

8. Haque, M. M., Rovick, A. A., **Michael, J. A.**, & Evens, M. (1989). Tutoring rule authoring system (TRAS). In H. Maurer (Ed), *Computer Assisted Learning (Proceedings of the International Conference on Computer-Assisted Learning*. Dallas, TX). Berlin: Springer-Verlag. pp. 182-191.

9. Mayer, G., Yamamoto, C., Evens, M., & **Michael, J. A.** (1989). Constructing a knowledge base from a natural language text. *Proceedings of the Second IEEE Symposium on Computer-Based Medical Systems*. Minneapolis, MN. pp. 98-107.

10. Lee, Y.-H., Evens, M., **Michael, J. A.**, & Rovick, A. A. (1990). IFIHS: Ill-formed input handling system. *Proceedings of the Second Midwest Artificial Intelligence and Cognitive Science Society Conference*. Carbondale, IL. pp. 93-97.

11. Shim, L., Evens, M., Rovick, A. A., & **Michael, J. A.** (1990). Student modelling issues in intelligent tutoring systems. *3rd University of New Brunswick Artificial Intelligence Workshop*, Fredericton, NB, Canada. pp. 127-136.

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COMPUTER-BASED EDUCATION PROGRAMS

1. **Michael, J. A.** *Length-Tension*. Apple and IBM (authored and programmed) and PLATO (authored).

2. **Michael, J. A.** *Force-Velocity*. Apple and IBM (authored and programmed).

3. **Michael, J. A.** *Fluid Compartments*. Apple and IBM (authored/programmed) and PLATO (authored).

4. Rovick, A. A., & **Michael, J. A.** *Circsim*. IBM version (programmed by JAM) of Heartsim (PLATO version).

5. Rovick, A. A., & **Michael, J. A.** *GASP*. IBM version (programmed by JAM) of PLATO version.

6. Rovick, A. A., Li, J. and **Michael, J. A.** *ABASE*. Macintosh.

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i-HUMAN CASES

1. Boyd, K., **Michael, J.**, Baldwin, D. and Knoche, C. *Melissa Stewart* (diabetic ketoacidosis)

2. Kent, P., Boyd, K., **Michael, J.,** Shannon, T., Abdulla, R. *Juan Garcia* (atrial septal defect)

3. **Michael, J.** *Edgar Campbell 2* (hypertension – renal artery stenosis)

4. Kent, P. and **Michael, J.** *Marvin the Med Student* (influenza)

5. Kent, P., Boyd, K., **Michael, J.,** and Cs-Szabo, G. *Miah* (sickle cell)

6. Ellis, A. K., Hogan, P. M., and **Michael, J.** *John Quimby* (atrial septal defect); University of Buffalo School of Medicine

7. Koo, J.-W., **Michael, J**., Boyd, K. M., Shah, S., Cobleigh, M., Cole, A., and Cs-Szabo, G. *Betty Burns Chapter 1 V2* (Breast cancer).