

Lei Bao

Department of Physics, The Ohio State University

Education

Ph.D., Physics, 1999, University of Maryland at College Park
M.S., Physics, 1996, University of Maryland at College Park
M.S., Electrical Engineering, 1992, SouthEast University, Nanjing, China
B.S., Electrical Engineering, 1990, SouthEast University, Nanjing, China

Appointments

10/2011 – present Professor, Department of Physics, The Ohio State University
10/2006 – 09/2011: Associate Professor, Department of Physics, The Ohio State University.
(Courtesy appointment) School of Teaching and Learning, The Ohio State University.
08/2000 – 09/2006: Assistant Professor, Department of Physics, The Ohio State University.
08/1999 – 07/2000: Research Associate, Physics Department, Kansas State University.

Academic Affiliations

Guest Professor at Beijing JiaoTong University, Beijing Normal University, South China Normal University, SouthEast University, NingXia University.
Science Education Coordinator, the Overseas Chinese Physics and Astronomy Association (OCPA)
Past Chair of AAPT international education committee
Council member of the Chinese National Association of Research in Higher Education of Physics
Science Education Section Editor, *Physics and Engineering*

Research Interests and Fields

Information theory and intelligent agent modeling of learning and socio-economic systems.
Inquiry based and technology assisted education methods and curriculum for science learning and scientific reasoning.
Assessment instruments for assessing science content knowledge and scientific reasoning skills.
Measurement and assessment methods

- Model Analysis – multi-dimensional modeling for assessing learning.
- Dynamic models of learning and a unified probability framework for education measurement, which integrates Model Analysis, normalized gain and IRT under a single coherent theoretical frame.
- Development of quantitative assessment instruments and methods for assessing content knowledge, reasoning, and views and attitudes.
- Large scale quantitative assessment and targeted comparisons.
- International assessment data center.

Computational models of student learning processes such as neural network models
Experimental technology and methods for measuring and modeling behavioral data of student learning (e.g. automatic group dynamics analysis and eye-tracking analysis of human interactions with computer simulations).
Technologies in education (e.g. in-class polling, web based interactive learning modules, technology enhanced science inquiry, virtual reality experiments, learning games)

Grants

1. *Data Analytics for Efficient STEM Assessment: Developing Equivalent Short Concept Inventories*, NSF DUE-1712238, Co-PI, \$299,897, 2017-2020.
2. *Teacher Professional Development for Technology-Enhanced Inquiry to Foster Students' 21st Century Learning*, NSF, DRK-12, collaborative, PI at OSU, \$206,632, 2014-2018.
3. *Developing Scientific Reasoning: Targeted Physics Instruction for STEM Majors*, NSF, IUSE, collaborative, PI at OSU, \$307,973, 2014-2018.
4. *Developing Scientific Reasoning Assessment Tools for STEM Education and Teacher Preparation*, NSF, PI, \$199,801, 2010~2015.
5. *Mathematics Coaching Program – Year Six* funded by the Ohio Department of Education for \$2.6 million from 2012-2015. Share of Budget \$75,000 for 2014-2015.
6. *Science Learning and Scientific Reasoning*, NIH, PI, \$998,658, 2009~2013.
7. *Developing Scientific Reasoning Abilities in Pre-service Teachers*, NSF, CCLI, Co-PI, \$125,000, 2010~2012.
8. *Virtual Experiments for Physics Labs*, NSF, CCLI, PI \$100,396, 2007~2011.
9. *Building a solid foundation for multidisciplinary STEM education research*, NSF, CCLI, Co-PI, \$148,711, 2008~2011.
10. *STEP: Gateway into first-year STEM curricula: A community college/university collaboration promoting retention and articulation*, NSF Subcontract, \$18,827, 2008~2010.

11. *Creating Research-based Single-Concept Question Sequences for In-class Polling Systems*, NSF CCLI, Co-PI, 2006~2010, \$489,999.
12. *Develop and Assess The Ohio State Standardized Clicker System*, OSU, Co-PI, 07/2005~06/2007, \$84,796.
13. *Scientific Misconceptions: From Cognitive Underpinnings to Educational Treatment*, CASL, US Department of Education, Collaborator (10%) 09/2005~08/2008, \$933,397.
14. *Context Cues, Associative Memory and Learning of Physics*. NSF (REC 0126070) PI. 01/2002 – 12/2005, \$269,305.
15. *Technology & Model-Based Conceptual Assessment*. NSF (REC 0087788) Co-PI. (Subcontract from Kansas State University – PI. at OSU) (01/2001 – 12/2004), \$241,947 at OSU.
16. Ohio State University Seed Grant PI 2001-02 \$9,000.

Selected Publications:

1. Lei Bao, Yang Xiao, Kathleen Koenig, & Jing Han, “Validity Evaluation of the Lawson Classroom Test of Scientific Reasoning,” *Phys. Rev. Phys. Educ. Res.* 14, 020106 (2018).
2. Kathleen Koenig, Krista E. Wood, Larry Bortner, & Lei Bao, “Modifying Traditional Labs to Target Scientific Reasoning,” *Journal of College Science Teaching*, (in press, 2018).
3. Yang Xiao, Jing Han, Kathleen Koenig, Jianwen Xiong, & Lei Bao, “Multilevel Rasch modeling of two-tier multiple choice test: A case study using Lawson’s classroom test of scientific reasoning,” *Phys. Rev. Phys. Educ. Res.* 14, 020104 (2018).
4. Bao, L. & Fritchman J., (2018) Information of Complex Systems and Applications in Agent Based Modeling, *Nature: Scientific Reports* 8, Article number: 6177, <https://www.nature.com/articles/s41598-018-24570-1>.
5. Jing Han, Li Chen, Zhao Fu, Joseph Fritchman, and Lei Bao, (2017) An Eye-tracking Study of Visual Attention in Web based Assessment with the Force Concept Inventory, *Eur. J. Phys.* 38 (4) 045702.
6. Koenig, K., Zydney, J., & Bao, L. (2017) Enhancing a Scientific Inquiry Lesson through Computer Supported Collaborative Learning, *Science Scope*, 041(9), 80-87, doi 10.2505/4/ss17_041_01_80.
7. Han, J., Koenig, K., Cui, L., Fritchman, J., Li, D., Sun, W., Fu, Z., & Bao, L. (2016) Experimental Validation of the Half-Length Force Concept Inventory, *Physical Review Physics Education Research*, 12, 020122.
8. Zhou, S., Han, J., Koenig, K., Raplinger, A., Pi, Y., Li, D., Xiao, H., Fu, Z., & Bao, L. (2016) Assessment of Scientific Reasoning: the Effects of Task Context, Data, and Design on Student Reasoning in Control of Variables, *Thinking Skills and Creativity*, 19, 175–187.
9. Han, J., Bao, L., Chen, L., Cai, T., Pi, Y., Zhou, S., Tu, Y., & Koenig, K., (2015) Dividing the Force Concept Inventory into Two Equivalent Half-Length Tests, *Physical Review Physics Education Research*, 11, 010112.
10. Koenig, K., Schen, M., & Bao, L., “Explicitly Targeting Pre-service Teacher Scientific Reasoning Abilities and Understanding of Nature of Science through an Introductory Science Course,” *Science Educator*, 21, no. 2, 1-9 (2012).
11. Koenig, K., Schen, M., Edwards, M. & Bao, L., “Addressing STEM Retention through a Scientific Thought and Methods Course,” *Journal of College Science Teaching*, 41, no. 4, 23-29 (2012).
12. Shaona Zhou, Jing Han, Nathaniel Pelz, Xiaojun Wang, Liangyu Peng, Hua Xiao, Lei Bao, Inquiry Style Interactive Virtual Experiments: A Case on Circular Motion, *European Journal of Physics*, 32, 1597-1606, (2011).
13. Lin Ding, Neville Reay, Albert Lee, and Lei Bao, Exploring the role of conceptual scaffolding in solving synthesis problems, *Phys. Rev. ST Physics Ed. Research* 7, 020109 (2011).
14. Albert Lee, Lin Ding, N. W. Reay, and Lei Bao, “Single-Concept Clicker Question Sequences,” *Physics Teacher*, 49 (6) p385-389, (2011).
15. Jing Wang and Lei Bao, “Analyzing Force Concept Inventory with Item Response Theory,” *Am. J. Phys.*, 78 (10), 1064-1070 (2010).
16. Lei Bao, Tianfan Cai, Kathy Koenig, Kai Fang, Jing Han, Jing Wang, Qing Liu, Lin Ding, Lili Cui, Ying Luo, Yufeng Wang, Lieming Li, Nianle Wu, “Learning and Scientific Reasoning”, *Science*, Vol. 323. no. 5914, pp. 586 – 587 (2009).
17. David E. Pritchard, Young-Jin Lee and Lei Bao, “Mathematical learning models that depend on prior knowledge and instructional strategies,” *Phys. Rev. ST Phys. Educ. Res.* 4, 010109 (2008)
18. L. Bao and E. F. Redish, “Model Analysis: Assessing the Dynamics of Student Learning,” *Phys. Rev. ST Phys. Educ. Res.* 2, 010103 (2006).
19. N. W. Reay, L. Bao, P. Li, R. Warnakulasooriya and G. Baugh, “Toward an effective use of voting machines in physics lectures,” *Am. J. Phys.* 73, 554 (2005)

Selected Media and News Coverage:

- Nature Physics: Science education: Lessons to be learned, Vol.6, 6, 2010.
- Science News: Feature: Think Like a Scientist, Vol.175 #13 (p. 20), 06/20, 2009.
- NPR: Can Scientific Reasoning Be Taught? 1/30, 2009
- NPR Science Friday: Learning Facts vs. Learning to Reason. 1/30, 2009
- The Columbus Dispatch: Study: Chinese students know more science facts than U.S. counterparts, 1/29, 2009.
- China Daily: Science students lack ability to reason 1/30, 2009.
- Inside Higher Ed: Blinding Them with Science 1/30, 2009