

Lei Bao

Department of Physics, The Ohio State University
191 W Woodruff Ave., Columbus, OH 43210-1117
Tel: 614-292-2450, Fax: 614-292-7557; bao.15@osu.edu

Education

Ph.D., Physics, 1999, 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.
(Affiliated 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.
08/1994 – 07/1999 Graduate Research and Teaching Assistant, Physics Department, University of Maryland.

Academic Affiliations

President, the International Organization of Chinese Physicists and Astronomers (OCPAWeb.org)
Past Chair of AAPT international education committee

Research Interests and Fields

Information theory and intelligent agent modeling of learning and socio-economic systems

Scientific Reasoning: modeling, assessment, and development

Knowledge Integration and Deep Learning in STEM: modeling, assessment, and instruction

Measurement and assessment methods

- Information theory and intelligent agent modeling
- 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)

Current and Past Grants

1. *Assessment of Student Knowledge Integration for Deep Learning in Physics*, NSF DUE-2043817, PI, \$299,884, 2022-2025.
2. *Collaborative Research: Advancing Scientific Reasoning in Online and In-person Physics Labs for STEM Majors*, NSF DUE-2110343, PI, \$268,072, 2022-2025.
3. *Data Analytics for Efficient STEM Assessment: Developing Equivalent Short Concept Inventories*, NSF DUE-1712238, co-PI, \$299,897, 2017-2021.
4. *Teacher Professional Development for Technology-Enhanced Inquiry to Foster Students' 21st Century Learning*, NSF, DRL-1417983, collaborative, PI at OSU, \$206,632, 2014-2018.
5. *Developing Scientific Reasoning: Targeted Physics Instruction for STEM Majors*, NSF, DUE-1431908, collaborative, PI at OSU, \$307,973, 2014-2020.

6. *Developing Scientific Reasoning Assessment Tools for STEM Education and Teacher Preparation*, NSF, DUE-1044724, \$199,801, 2010~2015.
7. *Science Learning and Scientific Reasoning*, NIH, 1RC1RR028402-01, \$972,451, 2009~2013.
8. *Developing Scientific Reasoning Abilities in Pre-service Teachers*, NSF, DUE-0942573, Co-PI, \$124,898, 2010~2012.
9. *Virtual Experiments for Physics Labs*, NSF, DUE-0633473, \$100,397, 2007~2012.
10. *Building a solid foundation for multidisciplinary STEM education research*, NSF, DUE-0737481, Co-PI, \$148,711, 2008~2010.
11. *STEP: Gateway into first-year STEM curricula: A community college/university collaboration promoting retention and articulation*, NSF Subcontract, \$18,827, 2008~2010.
12. *Creating Research-based Single-Concept Question Sequences for In-class Polling Systems*, NSF, DUE 0618128, 2006~2010, Co-PI, \$399,999.
13. *Develop and Assess The Ohio State Standardized Clicker System*, OSU, 07/2005~06/2007, \$84,796.
14. *Scientific Misconceptions: From Cognitive Underpinnings to Educational Treatment*, CASL, US Department of Education, Collaborator (10%) 09/2005~08/2008, \$933,397.
15. *Context Cues, Associative Memory and Learning of Physics*. NSF (DRL 0126070) 01/2002 – 12/2005, \$269,305.
16. *Technology & Model-Based Conceptual Assessment*. NSF (REC 0087788) (Subcontract from Kansas State University – PI. at OSU) (01/2001 – 12/2004), \$241,947 at OSU.
17. Ohio State University Seed Grand PI 2001-02 \$9,000.

Selected Media and News Coverage:

Lei Bao, et al., “Learning and Scientific Reasoning”, **Science**, Vol. 323. no. 5914, pp. 586 – 587 (2009).
 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

Publications and Academic Activities

Selected Journal Articles (SCI/SSCI):

1. Chuting Lu, Yating Liu, Shaorui Xu, Shaona Zhou, Heather Mei, Xiangqun Zhang, Lan Yang, Lei Bao, (2023) Conceptual Framework Assessment of Knowledge Integration in Student Learning of Measurement Uncertainty, *Physical Review Physics Education Research*, 19 (2), 020145, DOI:<https://doi.org/10.1103/PhysRevPhysEducRes.19.020145>.
2. Wangyi Xu, Yonggui Jiang, Lan Yang, and Lei Bao, (2023) Conceptual Framework based Instruction for Promoting Knowledge Integration in Learning Momentum, *Physical Review Physics Education Research*, 19 (2), 020124, DOI: 10.1103/PhysRevPhysEducRes.19.020124.
3. Lei Bao, Li Xie, Shihong Ma, Cheng Chen, Xiangqun Zhang, Min He, Hui Lu, Xiumei Feng, Ende Zhang, Ying Nie, Yingjie Han & Jacqueline Y. Bao, (2023), The STEM Aspirations of China’s Future Workforce, *Journal of Science Education and Technology*, 05/01/2023 online first, <https://doi.org/10.1007/s10956-023-10044-1>.
4. Dazhen Tong, Jia Liu, Yechao Sun, Qiaoyi Liu, Xiangqun Zhang, Sudong Pan, and Lei Bao, (2023) Assessment of student knowledge integration in learning work and mechanical energy, *Physical Review Physics Education Research*, 19 (1), 010127, DOI: 10.1103/PhysRevPhysEducRes.19.010127.
5. Jiabei Lin, Yuting Xing, Yudi Hu, Jian Zhang, Lei Bao, Kaiqing Luo, Keke Yu, and Yang Xiao, (2023) Inhibitory control involvement in overcoming the position-velocity indiscrimination misconception among college physics majors, *Physical Review Physics Education Research*, 19 (1), 010112, DOI:<https://doi.org/10.1103/PhysRevPhysEducRes.19.010112>.
6. Zengze Liu, Sudong Pan, Xiangqun Zhang, and Lei Bao, (2022) Assessment of knowledge integration in student learning of simple electric circuits, *Physical Review Physics Education Research*, 18 (2), DOI:<https://doi.org/10.1103/PhysRevPhysEducRes.18.020102>.
7. Lei Bao, Kathleen Koenig, Yang Xiao, Joseph Fritchman, Shaona Zhou, Cheng Chen, (2022) Theoretical model and quantitative assessment of scientific thinking and reasoning, *Physical Review Physics Education Research*, 18 (1), DOI:<https://doi.org/10.1103/PhysRevPhysEducRes.18.010115>.
8. Li Xie, Qiaoyi Liu, Hui Lu, Qingyong Wang, Jing Han, XiuMei Feng, and Lei Bao, (2021) Student knowledge integration in learning mechanical wave propagation, *Physical Review Physics Education Research*, 17 (2), 020122, doi.org/10.1103/PhysRevPhysEducRes.17.020122.

9. Lei Bao & Joseph C. Fritchman, (2021) Knowledge integration in student learning of Newton's third law: Addressing the action-reaction language and the implied causality, *Physical Review Physics Education Research*, 17 (2), 020116, doi.org/10.1103/PhysRevPhysEducRes.17.020116.
10. Haoli Zhuang, Yang Xiao, Qiaoyi Liu, Bing Yu, Jianwen Xiong, & Lei Bao, (Published online: 30 May 2021) Comparison of Nature of Science Representation in Five Chinese High School Physics Textbooks, *International Journal of Science Education*. <https://doi.org/10.1080/09500693.2021.1933647>.
11. Cheng Chen, Lei Bao, Joseph C. Fritchman, and Hemin Ma, (2021) Causal reasoning in understanding Newton's third law, *Physical Review Physics Education Research*, 17 (1), 010128, doi.org/10.1103/PhysRevPhysEducRes.17.010128.
12. Zhou, S., Liu, Q, Koenig, K., Li, Q, Xiao, Y., & Bao, L. (2021). Analysis of two-tier question scoring methods: a case study on the Lawson's classroom test of scientific reasoning. *Journal of Baltic Science Education*, 20(1), 146-159. doi:<https://doi.org/10.33225/jbse/21.20.146>
13. Qingwei Chen, Guangtian Zhu, Qiaoyi Liu, Jing Han, Zhao Fu, & Lei Bao, (2020) Development of a multiple-choice problem-solving categorization test for assessment of student knowledge structure, *Physical Review Physics Education Research*, 16 (2), 020120, DOI: 10.1103/PhysRevPhysEducRes.16.020120
14. Yang Xiao, Guiqing Xu, Jing Han, Hua Xiao, Jianwen Xiong, & Lei Bao, (2020) Assessing the Longitudinal Measurement invariance of the Force Concept Inventory and the Conceptual Survey of Electricity and Magnetism, *Phys. Rev. Phys. Educ. Res.* 16(2):020103, DOI: 10.1103/PhysRevPhysEducRes.16.020103
15. Wangyi Xu, Qiaoyi Liu, Kathleen Koenig, Joseph Fritchman, Jing Han, Sudong Pan & Lei Bao, (2020) Assessment of Knowledge Integration in Student Learning of Momentum, *Physical Review Physics Education Research*, 16(1), 010130. DOI: 10.1103/PhysRevPhysEducRes.16.010130
16. Yang Xiao, Joseph C. Fritchman, Jacqueline Y. Bao, Ying Nie, Jing Han, Jianwen Xiong, Hua Xiao, & Lei Bao, (2019) Linking and comparing short and full-length concept inventories of electricity and magnetism using item response theory, *Phys. Rev. Phys. Educ. Res.* 15 (2) 020149. <https://doi.org/10.1103/PhysRevPhysEducRes.15.020149>
17. Bao, L., Koenig, K. Physics education research for 21st century learning. *Discip Interdiscip Sci Educ Res* **1**, 2 (2019) doi:10.1186/s43031-019-0007-8
18. Ying Nie, Yang Xiao, Joseph C. Fritchman, Qiaoyi Liu, Jing Han, Jianwen Xiong & Lei Bao (2019) Teaching towards knowledge integration in learning force and motion, *International Journal of Science Education*, 41:16, 2271-2295, DOI:10.1080/09500693.2019.1672905
19. Rui Dai, Joseph C. Fritchman, Qiaoyi Liu, Yang Xiao, Haibo Yu, & Lei Bao, (2019) Assessment of student understanding on light interference, *Phys. Rev. Phys. Educ. Res.* 15(2), 020134. <https://doi.org/10.1103/PhysRevPhysEducRes.15.020134>
20. Bao, L. & Fritchman, J. Dual-Space Information Modeling of Socio-Economic Systems under Information Asymmetry. *Entropy*, 21(5), 528, (2019). <https://doi.org/10.3390/e21050528>
21. Yang Xiao, Kathleen Koenig, Jing Han, Qiaoyi Liu, Jianwen Xiong, Lei Bao, "Test equity in developing short version conceptual inventories: A case study on the Conceptual Survey of Electricity and Magnetism," *Phys. Rev. Phys. Educ. Res.* 15, 010122, (2019).
22. Kathleen Koenig, Krista E. Wood, Larry Bortner, & Lei Bao, "Modifying Traditional Labs to Target Scientific Reasoning," *Journal of College Science Teaching*, 48(5), 28-35, (2019).
23. 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).
24. 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).
25. 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>.
26. Han, J., Chen, L., Fu, Z., Fritchman, J., & Bao, L. (2017). An Eye-tracking Study of Visual Attention in Web based Assessment with the Force Concept Inventory, *Eur. J. Phys.* 38 (4) 045702.
27. 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.
28. 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.
29. 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.
30. 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.
31. 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).
32. 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).

33. 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).
34. 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).
35. Albert Lee, Lin Ding, N. W. Reay, and Lei Bao, "Single-Concept Clicker Question Sequences," *Physics Teacher*, 49 (6) p385-389, (2011) .
36. Jing Wang and Lei Bao, "Analyzing Force Concept Inventory with Item Response Theory," *Am. J. Phys.*, 78 (10), 1064-1070 (2010).
37. 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).
38. Lei Bao, Kai Fang, Tianfang Cai, Jing Wang, Lijia Yang, Lili Cui, Jing Han, Lin Ding, and Ying Luo "Learning of Content Knowledge and Development of Scientific Reasoning Ability: A Cross Culture Comparison," *Am. J. Phys.*, 77 (12), 1118-1123 (2009).
39. Lin Ding, Neville W. Reay, Albert Lee and Lei Bao, "Are we asking the right questions? Validating clicker question sequences through student interviews," *Am. J. Phys.*, 77 (7), 643-650 (2009).
40. L. Bao, S. Stonebraker, and H. Sadaghiani, "A Flexible Homework System," *Am. J. Phys.*, 76 (9), 878-881 (2008).
41. Lin Ding, Neville W. Reay, Albert Lee and Lei Bao, "The effects of testing conditions on conceptual survey results," *Phys. Rev. ST Phys. Educ. Res.* 4, 010112 (2008).
42. 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)
43. N.W. Reay, P. Li, and L. Bao, "Testing a New Voting Machine Methodology," *Am. J. Phys.* 76 (2) 171-178 (2008).
44. L. Bao and E. F. Redish, "Model Analysis: Assessing the Dynamics of Student Learning," *Phys. Rev. ST Phys. Educ. Res.* 2, 010103 (2006).
45. L. Bao, "Theoretical Comparison of Average Normalized Gain Calculations," *Am. J. Phys.* 74 (10) 917-922 (2006).
46. Gyoungho Lee, Jongho Shin, Jiyeon Park, Sangho Song, Yeonsoo Kim, Lei Bao, "An Integrated Theoretical Structure of Mental Models in Science Education: Students' ideas of the circular motion," *J. Korea Assoc Res. Sci. Edu.* 25-6, 698-709 (2005).
47. M. C. Wittmann, J. T. Morgan, and L. Bao, "Addressing student models of energy loss in quantum tunneling," *Eur. J. Phys.* 26 939-950 (2005). Chosen for "Highlights of 2005" by the journal.
48. 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)
49. L. Bao and E. F. Redish, "Understanding probabilistic interpretations of physical systems: A pre-requisite to learning quantum physics", *Am. J. Phys.* 70 (3), 210-217, (2002)
50. L. Bao, K. Hogg, and D. Zollman, "Model Analysis of Fine Structures of Student Models: An Example with Newton's Third Law," *Am. J. Phys.* 70 (7), 766-778 (2002).
51. L. Bao and E. F. Redish, "Concentration Analysis: A Quantitative Assessment of Student States," *PERS of Am. J. Phys.* 69 (7), S45-53, (2001).

Book/Chapters (Peer Reviewed):

1. L. Bao and E. F. Redish, "Educational Assessment and Underlying Models of Cognition" In *The Scholarship Of Teaching And Learning In Higher Education: The Contributions Of Research Universities* , Ed. William E. Becker & Moya L. Andrews, pp 221-264, Indiana University Press, 2004.

Peer Reviewed Conference Proceedings:

1. Koenig, K., Wood, K., & Bao, L. (2020). Development and evaluation of introductory Physics lab curriculum to promote scientific reasoning abilities, *Journal of Physics: Conference Series (GIREP)*.
2. Koenig, K., Zydney, J., Hord, C., & Bao, L. (2018). Enhancing scientific inquiry through computer supported collaborative learning. *Proceedings of EdMedia World Conference on Educational Media & Technology- Association for the Advancement of Computing in Education, Amsterdam, Netherlands.*
3. Wood, K.E., Koenig, K., Owens, L., & Bao, L. (2018). Development of student abilities in control of variables at a two-year college. *AURCO Journal*, 24, 164-179.
4. Koenig, K., Wood, K., & Bao, L. (2016). Progression of student abilities in control of variables in an introductory physics lab course. *NSF Envisioning the Future of Undergraduate STEM Education: Research and Practice Symposium Proceedings.*
5. Koenig, K. & Bao, L. (April 2013). Impacting the Scientific Reasoning Abilities of STEM Majors through an Introductory Physics Laboratory Course. *Proceedings of the Annual Meeting of the National Association for Research in Science Teaching, Puerto Rico.*

6. Koenig, K., Bao, L. & Schen, M. (March 2012). Using specialized instruction to develop scientific reasoning abilities in teacher candidates. Proceedings of the Annual Meeting of the National Association for Research in Science Teaching, Indianapolis, IN.
7. Liangyu peng, Lei Bao, Manchi Huan. Research of Generalized Lorenz System Family and Chua's Circuit Based on Simulink. 2011 International Conference on Computers, Communications, Control and Automation (CCCA 2011). Hong Kong, China, February 20-21, 2011. Volume I: 417-420. (IEEE publication)
8. Liangyu peng, Lei Bao, Manchi Huan. The Study of Removing Image Noise with Median Filter and Wavelet Transform. 2011 International Conference on Computers, Communications, Control and Automation (CCCA 2011). Hong Kong, China, February 20-21, 2011. Volume I: 421-424. (IEEE publication)
9. Liangyu peng, Lei Bao. Application of Matlab/Simulink and Orcad/PSpice Software in Theory of Circuits. 2010 International Conference on Broadcast Technology and Multimedia Communication (BTMC 2010), 2010 Second Pacific-Asia Conference on Knowledge Engineering and Software Engineering (KESE 2010). Chongqing, China, December 13-14, 2010. Volume III: 514-517. (IEEE publication)
10. Scott Zollinger, Patti Brosnan, Diana B. Erchick, and Lei Bao, "Mathematics Coaching: Impact on Student Proficiency Levels After One Year of Participation", North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA), (2010).
11. L. Ding, N. W. Reay, A. Heckler, and L. Bao, "Sustained effects of solving conceptually-scaffolded synthesis problems", PERC Proceedings (2010).
12. Lin Ding, Neville Reay, Albert Lee and Lei Bao, "Using Conceptual Scaffolding to Foster Effective Problem Solving" *PERC proceedings* (2009).
13. Homeyra R. Sadaghiani and Lei Bao, "Student Difficulties in Understanding Probability in Quantum Mechanics" *PERC proceedings* (Aug. 2005).
14. Yeounsoo Kim, Lei Bao and Omer Acar, "Students' Cognitive Conflict and Conceptual Change in a PBI Class," *PERC proceedings* (Aug. 2005).
15. Yeounsoo Kim and Lei Bao, "Development of an Instrument for Evaluating Anxiety Caused by Cognitive Conflict," *PERC proceedings* (Aug. 2004).
16. Gyounggho Lee, Jiyeon Park, Yeounsoo Kim and Lei Bao, "Alternative Conceptions, Memory & Mental Model in Physics Education," *PERC proceedings* (Aug. 2004).
17. Dedra Demaree, Stephen Stonebraker, Wenhui Zhao and Lei Bao, "Virtual Reality Experiments in Introductory Physics Laboratories," *PERC proceedings* (Aug. 2004).
18. Rasil Warnakulasooriya and Lei Bao, "Procedural Rules in Students' Reasoning," *PERC proceedings* July 2003.
19. Neville W. Reay, Lei Bao, Gordon Baugh and Rasil Warnakulasooriya, "Business-Style" Group Work in a Freshman Engineering Honors Class," *PERC proceedings* July 2003.
20. Florin Bocaneala and Lei Bao, "Neural Network Modeling for Physics Learning: A Case on E&M," *PERC proceedings* July 2003.
21. Homeyra Sadaghiani and Lei Bao, "Lecture Demonstrations in Modern Physics: Quality vs. Quantity," *PERC proceedings* July 2003.
22. Homeyra R. Sadaghiani and Lei Bao, "Immediate Informative Feedback Using a New Homework System," *PERC proceedings* Aug. 2002.
23. Keith Oliver and Lei Bao, "Student Resources in Quantum Mechanics, or Why Students Need Meta Resources," *PERC proceedings* Aug. 2002.
24. Gyounggho Lee and Lei Bao, "Context Map: A Method to Represent The Interactions Between Students' Learning and Multiple Context Factors," *PERC proceedings* Aug. 2002.
25. Rasil Warnakulasooriya and Lei Bao, "Toward a Model-Based Diagnostic Instrument in Electricity and Magnetism - An Example," *PERC proceedings* Aug. 2002.
26. Gyounggho Lee and L. Bao, "Graduate and undergraduate students' views on learning and teaching physics," *PERC proceedings*, July 2001.
27. R. Warnakulasooriya and L. Bao, "Students' understanding of Electricity and Magnetism for the development of a model based diagnostic test," *PERC proceedings*, July 2001.
28. Richard N. Steinberg., Michael. C. Wittmann, Lei Bao, and Edward F. Redish, "The Influence of Student Understanding of Classical Physics When Learning Quantum Mechanics," Research on the Teaching and Learning of Quantum Science, NARST Annual Meeting, Boston, March, 1999. <http://www.phys.ksu.edu/perg/paper/narst/>.
29. Zhonghan Woo, Lei Bao, Wang Ling and Yuan Chunwei, "AFM Analysis on the Bioelectric Property of Fish Scale Plates," The Eighth Symposium on Electrets, Paris, Sept., 1994.
30. Zhonghan Woo, Lei Bao, et al, "Electrostatic Technology and Clean Engineering," International Conference on Air and Water Cleaning Technology, China, June, 1993.
31. Lei Bao, Yiming Ling, "Ozone Synthesis with UV and Silent Discharge," The Asia-Pacific Conference on Plasmas Science and Technology, China, Sept. 1992.

Invited Review Papers:

1. Lei Bao and ZuRen Wu, "Physics Education in China: From Past to Future," AAPT Interactions, 38 (1), 24-25, (2008).

Invited Talks:

1. L. Bao, "STEM Education for the 21st Century," July, 2023, Fudan University, Shanghai, China.
2. K. Koenig, K. Wood, L. Bao, "Promoting Scientific Reasoning in the Introductory Physics Lab Course," July, 2023, AAPT Summer Conference. (Invited collaboration talk)
3. L. Bao, "Knowledge Integration and Scientific Reasoning," June, 2023, University of Macau, Macau, China.
4. L. Bao, "Fostering Talent for the New Century," Invited Keynote Speech, Annual meeting of the Science Education Sector of China Education Association, June, 2023, Xian, China.
5. L. Bao, "STEAM Learning in the 21st Century," Plenary Speech, International STEAM Coalition Annual Meeting, August, 2022, Suzhou, China.
6. L. Bao, "The Conceptual Framework Model for Knowledge Integration and Deep Learning in Physics," Invited Keynote Speech, The 15th Asia Pacific Physics Conference, August, 2022, South Korea.
7. L. Bao, "Promoting Deep Learning and Reasoning in Science Education," Invited Keynote Speech, Annual meeting of the Science Education Sector of China Education Association, July, 2022, Changsha, China.
8. L. Bao, "Promoting Scientific Reasoning and Knowledge Integration in Physics Learning," July, 2022, Fudan University, Shanghai, China.
9. L. Bao, "Scientific Reasoning and Deep Learning," June, 2022, South China Normal University, Guangzhou, China.
10. L. Bao, "The Education for the New Century: Goals and Methods for Innovations in Teaching and Learning," Plenary speech, 2021 Conference on Teaching and Learning Innovation, December, 2021, Fudan University, Shanghai, China.
11. L. Bao, "Towards a Modeling Framework for Assessment of Scientific Reasoning," Plenary speech, 4th International Annual Meeting on STEM Education, August, 2021, Taiwan.
12. L. Bao, "Development of a Modeling Framework for Assessment of Scientific Reasoning," AAPT Summer Meeting, July, 2021.
13. L. Bao, "A Modeling Framework of Scientific Thinking and Reasoning," AAPT Summer Meeting, July, 2020.
14. L. Bao, "Effective STEM Education for the 21st Century," Keynote Speech, OCPA 9th Triennial International Conference, Tsinghua University, Beijing, China, July, 2017.
15. L. Bao, "Deep Learning and Education Modeling," East China Normal University, Shanghai, China, July, 2017.
16. L. Bao, "Science Inquiry for STEM Education," Plenary Speech, International Workshop on Strategic Development and Reform in Physics Education, Tongji University, Shanghai, China, July, 2017.
17. L. Bao, "Active Learning Environment for the 21st Century Classrooms," University of Electronic Science and Technology of China, Chengdu, China, July, 2017.
18. L. Bao, "STEM Education Research: Assessment of Scientific Reasoning," South China Normal University, GuangZhou, China, June, 2017.
19. L. Bao, "Developing Scientific Reasoning in STEM Education," Nanjing Normal University, Nanjing, China, June 2017.
20. L. Bao, "Science Education in the 21st Century: Fostering Ability for Teachers and Students," Capital Normal University, Beijing, China, June, 2017.
21. L. Bao, "Big Data and 21st Century Education," Plenary speech, International Symposium for Big Data in Education, Qufu Normal University, Qufu, China, November, 2016.
22. L. Bao, "Physics and Science Education in U.S. Schools," Fudan University, Shanghai, China, November, 2016.
23. L. Bao, "Developing and Assessing Student Ability: 21st Century Skills and 21st Century Education," SouthWest University, Chongqing, China, November, 2016.
24. L. Bao, "STEM Education For the 21st Century," East China Normal University, Shanghai, China, November, 2016.
25. L. Bao, "21st Century Learning: Physics Education and Scientific Reasoning," Plenary Lecture, Fudan Summer School for Physics Education Research, Fudan University, Shanghai, China, July, 2016.
26. L. Bao, "Science Education for the 21st Century," Plenary Speech, National College Physics Education Symposium, Shenzhen, China, July, 2016.
27. L. Bao, "Recent advancement in physics education research: assessment development and education technology," Plenary Speech, Tsinghua University Physics Education Research Symposium, Tsinghua University, Beijing, China, July, 2016.
28. L. Bao, "A Cognitive based Framing of Quantum Cognition," Penn State University, December, 2015.
29. L. Bao, "STEM Education for the 21st Century," ICPE 2015, Plenary Speech, Beijing, August, 2015.
30. L. Bao, "Assessment and Development of 21st Century Skills," Plenary Speech, 8th Annual Meeting of Chinese Science Education Association, Chengdu, August, 2015.
31. L. Bao, "Developing Critical Thinking and Scientific Reasoning in K-12 Science Courses," Hangzhou Normal University, Hangzhou, August, 2015.
32. L. Bao, "Research in Assessment of Critical Thinking," Shaanxi Normal University, Xi'an, July, 2015.

33. L. Bao, "Promoting 21st Century Skills in Physics Education," Tokyo University of Agriculture & Technology & Science Council of Japan, Tokyo, July, 2015.
34. L. Bao, "Research in Physics Education and Scientific Reasoning," Kyoto University of Education, Kyoto, July, 2015.
35. L. Bao, "21st Century Skills and 21st Century Education," Purdue University, October, 2014.
36. L. Bao, "MOOC and Its Impact," Keynote of Science Education Panel, OCPA 8 International Conference on Physics Education and Frontier Physics, Singapore, June, 2014.
37. L. Bao, "Developing and Assessing Student Ability: 21st Century Skills and 21st Century Education", OCPA8 International Conference on Physics Education and Frontier Physics, Singapore, June, 2014.
38. L. Bao, "Education Research Case Studies on Scientific Reasoning," Beijing Jiaotong University, Beijing, China, July, 2014.
39. L. Bao, "Science Education Research in the 21st Century," Jiangsu University of Science and Technology, Zhenjiang, China, July, 2014.
40. L. Bao, "Education Assessment of Higher Order Abilities," East China Normal University, Shanghai, China, July, 2014.
41. L. Bao, "Developing and Assessing 21st Century Skills," Shanxi Normal University, Xi'an, China, June 2014.
42. L. Bao, "21st Century Education: Developing and Assessing Student Critical Thinking and Scientific Reasoning," Plenary Talk, Global Chinese Conference on Science Education, GuangZhou, China, July, 2013.
43. L. Bao, "Research and Best Practices to Improve Student Learning," Plenary Talk, Workshop on Research based STEM Education, STEM Learning Center, Beijing Jiaotong University, Beijing, China, July, 2013.
44. L. Bao, "Research and Best Practices to Improve Student Learning," Plenary Talk, Teacher Workshop on STEM Education, South China Normal University, GuanZhou, China, July, 2013.
45. L. Bao, "Developing and Assessing Student Ability," Colloquium, Sichuan Normal University, Chengdu, China, June, 2013.
46. L. Bao, "Developing Effective Scientific Reasoning and Problem Solving Skills," Colloquium, University of Cincinnati, Department of Physics and FUSION science education center, October, 2012.
47. L. Bao, "Developing and Assessing Student Ability: 21st Century Skills and 21st Century Education," Plenary Talk, China Physical Society, China-US Advanced Forum on Physics Education, Tsinghua University, Beijing China, August, 2012.
48. L. Bao, "Scientific Reasoning and Problem Solving Skills," Colloquium, ChangJiang University, JingZhou, China, August, 2012.
49. L. Bao, "Developing Effective Problem Solving Skills," Plenary Talk and Workshop, Strengthening Teaching and Learning in the STEM Fields, LASPAU, Harvard University, June, 2012.
50. L. Bao, "Learning, Reasoning, and Science Inquiry," Colloquium, Harvard University, School of Engineering and Applied Sciences, Cambridge, MA, April, 2012.
51. L. Bao, "Jobs, Physics, and Education Reforms," Invited Conference Speech, Annual Meeting of The Physical Society of Republic of China, National Chung Cheng University, Taiwan, January, 2012.
52. L. Bao, "STEM Education: US-China Comparison," Plenary Talk, Advanced Workshop on Investigative Learning, Nanjing, China, August, 2011.
53. L. Bao, "Technology in Physics Education," Hong Kong Institute of Education, Hong Kong, August, 2011.
54. L. Bao, "Scientific Reasoning and Science Education," Plenary Talk, OCPA7 Biannual Meeting, Kaohsiung, Taiwan, August, 2011.
55. L. Bao, "STEM Learning and Scientific Reasoning," NARST Annual Meeting, Orlando, FL, April, 2011.
56. L. Bao, "Assessment of Advanced Ability in Chinese College Admission Test," AAPT Winter Meeting, Jacksonville FL, January, 2011.
57. L. Bao, "Science Learning and Scientific Reasoning," Indiana University Purdue University Indianapolis, October, 2010.
58. L. Bao, "Advanced Methods in Education Assessment," Beijing Education Testing Center, Beijing, September, 2010.
59. L. Bao, "Current Trends in Physics Education Research," Beijing University of Posts and Telecommunications, Beijing, September, 2010.
60. L. Bao, "Introductory to Physics Education Research," Beijing Institute of Technology, Beijing, September, 2010.
61. L. Bao, "Interactive Classrooms for Fostering Student General Abilities," Central China Normal University, WuHan, September, 2010.
62. L. Bao, "Physics Education and Training of Scientific Reasoning," South China Normal University, GuangZhou, August, 2010.
63. L. Bao, "Physics Education Research: A Research based Framework for Education Reform," Hunan Normal University, ChangSha, August, 2010.
64. L. Bao, "Recent Development in Physics Education Research," Plenary Speech, Annual Meeting of the Chinese National Association of Research in Higher Education of Physics, YunNan Normal University, KunMing, August, 2010.
65. L. Bao, "Developing Interactive Classroom Environments," TongJi University, ShangHai, August, 2010.
66. L. Bao, "Assessment Methods and Instrument Design," Beijing Normal University, Beijing, August, 2010.
67. L. Bao, "Physics Education Research Around the World," 2010 International Physics and Science Education Research Forum, the Annual Meeting of Chinese Society of Education, Physics Education Committee, August, 2010.

68. L. Bao, "Current Trends in Physics Education Research: Methodology and Development," Plenary Speech, Annual Meeting of the Education Committee of the Chinese Physical Society, Beijing, July, 2010.
69. L. Bao, J. Han, and K. Koenig, "Assessment of Scientific Reasoning: A Case in Proportional Reasoning," AAPT-PERC, Portland, OR, July, 2010.
70. L. Bao, "Learning and Scientific Reasoning," University at Buffalo (SUNY), July, 2010.
71. L. Bao, "Learning to Teach and Teaching to Learn," APS/AAPT Winter Meeting, Washington DC, February, 2010.
72. L. Bao, "Learning and Scientific Reasoning" OSU Physics Colloquium, OSU, January, 2010.
73. L. Bao, "Establishing a Productive Global Collaboration," OSU Research Symposium on Research and the Global University, OSU, November, 2009.
74. L. Bao, "Assessment of Learning and Reasoning," AAPT Summer Meeting, Ann Arbor, July, 2009.
75. L. Bao, "Assessment and training in scientific reasoning," IPERC Summer Workshop, Columbus, Ohio, July, 2009
76. L. Bao, "Connections between Science Content, Instruction, and Development of Scientific Reasoning: Developing a Research Based Framework for Sustainable Education Improvement," Forum for School Science, AAAS Annual Meeting, Chicago, February, 2009.
77. L. Bao, "Physics Education Research Methods and Current Development," China Eastern Normal University, ShangHai, November, 2008.
78. L. Bao, "Methods and Current Development in Science Education and Education Research," Southeast University, Nanjing, November, 2008
79. L. Bao, "Physics Education Research: A Research Based Framework for Sustainable Education Improvement," Higher Education Forum, TongJi University, ShangHai, November, 2008
80. L. Bao, "K-12 Science Education and Education Research," BoYa Colloquium, HuaZhong Normal University, Wuhan, November, 2008.
81. L. Bao, "Physics Education Research," Annual Meeting of the Education Committee of the Chinese Physical Society, Peking University, Beijing, November, 2008.
82. L. Bao, "Science Education and Education Research," Forum on Physics Education and Teacher Training, Beijing Normal University, Beijing, November, 2008.
83. L. Bao, "Assessment of Learning: Review on Methodology," IPERC Workshop, Beijing Jiaotong University, Beijing, November, 2008.
84. L. Bao, "Assessment of Scientific Reasoning," Center for Research on College Science Teaching and Learning, Michigan State University, September, 2008.
85. L. Bao, "Cross Culture Comparison of Student Content Knowledge and Reasoning Ability," AAPT Summer Meeting 2008.
86. L. Bao, "Student Learning/Reasoning Ability and Content Knowledge," Wright State University, March 2008.
87. L. Bao, "Understanding Quantitative Assessment: Probability Frames and Methods," University of Maryland, November, 2007.
88. L. Bao, Plenary Talk -- "Measurement and Cognitive Modeling," Biennial Meeting for Foundations and Frontiers of Physics Education Research, Bar Harbor, Maine, 2007.
89. L. Bao, "Comparing the probabilistic frameworks of popular quantitative education measurement methods," AAPT Summer Meeting 2007.
90. L. Bao, "Cognitive Modeling and Measurement in Education Research," Center for Learning Science, Southeast University, Nanjing, China, July, 2007
91. L. Bao, "Research and Measurement Methodology in Physics Education," GuangXi Normal University, Guilin, China, July, 2007
92. L. Bao, "Modeling Quantitative Assessment Data," Tsinghua University, Beijing, China, June, 2007
93. L. Bao, "Physics Education Research and Quantitative Assessment," BeiJing Normal University, Beijing, China, June, 2007
94. L. Bao, "Physics Education Research: An Interdisciplinary Field of Research," BeiJing JiaoTong University, Beijing, China, June, 2007
95. L. Bao, "Model Analysis: Representing and Assessing the Dynamics of Student Learning," APS April Meeting, Jacksonville Florida, April 15-17, 2007
96. L. Bao, "Theoretical Analysis of Models and Methods for Quantitative Assessment," AAPT Summer Meeting 2006.
97. L. Bao, "Introduction to Model Analysis," University of Toledo, Oct. 2005.
98. L. Bao, "Physics Education Research at The Ohio State University," Tsinghua University, Beijing China, Aug. 2005.
99. L. Bao, "Research in Physics Education: An Overview," Nanjing University, Nanjing China, Aug. 2005.
100. L. Bao, "Research and Development in Physics Education," China-Japan-US Symposium on Physics Education and Experiment in University, Hangzhou China, Aug. 2005.
101. L. Bao, "Physics Principles in Modeling Education Assessment," AAPT Summer Meeting, 2005
102. L. Bao, N. Reay, and L. Pengfei "Formative Use of In-Class Polling Technology in Physics Lectures," AAPT Summer Meeting, 2005
103. L. Bao, "Theoretical and Experimental Approaches in Physics Education Research," Invited Seminar, University of Washington, May 2005.

- 104.L. Bao, "Formative Use of In-class Polling Technology in Physics Lectures," Invited Seminar, Rutgers University, April 2005.
- 105.L. Bao, "Model Analysis: a Framework for Cognitive Representation and Educational Assessment," Physics Colloquium, North Carolina State University, Nov. 2004.
- 106.L. Bao, "Model Analysis as a Method for Cognitive Representation and Measurement," *AAPT Announcer* 34 (2) 90 (Aug. 2004).
- 107.L. Bao, "Recent Advancement in Physics Education Research," Symposium on Physics Research and Education, Nanjing, China, Aug. 2004.
- 108.L. Bao, "Formative Assessment: Theory, Methodology and Applications," Fifth National Competition of Multi-Media and Internet Materials for Physics Education, ShiJiaZhuang, China, Aug. 2004. Keynote Speech.
- 109.L. Bao, "Internet and Virtual Reality Technology for Teaching Science," Rainbow Education Research Institute, ShuZhou, China, Aug. 2004.
- 110.L. Bao, "Education Research in US," Department of Education, ShengZheng BaoShang District, China, Aug. 2004.
- 111.L. Bao, "Computational Modeling of the Learning Process: A neural net simulation of students' learning of charge distribution and polarization," University of Maryland, Oct. 2003.
- 112.L. Bao, "Virtual Reality in the Teaching and Learning of Physics," China Physics Society (CPS) Autumn Annual Meeting, HeFei, China, Sept. 2003.
- 113.L. Bao, "Recent Advancement in Physics Education Research: Theories and Experiments," Physics Colloquium, SouthEast University, Nanjing, China, Aug. 2003.
- 114.L. Bao, "Current Research Issues and Advancement in Physics Education Research," International Conference on Physics Education Research and Reform, JiAn, China, Aug. 2003. Keynote Speech.
- 115.L. Bao, "Model Analysis and Education Assessment," *AAPT Announcer* 33 (2) 90 (Aug. 2003).
- 116.L. Bao, "Cognitive Representations: Philosophy and Design of Measurement," *AAPT Announcer* 32 (2) 143 (Aug. 2002).
- 117.L. Bao, "States and Perturbations of Cognitive Processes in Learning Quantum Mechanics," Gordon Research Conferences, June, 2002, *Physics Research And Education: Quantum Mechanics*.
- 118.L. Bao, "Quantum Cognition: Are we ready?" AAPT National Conference, January, 2002, *Announcer* 31 (4) 67.
- 119.L. Bao, "Research on Physics Education," International Conference on Physics Education Research and Reform, Hangzhou, China, April 1997.
- 120.L. Bao, "Physics of Flash Memory and Applications in Instruction of Quantum Mechanics", University of Maryland, September 2000.
- 121.L. Bao, "Introduction to Model Analysis," University of Washington, November 1999.
- 122.L. Bao, "Dynamics of Student Modeling and Assessment Method," Rutgers University, October 1999.
- 123.L. Bao, "Model Analysis: A Quantitative Approach to Study Student Understandings of Physics," Syracuse University, May 1999.

Contributed Conference Presentations:

1. Lan Yang, Lei Bao (January, 2024). "The Conceptual Framework Model for Knowledge Integration and Deep Learning in Physics," AAPT Winter Meeting.
2. Lei Bao, Lan Yang, Kathleen Koenig, (January, 2024). "The iSTAR Framework for Modeling and Assessing Scientific Reasoning," AAPT Winter Meeting.
3. Krista Wood, Kathleen Koenig, Lei Bao, (July, 2023). "Scientific Reasoning in a Two-Year College Introductory Physics Lab Course," AAPT Summer Conference.
4. Kathleen Koenig, Krista Wood, and Lei Bao, (April, 2023). Modifying your labs to promote scientific reasoning skills, Southern Ohio Section of AAPT Spring meeting.
5. Xiangqun Zhang, Lei Bao, (January, 2022). Instruction to Improve Student Understanding of Gravity and Weight, AAPT Winter Meeting.
6. Kathleen Koenig, Lei Bao, (July, 2021). Comparing In-person and Online Physics Labs for Developing Scientific Reasoning, AAPT Summer Meeting.
7. Xiangqun Zhang, Lei Bao, (July, 2021). The Conceptual Development of Student Understanding of Weight, AAPT Summer Meeting.
8. Kathleen Koenig, Krista E. Wood, Lei Bao, (Jan., 2021). Online Labs: Learning Scientific Reasoning Skills, AAPT Winter Meeting.
9. Krista E. Wood, Kathleen Koenig, Lei Bao, (Jan., 2021). Teaching Scientific Reasoning through Synchronous Online Physics Labs, AAPT Winter Meeting
10. Lei Bao, Joseph Fritchman, Kathleen Koenig, (July, 2020). The Conceptual Framework Approach for Modeling Deep Learning in Physics, AAPT Summer Meeting.
11. Lei Bao, Joseph Fritchman, Kathleen Koenig, (July, 2020). Assessment of Knowledge Integration in Learning Physics, AAPT Summer Meeting.
12. Yue Xiao, Jian Wen Xiong, Lei Bao, (July, 2020). Assessment of Knowledge Integration in Learning Geometric Optics, AAPT Summer Meeting.

13. Yue Xiao, Jian Wen Xiong, Lei Bao, (July, 2020). Teaching Geometric Optics Through Drawing Ray Diagrams, AAPT Summer Meeting.
14. Yikun Han, Feipeng Pi, Lei Bao, (July, 2020). Assessment of Student Learning of the Hand Rules in Electromagnetism, AAPT Summer Meeting.
15. Yikun Han, Feipeng Pi, Lei Bao, (July, 2020). Evaluation of Student Understanding of the Hand Rules in Electromagnetism, AAPT Summer Meeting.
16. Krista E. Wood, Kathleen Koenig, Lei Bao, (Jan., 2020). Investigating Student Reasoning in Theory Evidence Coordination, AAPT Winter Meeting, Orlando, FL.
17. Kathleen Koenig, Krista E. Wood, Lei Bao, (Jan., 2020). Promoting Theory-Evidence Coordination through Scaffolded Question Prompts, AAPT Winter Meeting, Orlando, FL
18. Lei Bao, Kathleen Koenig, Yang Xiao, Zhaona Zhou, Jing Han, (July, 2019). Modeling and Assessing Scientific Reasoning, AAPT Summer Meeting, Provo, UT.
19. Lei Bao, Kathleen Koenig, Yang Xiao, Zhaona Zhou, Jing Han, (July, 2019). iSTAR: An Assessment Instrument on Scientific Thinking and Reasoning, AAPT Summer Meeting, Provo, UT.
20. Krista Wood, Kathleen Koenig, Lei Bao, (July, 2019). Supporting Claims with Evidence: Scaffolding Student Lab Writing, AAPT Summer Meeting, Provo, UT.
21. Larry J. Bortner, Kathleen Koenig, Krista Wood, Lei Bao, (July, 2019). Using Staggered Post-Testing to Improve Targeted Scientific Reasoning Skills, AAPT Summer Meeting, Provo, UT.
22. Haoli Zhuang, Jianwen Xiong, Lei Bao, (July, 2019). Nature of Science in Chinese High School Physics Textbooks, AAPT Summer Meeting, Provo, UT.
23. Yang Xiao, Haoli Zhuang, Jing Han, Jianwen Xiong, Lei Bao, (July, 2019). Evaluating Assessment Construct of Concept Inventories in Pre- and Post-test, AAPT Summer Meeting, Provo, UT.
24. Anthony Crawford, Kathleen Koenig, Krista Wood, Lei Bao, (July, 2019). Assessing Multi-variable Reasoning, AAPT Summer Meeting, Provo, UT.
25. Yang Xiao, Kathleen Koenig, Jing Han, Lei Bao, (July, 2019). A Methodology for Developing and Validating Equivalent Short Concept Inventories, AAPT Summer Meeting, Provo, UT.
26. Wood, K., Koenig, K., & Bao, L., (January, 2019). Assessment of Scientific Reasoning Sub-skill: Control of Variables, AAPT winter meeting, Houston, TX.
27. Koenig, K., Wood, K., Bortner, L., & Bao, L. (January, 2019). Using Assessments to Develop Thinking Habits and Determine Lab Effectiveness, AAPT winter meeting, Houston, TX.
28. Wilke, E., Koenig, K., Wood, K., & Bao, L. (July, 2018). Advancing Middle School Students' Ability to Control Variables, AAPT summer meeting, Washington, DC.
29. Wood, K., Koenig, K., Bortner, L., Owens, L., & Bao, L. (July, 2018). From Traditional to Scientific Reasoning Labs in Introductory Physics, AAPT summer meeting, Washington, DC.
30. Bortner, L., Koenig, K., Wood, K., Owens, L., & Bao, L. (July, 2018). Transforming Introductory Physics Labs: Implementing Scientific Reasoning Instruction, AAPT summer meeting, Washington, DC.
31. Owens, L., Koenig, K., & Bao, L. (July, 2018). Interference of Control of Variable Skills with Causal Reasoning, AAPT summer meeting, Washington, DC.
32. Koenig, K., Zydney, J., Hord, C. & Bao, L. (January, 2018). Fostering Student Abilities to Synthesize Information in Scientific Inquiry, AAPT Winter Meeting, San Diego, CA.
33. Koenig, K., Bortner, L., Wood, K., Owens, L., & Bao, L. (January, 2018). Using Introductory Physics Labs to Promote Scientific Reasoning: Implementation and Dissemination, AAPT Winter Meeting, San Diego, CA.
34. Zydney, J., Koenig, K., Hord, C. & Bao, L. (2017). Best Practices in Developing a Universally Designed Assessment on Scientific Reasoning. EdMedia World Conference on Educational Media & Technology- Association for the Advancement of Computing in Education (AACE), Washington DC.
35. Owens, L., Koenig, K., & Bao, L. (July, 2017). Identifying Three Common Difficulties in Causal Reasoning Using Think-Aloud Protocols. American Association of Physics Teachers Conference, Cincinnati, OH.
36. Lindsay Owens, Kathy Koenig, & Lei Bao, "Common Difficulties in Causal Reasoning," 2017 AAPT Winter Meeting, Atlanta Georgia, January, 2017.
37. Krista Wood, Kathy Koenig, & Lei Bao, "Effect of Scientific Reasoning Curriculum for Different Prior COV Ability," 2017 AAPT Winter Meeting, Atlanta Georgia, January, 2017.
38. Lindsay Owens, Kathy Koenig, & Lei Bao, "Identify Difficulties in Causal Reasoning," 2017 AAPT Winter Meeting, Atlanta Georgia, January, 2017.
39. Joeseeph Fritchman, Zhao Fu, Jing Han, & Lei Bao, "Practical Application of a Web-based Personal Response System," 2016 Summer AAPT Meeting, Sacramento, California, July, 2016.
40. Jing Han, Zhao Fu, Joseph Fritchman, & Lei Bao, "Usage of Web-based Personal Response System," 2016 Summer AAPT Meeting, Sacramento, California, July, 2016.
41. Kathleen Koenig, Krista Wood, Lei Bao, Carol. Fabby, & Lindsay Owens, "Developing Scientific Reasoning: Targeted Physics Instruction for STEM Majors," 2016 Summer AAPT Meeting, Sacramento, California, July, 2016.
42. Krista Wood, Kathy Koenig, & Lei Bao, "Scientific Reasoning Curriculum Effect on Students' Control of Variables Skills," 2016 Summer AAPT Meeting, Sacramento, California, July, 2016.

43. Lindsay Owens, Kathy Koenig, & Lei Bao, "Identify Student Difficulties in Causal Reasoning," 2016 Summer AAPT Meeting, Sacramento, California, July, 2016.
44. Kathleen M. Koenig & Lei Bao, "Student Difficulties in Synthesizing Information in Scientific Inquiry," 2016 AAPT Winter Meeting: New Orleans, January, 2016.
45. Lindsay Owens, Lei Bao & Kathy Koenig, "Developing Questions to Assess Causal and Correlational Reasoning Abilities," 2015 Summer AAPT Meeting, College Park, Maryland, July, 2015.
46. Nianle Wu, Tianfangcai, Lei Bao, "Teaching and Learning of Relativity," OCPA 8, Singapore (2014).
47. Lei Bao, From Clickers to Web Clicker: The New Generation Mobile and Internet based Classroom Response System, Ohio-AAPT (May 2014).
48. Koenig, K. & Bao, L. (April 2014). Developing student scientific reasoning abilities in a first semester introductory lab course, Learning Assistant Regional Workshop, Chicago, IL.
49. Koenig, K., Bortner, L., Fabby, C. & Bao, L. (January 2013). Promoting scientific reasoning abilities in the introductory physics lab course. American Association of Physics Teachers Conference, New Orleans, LA.
50. Koenig, K., Fabby, C., Huard, Z., & Bao, L. (July 2013). Exploring attributes of college courses that develop scientific reasoning abilities, American Association of Physics Teachers National Conference, Portland, OR.
51. Fabby, C., Koenig, K., Huard, Z., & Bao, L. (July 2013). Impact of Targeted Scientific Reasoning in the Introductory Physics Lab, American Association of Physics Teachers National Conference, Portland, OR.
52. Lei Bao, Shaona Zhou, Jing Han, Amy Raplinger, and Kathleen Koenig, "Assessment of Student Reasoning in Control of Variables," NARST Annual Meeting, Indianapolis, Indiana (2012).
53. Kathleen Koenig, Lei Bao, Melissa Schen, "Using Specialized Instruction to Develop Scientific Reasoning Abilities in Teacher Candidates," NARST Annual Meeting, Indianapolis, Indiana (2012).
54. Lei Bao & Aaron M. Adair, "Probing the Origins of Students' Naïve Preconceptions: Force and Motion" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
55. Aaron M. Adair & Lei Bao, "Project Based Learning: A Review and an Implementation" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
56. Aaron M. Adair, Jing Han & Lei Bao, "Using a Roller Coaster to Teach Physics: A PBL Implementation" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
57. Carol Fabby, Kathleen Koenig & Lei Bao, "Reforming the Introductory Physics Laboratory to Impact Scientific Reasoning Abilities" AAPT 2012 Summer Meeting, Philadelphia, Pennsylvania (2012)
58. Kathleen Koenig, Carol Fabby, Lei Bao, "Importance of Scientific Reasoning Abilities: Should this Influence Our Teaching?" AAPT Winter Meeting, Ontario, California (2012)
59. Shaona Zhou , Hua Xiao, Jing Han , Yuan Pi , Lei Bao, "Students' Understanding of the Concept of Sampling" AAPT Summer Meeting: Omaha, Nebraska (2011)
60. Li Chen, Jing Han, Liangyu Peng, Yan Tu, Lei Bao, "The impact of sample size in using IRT with FCI," AAPT Summer Meeting: Omaha, Nebraska (2011).
61. Jiawu Fan, Shaona Zhou, Chunhui Du, Jing Han, Lei Bao, "The Impact of Virtual Experiments on Students' Reasoning in Physics" AAPT Summer Meeting: Omaha, Nebraska (2011).
62. Jiawu Fan, Shaona Zhou, Chunhui Du, Jing Han, Lei Bao, "Using virtual experiments to help student reasoning in physics" AAPT Summer Meeting: Omaha, Nebraska (2011)
63. Lei Bao, Jing Han, Kathy Koenig, and Tianfang Cai, "Assessment of Scientific Reasoning: A Case in Probabilistic Reasoning," AAPT Winter Meeting: Jacksonville, FL (2011).
64. Li Chen, Jing Han, Jing Wang, Yan Tu, Lei Bao, "Comparison of Item Response Theory Methods," AAPT Winter Meeting: Jacksonville, FL (2011).
65. Li Chen, Jing Han, Jing Wang, Yan Tu, Lei Bao, "Item Response Theory: A Comparison of Algorithms," AAPT Winter Meeting: Jacksonville, FL (2011).
66. Lei Bao, Jing Han, Guiqing Xu, Yibing Zhang, and Kathleen M. Koenig, "Large Scale Assessment of Scientific Reasoning," AAPT Summer Meeting: Portland, Oregon (2010).
67. Jing Han, Guiqing Xu, Li Chen, Kathleen M. Koenig and Lei Bao, "Developing Assessment Instruments on Scientific Reasoning," AAPT Summer Meeting: Portland, Oregon (2010).
68. Kathleen M. Koenig and Lei Bao, "Developing Scientific Reasoning in Middle School Students", AAPT Summer Meeting: Portland, Oregon (2010).
69. Kathleen M. Koenig, Michael Edwards, Lei Bao, "Motivating First-Year College Students to Continue as a Science Major," AAPT Summer Meeting: Portland, Oregon (2010).
70. Lin Ding, Neville W. Reay, Lei Bao, and Albert H. Lee, "The Role of Conceptual Scaffolding in Students' Solving Synthesis Problems," AAPT Summer Meeting: Portland, Oregon (2010).
71. Nathaniel Caldwell, Jing Han, Lei Bao, "Interactive Tutorial for Developing Scientific Reasoning," AAPT Summer Meeting: Portland, Oregon (2010).
72. Tom Carter, Albert H. Lee, Lin Ding, Neville W. Reay, and Lei Bao, "Clicker Question Exchange for Introductory Physics Classes", AAPT Summer Meeting: Portland, Oregon (2010).
73. Kathy Koenig, Melissa Schen, Sachiko Tosa, and Lei Bao, "The Development of Scientific Reasoning Abilities in Pre-service Teachers," AAPT Winter Meeting: Washington DC (2010)

74. Kathleen M. Koenig, Michael Edwards, Douglas Bradley-Hutchison, and Lei Bao, "Using an Innovative Skills-based Course To Improve First Year Retention," AAPT Winter Meeting: Washington DC (2010)
75. Jing Han, Tianfang Cai, Kathy Koenig, Jing Wang, Lei Bao, "Exploring the Effects of Cultural Backgrounds on Student Attitudes on Learning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
76. Jing Han, Tianfang Cai, Kathy Koenig,, Jing Wang,, Lei Bao, "Cross Cultural Comparison of Students' Attitudes on Learning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
77. Jing Wang, Tianfang Cai, Kathy Koenig, Jing Han, Lei Bao, "The Developmental Trend of Scientific Reasoning Skills" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
78. Lin Ding Neville Reay, Albert Lee, Lei Bao, "Why Don't We Bring into Play Diverse Problems?" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
79. Young-Jin Lee, Lei Bao, David E Pritchard, "Modeling How Pre/Post Gain Depends on Prior Knowledge" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
80. Mark Schober, Hugh Ross, Kathleen Koenig, Lei Bao, " Correlation Analysis of High School Students' Coursework and Reasoning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
81. Xiumei Feng, Tianfang Cai, Ying Luo, Kathy Koenig, Lei Bao, "Item Analysis of Gender Difference on Scientific Reasoning Test" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
82. Albert H. Lee, Lin Ding, Neville W. Reay, Lei Bao, Tom Carter, "Exchange of Clicker Questions for Your Introductory Physics Classes" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
83. Neville W. Reay, Lin Ding, Albert Lee, Lei Bao, "Developing, Validating and Evaluating Clicker Question Sequences" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
84. Lin Ding, Neville Reay, Albert Lee, Lei Bao, "From Conceptual Understanding to Problem Solving" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
85. Tianfang Cai, Jing Wang, Jing Han, Kathy Koenig, Lei Bao, "Development of Standardized Instruments for Assessment of Scientific Reasoning" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
86. Jing Wang, Tianfang Cai, Kathy Koenig, Jing Han, Lei Bao, "Developmental Convergence of Scientific Reasoning Skills" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
87. Xiumei Feng, Ying Luo, Tianfang Cai, Kathy Koenig, Lei Bao, "Comparing Gender Differences in Introductory Physics Between U.S. and China" AAPT Summer Meeting: Ann Arbor, Michigan (2009)
88. Lei Bao, Tianfang Cai, Jing Wang, Jing Han, Kathy Koenig, "Cross Culture Comparison of Assessment Results in Scientific Reasoning," AAPT Winter Meeting 2009.
89. Jing Han, Tianfang Cai, Xiumei Feng, Kathy Koenig, Lei Bao, "Teachers' Views on Science Learning and Reasoning," AAPT Winter Meeting 2009.
90. Jing Han, Tianfang Cai, Jing Wang, Kathy Koenig, Lei Bao, "Survey of Views on Science Learning and Reasoning," AAPT Winter Meeting 2009.
91. Tianfang Cai, Jing Han, Jing Wang, Xiumei Feng, Lei Bao, "Item and Skill Dimension Analysis of Scientific Reasoning Assessment Instruments," AAPT Winter Meeting 2009.
92. Jing Wang, Jing Han, Xiumei Feng, Kathy Koenig, Lei Bao, "Statistical analysis of developmental data of scientific reasoning ability," AAPT Winter Meeting 2009.
93. Jing Wang, Jing Han, Xiumei Feng, Kathy Koenig, Lei Bao, "Validity and reliability of Lawson's classroom test of scientific reasoning," AAPT Winter Meeting 2009.
94. Kathy Koenig, Tianfang Cai, Jing Wang, Jing Han, Lei Bao, "Lawson Classroom Test of Scientific Reasoning Scores and Student Background," AAPT Winter Meeting 2009.
95. Kathy Koenig, Tianfang Cai, Jing Wang, Jing Han, Lei Bao, "Connections between student backgrounds and scientific reasoning scores," AAPT Winter Meeting 2009.
96. Xiumei Feng, Tianfang Cai, Jing Wang, Kathy Koenig, Lei Bao, "A Developmental Scale of Gender Difference in Scientific Reasoning," AAPT Winter Meeting 2009.
97. Tianfang Cai, Xiumei Feng, Jing Han, Kathy Koenig, Lei Bao, "Dimensional Analysis of Gender Difference in Scientific Reasoning," AAPT Winter Meeting 2009.
98. Lei Bao, Tianfang Cai, Jing Wang, Jing Han, and Kathy Koenig, "On the Measurement of Scientific Reasoning Ability: A Developmental Perspective," AAPT Summer Meeting 2008.
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276. Michel. C. Wittmann, Lei Bao, Richard N. Steinberg, and E. F. Redish, "Curriculum Development to Address Student Difficulties with Models of Conductivity," *AAPT Announcer* 29 (2), (Aug. 1999)
277. Edward F. Redish, Lei Bao, and Richard N. Steinberg, "Student mental models of conductivity," *AAPT Announcer* 28 (2), 92 (July 1998)
278. Lei Bao, Edward F. Redish, and Richard N. Steinberg, "Seeing the Invisible: A new quantum tutorial with LED's," *AAPT Announcer* 28 (2), 106 (July 1998)
279. Lei Bao, et al., "Activity-Based Modern Physics: Introducing Quantum Mechanics to Undergraduate Science Majors," AOK Regional AAPT, Tulsa OK, Nov. 1999
280. Lei Bao, Edward F. Redish, and Richard N. Steinberg, "Student Models in Learning Modern Physics," PERC Meeting (Pre-meeting for AAPT on Physics Education), Lincoln, NE, Aug, 1998.
281. Lei Bao and E. F. Redish, "Study Classical Probability with Video," *AAPT Announcer* 29 (2), 102 (Aug. 1999)
282. Lei Bao, "The Bouncing Ball: An MBL Demonstration of the Period Doubling Approach to Chaos," *AAPT Announcer* 26 (2), 97 (July 1996)
283. Lei Bao, Pratibha Jolly, and Edward F. Redish, "Student Difficulties with Quantum Mechanics," *AAPT Announcer* 26 (2), 70-71 (July 1996)
284. Edward F. Redish, Lei Bao, and Pratibha Jolly, "Student difficulties with energy in quantum mechanics," *AAPT Announcer* 26 (4), 80 (Dec. 1996).
285. Lei Bao, Zhonghan Woo, "Change the Objective of Mid-level Science Education from University Entrance Rate to Quality and Ability Fostering," Third US/Japan/China Conference on Physics Education, ZhaoQing, China, July, 1993.

Workshops:

1. Koenig, K., Wood, K. & Bao, L. (March 3, 2024). Scientific Reasoning Labs. Virtual workshop for The Organization for Physics at Two-Year Colleges (OPTYC). (Invited collaboration workshop)
2. K. Keonig, K., Wood, L. Bao, "Modifying Introductory Labs to Target Scientific Reasoning and Decision-Making Abilities," *AAPT Summer Meeting*, Provo, UT, July, 2019
3. L. Bao, "Science Inquiry and Assessment in STEM Education," Invited Workshop, Tongji University, Shanghai, China, July, 2017.
4. L. Bao, "Active Learning Environment for the 21st Century STEM Education," Invited Workshop, University of Electronic Science and Technology of China, Chengdu, China, July, 2017.
5. L. Bao, "Science Inquiry and Flipped Classroom," Fudan Summer School for Physics Education Research, Fudan University, Shanghai, China, July, 2015.
6. L. Bao, "Develop Reasoning through Scientific Inquiry," Tokyo University of Agriculture & Technology & Science Council of Japan, Tokyo, July, 2015.
7. L. Bao, "Developing Scientific Reasoning Skills," Beijing Jiaotong University, Beijing, China, July, 2014
8. L. Bao, "Science Inquiry and the 21st Century Education," Beijing Jiaotong University, Beijing, China, June, 2013.
9. L. Bao, "Developing Effective Scientific Reasoning and Problem Solving Skills," Strengthening Teaching and Learning in the STEM Fields, LASPAU, Harvard University, June, 2012.
10. L. Bao, "Interactive Classroom Environment and Inquiry Based Learning," 2010 International Physics and Science Education Research Forum, the Annual Meeting of Chinese Society of Education, Physics Education Committee, August, 2010.
11. L. Bao, "Research in Physics Education: Theory and Methodology," 4-day workshop presented at the Science Education Institute of GuangXi Normal University, Guilin, China, July, 2007.
12. Lei Bao and Neville Reay, "Model Analysis: Theoretical Basis and Methodology for Developing Effective Assessment," *AAPT-PERC Summer Meeting*, 2005.

13. Lei Bao, "Using Voting Machine Systems as a Tool for In-class Formative Assessment," SouthEast University, Nanjing, China, Aug. 2004.
14. Lei Bao and Edward F. Redish, "Model Analysis: Theoretical Basis and Methodology for Developing Effective Assessment," *AAPT Announcer* 33 (2) 60 (Aug. 2003).
15. Lei Bao and Edward F. Redish, "Model Analysis: Theoretical Basis and Methodology for Developing Effective Assessment," *AAPT Announcer* 32 (2) 62 (Aug. 2002).
16. "Visual Quantum Mechanics and Quantum Tutorials", AAPT Workshop, July 2000.
17. "Physics Education Research and Instruction in Modern Physics / Quantum Mechanics", CSAAPT Workshop, UMBC, May 1998.
18. "Tutorials on Teaching Waves in Introductory Physics", CSAAPT Workshop, UVA, Nov. 1998.
19. "Tutorials in Teaching Introductory Physics," Workshops at Dickinson College for the Summer Seminar on Teaching Introductory Physics Using Interactive Methods and Computers, June 1995, June 1996 and June 1997.