Martina A. Rau *Curriculum Vitae*

Office address

University of Wisconsin-Madison
Department of Educational Psychology
1025 W. Johnson St.
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Formal education

2010 - 2013 Human-Computer Interaction HCI Institute, Carnegie Mellon University, Pittsburgh, PA, USA;
Degree: Ph.D.;
Ph.D. Certificates from Associate in Program for Interdisciplinary Education Research (PIER) and from the Pittsburgh Science of Learning Center (PSLC).
Thesis title: *Conceptual learning with multiple graphical representations: Intelligent tutoring systems support for sense-making and fluency-building processes.*

2008 - 2010 Human-Computer Interaction HCI Institute, Carnegie Mellon University, Pittsburgh, PA, USA
Degree: Master of Science.

2006 - 2009 Psychology at the Albert-Ludwigs-University Freiburg, Germany;
Degree: Dipl.-Psych., equivalent to Master of Science

2004 - 2006 Psychology at the Albert-Ludwigs-University Freiburg, Germany;
Degree: Vordiplom in Psychology, equivalent to Bachelor of Science

Academic positions

Since 2019 Associate Professor in the Department of Educational Psychology,
University of Wisconsin-Madison

2013 - 2019 Assistant Professor in the Department of Educational Psychology,
University of Wisconsin-Madison

Affiliations

2014 - current Affiliate Professor in the Department of Computer Sciences,
University of Wisconsin-Madison

Honors & awards

2019 NAEd/Spencer Postdoctoral Fellowship

2018 Best Student Paper Nomination at the 13th International Conference of the Learning Sciences (ICLS 2018), with doctorate student Sally Wu

2018 NAEd/Spencer Postdoctoral Fellowship Semifinalist

2018 VIP (Visiting International Professor) award by the Ruhr-Universität Bochum, Germany to outstanding scientists from around the globe to foster long-lasting international collaborations.

2017 CAREER award by the National Science Foundation

2016 Best Paper Nomination at the 9th International Conference on Educational Data Mining (EDM 2016)

2013 Best Paper Nomination at the 2013 SIGCHI Conference on Human Factors in Computing Systems (CHI 2013)

2013 Best Paper Award at the 6th International Conference on Educational Data Mining (EDM 2013)

2013 Siebel Scholar, Class of 2013: Awarded annually for academic excellence and demonstrated leadership to 85 top students from the world's leading graduate schools.

2009 Best Student Paper Award at the 14th International Conference on Artificial Intelligence in Education (AIED 2009)

Research & Publications

(* indicates peer-reviewed publications; ° signifies work prior to UW-Madison; bold indicates my own name; italicized names indicate students)

Publications in Journals

1. * **Rau, M. A.**, Zahn, M., Misback, E., Herder, T., & Burstyn, J. (in press). Adaptive Support for Representational Competencies during Technology-Based Problem Solving in Chemistry. *Journal of the Learning Sciences*. doi: 10.1080/10508406.2021.1888733
2. * *Wu, S. P.*, Vanveen, B. & **Rau, M. A.** (in press). How Drawing Prompts Can Increase Cognitive Engagement in an Active Learning Engineering Course. *Journal of Engineering Education*, *109*(4), 723-742. doi: https://doi.org/10.1002/jee.20354
3. * **Rau, M. A.,** Keesler, W., Zhang, Y., & *Wu, S.* (2020). Resolving Design Tradeoffs of Interactive Visualization Tools for Educational Technologies. *IEEE Transactions on Learning Technologies, 13*(2), 326-339. doi:10.1109/TLT.2019.2902546
4. * **Rau, M. A.,** (2020). Comparing Multiple Theories about Learning with Physical and Virtual Representations: Conflicting or Complementary Effects? *Educational Psychology Review, 32*, 297-325. doi: 10.1007/s10648-020-09517-1
5. * *Mason, B.*, **Rau, M. A.**, & Nowak, R. (2019). Modeling Implicit Knowledge about Visual Representations with Similarity Learning Methods. *Cognitive Science, 43*(9), e12744. doi: https://doi.org/10.1111/cogs.12744
6. * *Wu, S. P.*, & **Rau, M. A.** (2019). How students learn content in Science, Technology, Engineering, and Mathematics (STEM) through drawing activities. *Educational Psychology Review, 31*(1), 87-120. doi: https://doi.org/10.1007/s10648-019-09467-3
7. * *Wu, S. P., Corr, J. &* **Rau, M. A.** (2019). How instructors frame students' interactions with educational technologies can enhance or reduce learning with multiple representations. *Computers & Education, 128*, 199-213. doi: https://doi.org/10.1016/j.compedu.2018.09.012
8. * **Rau, M. A.**, & *Wu, S. P. W.* (2018). Combining instructional activities for sense-making processes and perceptual-induction processes involved in connection-making among multiple visual representations. *Cognition and Instruction, 36*(4), 361-395. doi: https://doi.org/10.1080/07370008.2018.1494179
9. * **Rau, M. A.** (2018a). Making connections among multiple visual representations: How do sense-making competencies and perceptual fluency relate to learning of chemistry knowledge? *Instructional Science, 46*(2), 209-243. doi: 10.1007/s11251-017-9431-3
10. * **Rau, M. A.** (2018b). Sequencing Sense-Making Support and Fluency-Building Support for Connection Making among Multiple Visual Representations. *Journal of Educational Psychology, 110*(6), 811-833. doi: http://dx.doi.org/10.1037/edu0000229
11. * *Wu, S. P. W.,* & **Rau, M. A.** (2018). The effectiveness and efficiency of adding drawing prompts to an interactive educatio2nal technology when learning with conventional visual representations. *Learning and Instruction, 55*, 93-104. doi: https://doi.org/10.1016/j.learninstruc.2017.09.010
12. * **Rau, M. A.** (2017a). Conditions for the effectiveness of multiple visual representations in enhancing STEM learning. *Educational Psychology Review, 29*(4), 717–761. doi:10.1007/s10648-016-9365-3
13. * **Rau, M. A.** (2017b). A framework for discipline-specific grounding of educational technologies with multiple visual representations. *IEEE Transactions on Learning Technologies, 10*(3), 290-305. doi: 10.1109/TLT.2016.2623303
14. * **Rau, M. A.** (2017c). How do Students Learn to See Concepts in Visualizations? Social Learning Mechanisms with Physical and Virtual Representations. *Journal of Learning Analytics, 4*(2), 240–263. doi: http://dx.doi.org/10.18608/jla.2017.42.16

15. * **Rau, M. A.** (2017d). Do knowledge-component models need to incorporate representational competencies? *International Journal of Artificial Intelligence in Education*, 27(2), 298-319. doi: 10.1007/s40593-016-0134-8

16. * ° **Rau, M. A.,** Aleven, V., & Rummel, N. (2017a). Making connections among multiple graphical representations of fractions: sense-making competencies enhance perceptual fluency, but not vice versa. *Instructional Science, 45*(3), 331-357. doi: 10.1007/s11251-017-9403-7

17. * ° **Rau, M. A.,** Aleven, V., & Rummel, N. (2017b). Supporting Students in Making Sense of Connections and in Becoming Perceptually Fluent in Making Connections among Multiple Graphical Representations. *Journal of Educational Psychology, 109*(3), 355-373. doi: http://dx.doi.org/10.1037/edu0000145

18. * **Rau, M. A.**, *Bowman, H. E.*, & Moore, J. W. (2017). An adaptive collaboration script for learning with multiple visual representations. *Computers & Education, 109*(C), 38-55. doi: http://dx.doi.org/10.1016/j.compedu.2017.02.006

19. * **Rau, M. A.**, & Matthews, P. G. (2017). How to make 'more' better? Principles for effective use of multiple representations to enhance student learning. *ZDM - Mathematics Education. 49*(4), 491-496. doi: 10.1007/s11858-017-0846-8

20. * **Rau, M. A.**, *Kennedy, K., Oxtoby, L., Bollom, M.,* & Moore, J., (2017). Unpacking "active learning" interventions: A combination of flipped classroom and collaboration support is more effective but collaboration support alone is not. *Journal of Chemical Education, 94*(10), 1406–1414. doi: 10.1021/acs.jchemed.7b00240

21. * **Rau, M. A.** (2015). Enhancing Undergraduate Chemistry Learning by Helping Students Make Connections among Multiple Graphical Representations. *Chemistry Education Research and Practice, 16*, 654-669. doi: 10.1039/C5RP00065C

22. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2015). Successful learning with multiple graphical representations and self-explanation prompts. *Journal of Educational Psychology, 107*(1), 30-46. doi: 10.1037/a0037211

23. * **Rau, M. A.**, *Michaelis, J. E.*, & *Fay, N.* (2015). Connection making between multiple graphical representations: A multi-methods approach for domain-specific grounding of an intelligent tutoring system for chemistry. *Computers and Education*, 82, 460-485. doi: 10.1016/j.compedu.2014.12.009

24. * ° **Rau, M. A.**, Aleven, V., Rummel, N., & Pardos, Z. (2014). How Should Intelligent Tutoring Systems Sequence Multiple Graphical Representations of Fractions? A Multi-Methods Study. *International Journal of Artificial Intelligence in Education*, 24(2), 125-161. doi: 10.1007/s40593-013-0011-7

25. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2013). Interleaved practice in multi-dimensional learning tasks: which dimension should we interleave? *Learning and Instruction*, 23, 98-114. doi: 10.1016/j.learninstruc.2012.07.003

Chapters in Books

26. Rau, M. A. (2020). Cognitive and socio-cultural theories on competencies and practices involved in learning with multiple representations. Van Meter, P., List, A., Lombardi, D., & Kendeou (Eds.), *Handbook of Learning from Multiple Representations and Perspectives.* New York: Routledge.

27. Rau, M. A. & Moore, J. (2020). Flipped classrooms and collaborative support in chemistry. Mintzes, J. J. & Walter, E. M. (Eds.), *Active Learning in College Science: The Case for Evidence-Based Practice* (pp. 567-582). Dordrecht, Netherlands: Springer.

28. Rau, M. A. (2018). Supporting representational competences through adaptive educational technologies. In K. Halverson Daniel (Ed.), *Towards a Framework for Representational Competence in Science Education* (pp. 103-132). Dordrecht, Netherlands: Springer.

29. Rau, M. A. (2016). Supporting students' learning with multiple visual representations. In J. C. Horvath, J. Lodge & J. A. C. Hattie (Eds.), *From the Laboratory to the Classroom: Translating the Learning Sciences for Teachers* (pp. 155-171). New York, NY: Routledge Press.

Publications in Peer-Reviewed Conference Proceedings

30. * **Rau, M. A.**, Moore, J. & Burstyn, J. (2020). Do Affordances of Classroom Furniture Affect Learning in Undergraduate Active-Learning Courses? In M. Gresalfi & I. S. Horn (Eds.), *The Interdisciplinarity of the Learning Sciences (ICLS) 2020* (Vol. 2, pp. 967-974). Nashville, TN: International Society of the Learning Sciences.

31. * **Rau, M. A.**, *Sen, A.*, & Zhu, X. (2019). Using Machine Learning to Overcome the Expert Blind Spot for Perceptual Fluency Trainings. In M. E. Isotani S., Ogan A., Hastings P., McLaren B., Luckin R. (Ed.), *Artificial Intelligence in Education. AIED 2019. Lecture Notes in Computer Science* (Vol. 11625, pp. 406-418). Cham: Springer.

32. * **Rau, M. A.**, & *Schmidt, T.* (2019). Disentangling Conceptual and Embodied Mechanisms for Learning with Virtual and Physical Representations. In M. E. Isotani S., Ogan A., Hastings P., McLaren B., Luckin R. (Ed.), *Artificial Intelligence in Education. AIED 2019. Lecture Notes in Computer Science* (Vol. 11625, pp. 419-431). Cham: Springer.

33. * **Rau, M. A.**, *Zahn, M.*, Misback, E., & Burstyn, J. (2019). Adaptive Support for Representation Skills in a Chemistry ITS Is More Effective Than Static Support. In M. E. Isotani S., Ogan A., Hastings P., McLaren B., Luckin R. (Ed.), *Artificial Intelligence in Education. AIED 2019. Lecture Notes in Computer Science* (Vol. 11625, pp. 432-444). Cham: Springer.

34. * **Rau, M. A.**, & *Patel, P.* (2018). A Collaboration Script for Nonverbal Communication Enhances Perceptual Fluency with Visual Representations. In J. Kay & R. Luckin (Eds.), *Rethinking Learning in the Digital Age. Making the Learning Sciences Count (ICLS) 2018* (Vol. 1, pp. 272-279). London, UK: International Society of the Learning Sciences.

35. * **Rau, M. A.**, & *Zahn, M.* (2018). Sequencing Support for Sense Making and Perceptual Fluency with Visual Representations: Is There a Learning Progression? In J. Kay & R. Luckin (Eds.), *Rethinking Learning in the Digital Age. Making the Learning Sciences Count (ICLS) 2018* (Vol. 1, pp. 264-271). London, UK: International Society of the Learning Sciences.

36. * *Sen, A., Purav, P.*, **Rau, M.A.**, *Mason, B.*, Nowak, R., Rogers, T., & Zhu, X. (2018). Machine Beats Human at Finding the Optimal Sequence of Visual Representations for Students Learning of Perceptual Fluency. In K. E. Boyer & M. Yudelson (Eds.), *Proceedings of the 11th International Conference on Educational Data Mining* (pp. 137-146). Buffalo, NY: International Educational Data Mining Society.

37. * *Wu, S. P. &* **Rau, M. A.** (2018). Collaboration Scripts Should Focus on Shared Models, Not on Drawings, to Help Students Translate Between Representations. In J. Kay & R. Luckin (Eds.), *Rethinking Learning in the Digital Age. Making the Learning Sciences Count (ICLS) 2018* (Vol. 1, pp. 504-511). London, UK: International Society of the Learning Sciences. **Best Student Paper Nomination.**

38. * **Rau, M. A.**, & *Wu, S. P. W.* (2017). Educational Technology Support for Collaborative Learning With Multiple Visual Representations in Chemistry. In B. K. Smith, M. Borge, E. Mercier & K. Y. Lim (Eds.), *Making a Difference: Prioritizing Equity and Access in CSCL, 12th International Conference on Computer Supported Collaborative Learning (CSCL) 2017* (Vol. 1, pp. 79-86). Philadelphia, PA: International Society of the Learning Sciences.

39. * Sharma, K., Jermann, P., Dillenbourg, P., **Rau, M.**, Pardos, Z., Schneider, B., D'Angelo, S., Gergle, D., & Prieto, L. (2017). CSCL and Eye-tracking: Experiences, Opportunities and Challenges. In B. K. Smith, M. Borge, E. Mercier & K. Y. Lim (Eds.), *Making a Difference: Prioritizing Equity and Access in CSCL, 12th International Conference on Computer Supported Collaborative Learning (CSCL) 2017* (Vol. 2, pp. 727-734). Philadelphia, PA: International Society of the Learning Sciences.

40. * *Wu, S. P. W.*, & **Rau, M. A.** (2017). How Technology and Collaboration Promote Formative Feedback: A Role for CSCL Research in Active Learning Interventions. In B. K. Smith, M. Borge, E. Mercier & K. Y. Lim (Eds.), *Making a Difference: Prioritizing Equity and Access in CSCL, 12th International Conference on Computer Supported Collaborative Learning (CSCL) 2017* (Vol. 1, pp. 279-286). Philadelphia, PA: International Society of the Learning Sciences.

41. * **Rau, M. A.** (2016). Social, Perceptual, and Conceptual Factors of Learning With Multiple External Representations in Educational Technologies. In C.-K. Looi, J. Polman, U. Cress & P. Reimann (Eds.), *Proceedings*

of the International Conference of the Learning Sciences 2016 (Vol. 2, pp. 1378-1379). Singapore: ISLS.

42. * **Rau,** M. A. (2016). Pattern mining uncovers social prompts of conceptual learning with physical and virtual representations. In S. Barnes, M. Chi & M. Feng (Eds.), *Proceedings of the 9th International Conference on Educational Data Mining* (pp. 478-483). Raleigh, NC: International Educational Data Mining Society.

43. * **Rau, M. A.**, *Mason, B.*, & Nowak, R. (2016). How to model implicit knowledge? Use of metric learning to assess student perceptions of visual representations. In T. Barnes, M. Chi & M. Feng (Eds.), *Proceedings of the 9th International Conference on Educational Data Mining* (pp. 199-206). Raleigh, NC: International Educational Data Mining Society. **Best Paper Nomination.**

44. * **Rau, M. A.**, & Pardos, Z. A. (2016). Adding eye-tracking AOI data to models of representation skills does not improve prediction accuracy. In S. Barnes, M. Chi & M. Feng (Eds.), *Proceedings of the International Conference on Educational Data Mining* (pp. 622-623). Raleigh, NC: International Educational Data Mining Society.

45. * **Rau, M. A.**, *Wu, S. P., & Schuberth, J.* (2016). Sequencing physical representations with human tutors and virtual representations with a computer tutor in chemistry. In C.-K. Looi, J. Polman, U. Cress & P. Reimann (Eds.), *Proceedings of the International Conference of the Learning Sciences 2016* (Vol. 2, pp. 1173-1174). Singapore: ISLS.

46. * *Peterson, J.,* Pardos, Z., **Rau, M. A.**, *Swigart, A., Gerber, C., & McKinsey*, *J.* (2015). Understanding Student Success in Chemistry Using Gaze Tracking & Pupillometry. In C. Conati, N. Heffernan, A. Mitrovic & M. F. Verdejo (Eds.), *Artificial Intelligence in Education* (pp. 358–366). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-19773-9_36

47. * **Rau, M. A.** (2015). Why Do the Rich Get Richer? A Structural Equation Model to Test How Spatial Skills Affect Learning with Representations. In J. G. Boticario, O. C. Santos, C. Romero, M. Pechenizkiy, A. Merceron, P. Mitros, J. M. Luna, C. Mihaescu, P. Moreno, A. Hershkovitz, S. Ventura & M. Desmarais (Eds.), *Proceedings of the 8th International Conference on Educational Data Mining* (pp. 350-357).

48. * **Rau, M. A.**, & *Wu, S. P. W.* (2015). ITS Support for Conceptual and Perceptual Processes in Learning with Multiple Graphical Representations. In C. Conati, N. Heffernan, A. Mitrovic & M. F. Verdejo (Eds.), *Artificial Intelligence in Education* (pp. 398–407). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-19773-9_40

49. * **Rau, M. A.**, & *Evenstone, A. L.* (2014). Multi-Methods Approach for Domain-Specific Grounding: An ITS for Connection Making in Chemistry. In S. Trausan-Matu et al. (Ed.), *Proceedings of the 12th International Conference on Intelligent Tutoring Systems* (pp. 426-435).

50. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2014). Sequencing Sense-Making and Fluency-Building Support for Connection Making between Multiple Graphical Representations. In J. L. Polman, E. A. Kyza, D. K. O'Neill, I. Tabak, W. R. Penuel, A. S. Jurow, K. O'Connor, T. Lee & L. D'Amico (Eds.), *Learning and Becoming in Practice: The International Conference of the Learning Sciences (ICLS) 2014* (Vol. 2, pp. 977-981). Boulder, CO: International Society of the Learning Sciences.

51. * ° **Rau, M. A.**, Aleven, V., Rummel, N., & Rohrbach, S. (2013). Why Interactive Learning Environments can have it all: Resolving design conflicts between competing stakeholder goals. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 109-118). doi: 10.1145/2470654.2470670 **Best Paper Nomination.**

52. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2013). Complementary effects of sense-making and fluency-building support for connection making: A matter of sequence? In H. C. Lane, K. Yacef, J. Mostow & P. Pavlik (Eds.), *Artificial Intelligence in Education* (pp. 329-338). Berlin Heidelberg: Springer. doi: 10.1007/978-3-642-39112-5_34

53. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2013). How to use multiple graphical representations to support conceptual learning? Research-based principles in the Fractions Tutor. In H. C. Lane, K. Yacef, J. Mostow

& P. Pavlik (Eds.), *Artificial Intelligence in Education* (pp. 762-765). Berlin Heidelberg: Springer. doi: 10.1007/978-3-642-39112-5_107

54. * ° **Rau, M. A.**, Scheines, R., Aleven, V., & Rummel, N. (2013). Does Representational Understanding Enhance Fluency – Or Vice Versa? Searching for Mediation Models. In S. K. D'Mello, R. A. Calvo & A. Olney (Eds.), *Proceedings of the 6th International Conference on Educational Data Mining* (EDM 2013) (pp. 161-169). **Best Paper Award.**

55. * ° Carlson, R., Genin, K., **Rau, M.**, & Scheines, R. (2013). Student Profiling from Tutoring System Log Data: When do Multiple Graphical Representations Matter? In S. K. D'Mello, R. A. Calvo & A. Olney (Eds.), *Proceedings of the 6th International Conference on Educational Data Mining (EDM 2013)* (pp. 12-20).

56. * ° Hayashi, E., **Rau, M. A.**, Neo, Z. H., Tan, N., Ramasubramanian, S., & Paulos, E. (2012). TimeBlocks: mom, can I have another block of time? *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1713-1716). New York, NY: ACM.

57. * ° Matlen, B., Atit, K., Goksun, T., **Rau, M.**, & Ptouchkina, M. (2012). Representing Space: Exploring the Relationship between Gesturing and Geoscience Understanding in Children. In C. Stachniss, K. Schill & D. Uttal (Eds.), *Spatial Cognition VIII* (Vol. 7463, pp. 405-415). Berlin Heidelberg: Springer Berlin Heidelberg. doi: 10.1007/978-3-642-32732-2_26

58. * ° **Rau, M.**, Aleven, V., Rummel, N., & Rohrbach, S. (2012). Sense Making Alone Doesn't Do It: Fluency Matters Too! ITS Support for Robust Learning with Multiple Representations. In S. Cerri, W. Clancey, G. Papadourakis & K. Panourgia (Eds.), *Intelligent Tutoring Systems* (Vol. 7315, pp. 174-184). Berlin / Heidelberg: Springer. doi: 10.1007/978-3-642-30950-2_23

59. * ° **Rau, M. A.**, & Pardos, Z. A. (2012). Interleaved Practice with Multiple Representations: Analyses with Knowledge Tracing Based Techniques. In Yacef, K., Zaïane, O., Hershkovitz, H., Yudelson, M., and Stamper, J. (Eds.), *Proceedings of the 5th International Conference on Educational Data Mining*. (pp. 168-171).

60. * ° **Rau, M. A.**, & Scheines, R. (2012). Searching for Variables and Models to Investigate Mediators of Learning from Multiple Representations. In Yacef, K., Zaïane, O., Hershkovitz, H., Yudelson, M., and Stamper, J. (Eds.), *Proceedings of the 5th International Conference on Educational Data Mining*. (pp. 110-117).

61. * ° **Rau, M.**, Rummel, N., Aleven, V., Pacilio, L., & Tunc-Pekkan, Z. (2012). How to schedule multiple graphical representations? A classroom experiment with an intelligent tutoring system for fractions. In J. van Aalst, K. Thompson, M. J. Jacobson & P. Reimann (Eds.), *The future of learning: Proceedings of the 10th international conference of the learning sciences (ICLS 2012)* – Volume 1, Full Papers (pp. 64-71). Sydney, Australia: ISLS.

62. * ° Feenstra, L., Aleven, V., Rummel, N., **Rau, M. A.**, & Taatgen, N. (2011). Thinking with Your Hands: Interactive Graphical Representations in a Tutor for Fractions Learning. *Lecture Notes in Computer Science*, 6738, 453-455.

63. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2010). Blocked versus Interleaved Practice With Multiple Representations in an Intelligent Tutoring System for Fractions. In V. Aleven, J. Kay, & J. Mostow (Eds.), *Proceedings of the 10th International Conference of Intelligent Tutoring Systems* (pp. 413-422). Heidelberg / Berlin: Springer.

64. * ° **Rau, M. A.**, Aleven, V., & Rummel, N. (2009). Intelligent Tutoring Systems with Multiple Representations and Self-Explanation Prompts Support Learning of Fractions. In V. Dimitrova, R. Mizoguchi, & B. du Boulay (Eds.), *Proceedings of the 14th International Conference on Artificial Intelligence in Education* (pp. 441-448). Amsterdam, the Netherlands: IOS Press. **Best Student Paper Award.**

Research support

2019 - 2022 Principal Investigator on *Learning Internal Visualization Skills for Complex Engineering Concepts*

in Active Learning Classes, National Science Foundation, IUSE, #1933078;
Overall **$300,000.**

2020 - 2021 Co-Investigator on *An investigation of the Use of Representations in Early Childhood*, with Hala Ghouseeini; CRECE;
Overall **$29,997.**

2019 - 2020 Principal Investigator on *Educational-technology support for development of visual representation literacy in electrical engineering students*, Wisconsin Alumni Research Fund / WARF;
Overall **$57,935.**

2019-2021 Principal Investigator on *Collaboration Support for Learning with Visual Representations in Undergraduate Chemistry*, National Academy of Education / Spencer Postdoctoral Fellowship;
Overall **$70,000.**

2017 - 2022 Principal Investigator on *CAREER: Intelligent Representations: How to Blend Physical and Virtual Representations by Adapting to the Individual Student's Needs in Real Time*, National Science Foundation, Cyberlearning, #1651781;
Overall **$598,399.**

2016 - 2019 Principal Investigator on *EXP: Modeling perceptual fluency with visual representations in an intelligent tutoring system for undergraduate chemistry*, together with Co-Investigators Jerry Zhu (University of Wisconsin-Madison, Department of Computer Sciences) and Rob Nowak (University of Wisconsin-Madison, Department of Electrical and Computer Engineering), National Science Foundation, Cyberlearning, #1623605;
Overall **$549,392.**

2016 - 2019 Principal Investigator on *Supporting chemistry learning with adaptive support for connection making between graphical representations in a cognitive tutoring system*, together with Co-Investigator Judith Burstyn (University of Wisconsin-Madison, Department of Chemistry), National Science Foundation, Improving Undergraduate STEM Education (IUSE), # 1611782;
Overall **$599,829.**

2015 - 2020 Co-Investigator on *LUCID: A project-focused cross-disciplinary graduate training program for data-enabled research in human and machine learning and teaching,* together with Principal Investigator Tim Rogers (University of Wisconsin-Madison, Department of Psychology) and Co-Investigators Martha Alibali (University of Wisconsin-Madison, Department of Psychology), Rob Nowak (University of Wisconsin-Madison, Department of Electrical and Computer Engineering), Jerry Zhu (University of Wisconsin-Madison, Department of Computer Sciences), National Science Foundation / NRT Data-Enabled Science and Engineering, # 1545481;
Overall **$2,999,737.**

2016 - 2018 Cooperation Partner on *Enhancing the development of magnitude conceptions for fractions in middle school - behavioral effects and neural correlates,* together with Principal Investigator Andreas Obersteiner (University of Freiburg, Germany) and Co-Investigator Thomas Dresler (University of Tübingen, Germany), Deutsche Forschungsgesellschaft;
Overall **359,882 Euro.**

2016 - 2017 Principal Investigator on *Adaptive support for connection making among multiple visual representations in chemistry*, Wisconsin Alumni Research Fund / WARF;
Overall **$45,227.**

2015 - 2016 Co-Investigator on *Active learning*, together with John Moore (University of Wisconsin-Madison, Department of Chemistry), University of Wisconsin - Madison / Educational Innovation Small Grant;
Overall **$7,060.**

2015 - 2016 Principal Investigator on *Intelligently combining physical and virtual representations in educational technologies,* Wisconsin Center for Education Research (WCER) Faculty Research Support Award;

Overall **$6000.**

2015 - 2016 Principal Investigator on *Intelligent representations: How to integrate physical and virtual representations by adapting to the individual student's needs in real time,* Wisconsin Alumni Research Fund / WARF;
Overall **$42,073.**

2014 - 2015 Principal Investigator on *Learning with multiple, interactive graphical representations in organic chemistry,* Wisconsin Alumni Research Fund / WARF;
Overall **$53,642.**

2014 - 2015 Principal Investigator on *CAP: Student Travel Support for the 7th Int. Conference on Educational Data Mining,* National Science Foundation, Cyberlearning, #1445401;
Overall **$20,000.**

PRESENTATIONS

Invited Talks (external)

1. **Rau, M. A.** (2020). Individual and Collaborative Learning of Representational Competencies in College Chemistry. Invited talk in the Educational Psychology Institute at the Ruhr-Universität Bochum, Germany.
2. **Rau, M. A.** (2019). Teasing apart conceptual and embodied mechanisms of learning chemistry concepts with virtual and physical representations. Invited talk in the Educational Psychology Institute at the Ruhr-Universität Bochum, Germany.
3. **Rau, M. A.** (2018). Learning with Multiple Visual Representations. Invited talk in the Educational Psychology Institute at the Ruhr-Universität Bochum, Germany.
4. **Rau, M. A.** (2018). Helping students learn chemistry by supporting their representational competencies. Talk at invited symposium at the 2018 National Association for Research in Science Teaching (NARST) Annual International Conference in Atlanta, GA.
5. **Rau, M. A.** (2018). Technology-based support for students' representational competencies improves their learning of chemistry concepts. Invited talk at the 255th National Meeting of the American Chemical Society in New Orleans, LA.
6. **Rau, M. A.** (2018). How to support students in build intuitions about visual representations in chemistry? Invited talk at the Learning Sciences Research Institute at the University of Illinois at Chicago.
7. **Rau, M. A.** (2017). The use of educational data mining to investigate students' learning with visual representations. Invited talk at Harvard, Cambridge, MA.
8. **Rau, M. A.** (2017). Learning with adaptive support for making connections between visual representations. Invited talk at the Gordon Research Conference on Chemical Education Research and Practice, Lewiston, ME.
9. **Rau, M. A.** (2017). Technology-support learning with visual representations. Invited talk at the Ludwigs-Maximilians Universität, Munich, Germany.
10. **Rau, M. A.** (2017). Adaptive educational technologies to support learning with visual representations. Invited talk at Arizona State University, Tempe, AZ
11. **Rau, M. A.** (2017). Using educational technologies to help students acquire representational competencies: Research on math and chemistry learning. Invited talk at Berkeley.
12. **Rau, M. A.** (2017). How can adaptive educational technologies help students learn with visual representations? Invited talk at Stanford, CA.
13. **Rau, M.A.** (2016). Conceptual and perceptual competencies in learning with visual representations: Lessons learned from research on elementary-school fractions and undergraduate chemistry learning. Invited talk at

Carnegie Mellon University, Pittsburgh, PA.

14. **Rau, M.A.** (2016). Q&A – Things I wish I had known before becoming an assistant professor. Invited talk at Carnegie Mellon University, Pittsburgh, PA.
15. **Rau, M.A.** (2014). How can we help learners make connections between multiple representations? Support for conceptual and perceptual learning processes in an intelligent tutoring system for chemistry. Invited talk at the Ruhr-Universität Bochum, Germany.
16. **Rau, M. A.**, Aleven, V., & Rummel, N. (2014). How to use multiple graphical representations to support conceptual learning? Research-based principles in the Fractions Tutor. Talk given at the 2014 Annual Meeting of the American Educational Research Association, Washington, DC.
17. **Rau, M. A.** (2013). Searching for mediation models in intelligent tutoring systems data: representational understanding enhances representational fluency - but not vice versa. Invited talk at the Research Colloquium at the College of Computing and Digital Media at DePaul University, Chicago, IL.
18. **Rau, M. A.** & Scheines, R. (2013). Causal Model Search in Educational Research. Invited talk at the Workshop on Case Studies of Causal Discovery with Model Search at Carnegie Mellon University, Pittsburgh, PA.

Invited Talks (internal)

19. **Rau, M. A.** (2019). Using Machine Learning to Overcome the Expert Blind Spot for Perceptual Fluency Trainings. Invited talk at the annual eLUCID8 conference, University of Wisconsin - Madison.
20. **Rau, M. A.** (2019). Teasing apart conceptual and embodied mechanisms of learning chemistry concepts with virtual and physical representations. Invited talk in the Interdisciplinary Training Program Seminar, University of Wisconsin - Madison.
21. **Rau, M. A.** (2019). Publishing International Research: From Idea to Paper(s). Invited talk in the School of Education International Publication Workshop, University of Wisconsin - Madison.
22. **Rau, M. A.,** Zahn, M., & Schuster, H. (2017). Learning with Representations in Educational Technologies. Talk given at the Fall 2017 Board of Visitors Meeting, University of Wisconsin - Madison.
23. **Rau, M. A.** & Moore, J. (2016). Evaluating an Active Learning Intervention in Chem 109. Talk given at the Department of Chemistry Teacher's Meeting, University of Wisconsin - Madison.
24. **Rau, M. A.** (2016). Learning with Visual Representations: An Intelligent Tutoring System for Chemistry. Talk given at the LUCID Liftoff event, University of Wisconsin - Madison.
25. Hubbard, E., Matthews, P., & **Rau, M. A.** (2014). Leveraging the Rational Brain to Promote Fractions Competence. Invited talk at the Wisconsin Center for Education Research 50th anniversary meeting.

Peer Reviewed Conference Presentations, Session & Panel Discussions

26. **Rau, M.**, Aleven, V., & Rummel, N. (2013). Resolving design conflicts between competing goals in educational technologies. Talk given at the 15h biennial EARLI Conference, Munich, Germany.
27. **Rau, M.**, Aleven, V., & Rummel, N. (2013). Support for sense making and fluency in learning with multiple representations. Talk given at the 15h biennial EARLI Conference, Munich, Germany.
28. **Rau, M. A.** (2013). Sense-making support alone doesn't do it: fluency matters too! Support for learning with multiple representations. Talk given at the inter-Science of Learning Center Conference, February 2013.
29. **Rau, M. A.**, Aleven, V., & Rummel, N. (2011). How to schedule multiple graphical representations? A classroom experiment with an intelligent tutoring system for fractions. Talk given at the Society for Research on Educational Effectiveness Fall 2011 Conference, Washington, D.C.
30. **Rau, M. A.**, Tunc-Pekkan, Z. Pacilio, L., Aleven, V., & Rummel, N. (2011). Facilitating the Representational Fluency and Flexibility through Sequencing Multiple Graphical Representations. Talk given at the 14th bien-

nial EARLI Conference, Exeter, U.K.

31. **Rau, M. A.**, Aleven, V., & Rummel, N. (2010). Blocked versus Interleaved Practice with Multiple Graphical Representations of Fractions. Talk given at the International EARLI Special Interest Group on Text and Graphics Comprehension, Tübingen, Germany.
32. **Rau, M. A.**, Aleven, V., & Rummel, N. (2010). Supporting Learning with Multiple Graphical Representations with Intelligent Tutoring Technology. Talk given at the International EARLI Special Interest Group on Instructional Design and Learning with Computers, Ulm, Germany.

Teaching

Courses

2011	*How to Create Computer-Based Learning Materials: Principles and Practices* at the Institute of Educational Research, Ruhr-Universität Bochum, Germany.
2012	*Teaching and Learning with Multimedia* at the Institute of Educational Research, Ruhr-Universität Bochum, Germany.
2012	*Computer-Supported Collaboration* at the Institute of Educational Research, Ruhr-Universität Bochum, Germany.
2012	*Applications of the Classical Learning Theories* at the Institute of Educational Research, Ruhr-Universität Bochum, Germany.
2013 - 2018	*Introduction to Learning Sciences I*, taught every Fall Semester at the Department of Educational Psychology (EDPSYCH 795).
2014 - 2019	*Introduction to Learning Sciences II*, taught every Spring Semester at the Department of Educational Psychology (EDPSYCH 796).
2014	*Design of Intelligent Tutoring Systems* at the Department of Educational Psychology (EDPSYCH 711).
2015	*Educational Data Mining and Learning Analytics* at the Department of Educational Psychology (EDPSYCH 711).
2015	*Eye-tracking Research* at the Department of Educational Psychology (EDPSYCH 711).
2016	*Human-Computer Interactions* at the Departments of Computer Sciences, Psychology, and Educational Psychology (CS/PSYCH 770, EDPSYCH 711).
2016 - 2019	*Major Area Paper - A Course on Academic Writing*, taught every Spring Semester at the Department of Educational Psychology (EDPSYCH 711).

Workshops & Seminars

Moore, J., Rau, M. A., Kennedy, K., Oxtoby, L. (2016). Flip your general chemistry classroom the easy way. Webinar for Cengage Learning, November 1, 2016.

Shipley, T., Uttal, D., Rau, M. A. (2016). *Research at the Interface of DBER and Cognitive Science.* Workshop at the Earth Educators Rendezvous, Madison, WI, July 21-22, 2016.

Rau, M. A. (2014). *Multimedia Learning Principles.* Workshop at Thomas Jefferson Middle School, Madison, WI, January 16, 2014.

Short Lectures (internal & external)

Rau, M. A. (2018). *Log data of intelligent tutoring systems.* Lecture in Individual Learning and Problem Solving, Ruhr-Universität Bochum, German, June 12, 2018.

Rau, M. A. (2017). *Vlogging about your research.* Seminar for the LUCID graduate training program for data-enabled research in human and machine learning and teaching, University of Wisconsin - Madison, October 20, 2017.

Rau, M. A. (2015). *Translational research in educational psychology.* Lecture in Education Policy Across the

Disciplines for the Interdisciplinary Training Seminar in Education Sciences, University of Wisconsin - Madison, September 30, 2015.

Rau, M. A. (2014). *Educational Technologies.* Lecture in Human-Computer Interactions at the Computer Sciences Department, University of Wisconsin - Madison, November 6, 2014.

Rau, M. A. (2014). *Searching for mediation models in intelligent tutoring systems data: Representational understanding enhances representational fluency - but not vice versa.* Lecture in Models of Education Research for the Doctoral Research Program, University of Wisconsin - Madison, March 12, 2014.

SERVICE

Professional Activities

Member of Editorial Boards

International Journal of Artificial Intelligence in Education (since 2020)
Unterrichtswissenschaft (German Journal on Instructional Science) (since 2019)

Society Memberships

International Artificial Intelligence in Education Society
International Educational Data Mining Society, Publicity Chair for EDM 2018
International Society of the Learning Sciences, Member of Communication Committee since 2016, Co-chair since 2018
American Educational Research Association
Member of the Organizing committee of the 40th Annual Meeting of the Cognitive Science Society

Member of Program Committees

Artificial Intelligence in Education
Educational Data Mining (Senior member)
EATEL Summer School on Technology Enhanced Learning
International Conference on Artificial Intelligence in Education
International Conference on Educational Data Mining
ACM Conference on Intelligent User Interfaces

Peer-Review Activities for Journals and Books

Journal of Learning and Instruction
Journal of the Learning Sciences
International Journal of Artificial Intelligence in Education
International Journal of Science and Technology Education
International Journal of Technology-Enhanced Education
IEEE Transactions on Learning Technologies
Journal of Computers and Education
Chemistry Education Research and Practice
ZDM - Mathematics Education
Meetings of the Cognitive Science Society
International Conference on Artificial Intelligence in Education
International Conference on Educational Data Mining
International Conference on Intelligent Tutoring Systems
ACM Special Interest Group on Human-Computer Interaction

Grant Review Activities

National Science Foundation, CISE Directorate (2015, 2019)
Institute of Education Research (2017, Principal Member 2018-2021)
Canada Foundation for Innovation (2014)

Committees at UW-Madison

University / School of Education Committees

Organizing committee of the Wisconsin Ideas in Education Series (WIES): Academic years 2014/15,

2015/16
Education Graduate Research Scholars committee (Ed-GRS): Academic years 2015/16, 2016/17
Faculty Senate: Academic years 2014/15 (alternate), 2015/16, 2016/17 (alternate)
Global Education Committee: Academic years 2014/15, 2015/16, 2016/17, 2017/18, 2018/19

Departmental Committees

Recruitment, Admissions, Fellowships, and Awards Committee (Educational Psychology): Academic years 2014/15, 2015/16, 2018/19, Chair in 2020/21
Faculty/Staff Honors Committee (Educational Psychology): Academic years 2013/14, 2016/17, 2017/18
Chair Election Committee (Educational Psychology): Academic year 2017/18

Supervision of Students at UW-Madison

Joel Beier (Educational Psychology, since 2019)
Claudia Matta (Educational Psychology, since 2019)
Hanall Sung (Educational Psychology, since 2019)
Tiffany Herder (Educational Psychology, since 2018)
Purav Patel (Educational Psychology, 2017-2018)
Blake Mason (Electrical & Computer Engineering, coadvised with Robert Nowak since 2016)
Ayon Sen (Computer Sciences, coadvised with Jerry Zhu since 2016)
Nadia Al-Tabaa (Educational Psychology, 2016)
Sally Wu (Educational Psychology, since 2014)

Member of Master Committees at UW-Madison

Catherine Dornfeld-Tissenbaum (Educational Psychology - Learning Sciences)
Amanda Evenstone (Educational Psychology - Learning Sciences)
Yunji Park (Educational Psychology - Human Development)
Kelsey Schenck (Educational Psychology - Learning Sciences)
Zachari Swiecki (Educational Psychology - Learning Sciences)
Sally Wu (Educational Psychology - Learning Sciences)

Member of Prelim and PhD Committees at UW-Madison

Gol Arastoopour (Educational Psychology - Learning Sciences, graduated 2017)
Milijana Buac (Language Acquisition and Bilingualism, graduated 2019)
Jaclyn Brown (Chemistry, graduated 2014)
Catherine Dornfeld-Tissenbaum (Educational Psychology - Learning Sciences, graduated 2018)
Brian Gibson (Computer Sciences, graduated 2015)
Brendan Eagan (Educational Psychology - Learning Sciences, graduated 2020)
Amanda Evenstone (Educational Psychology - Learning Sciences, graduated 2020)
Laura Hobbes Legault (Computer Sciences, graduated 2018)
Jordan Thevenow-Harrison (Educational Psychology, graduated 2018)
Nicole Martin (Educational Psychology - Learning Sciences, graduated 2019)
Joe Michaelis (Educational Psychology - Learning Sciences, graduated 2019)
Elizabeth Pier (Educational Psychology, graduated 2017)
Lindsay Reiten (Curriculum & Instruction, graduated 2017)
Angela Samosorn (Curriculum & Instruction, graduated 2019)
Allison Sauppé (Computer Sciences, graduated 2015)
Ayon Sen (Computer Sciences)
Zachari Swiecki (Educational Psychology - Learning Sciences, graduated 2020)
Elizabeth Toomarian (Educational Psychology, graduated 2019)
Sally Wu (Educational Psychology - Learning Sciences, graduated 2019)