MEGAN WAWRO

Professor
Department of Mathematics
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EDUCATION

University of California, San Diego & San Diego State University	2007-2011	Ph.D.	Mathematics and Science Education
Miami University	2003-2005	M.A.	Mathematics
Cedarville University	1996-2000	B.A.	Mathematics

EMPLOYMENT

2023 - present	Professor, Department of Mathematics, Virginia Tech, Blacksburg, VA, USA
2016 - 2023	Associate Professor, Department of Mathematics, Virginia Tech, Blacksburg, VA
2011 - 2016	Assistant Professor, Department of Mathematics, Virginia Tech, Blacksburg, VA
2007 - 2011	Graduate Research Assistant, Department of Mathematics and Statistics, San Diego State University, San Diego, CA
2005 - 2007	Visiting Instructor, Department of Mathematics and Statistics, Miami University, Oxford, OH
2003 - 2005	Graduate Teaching Assistant, Department of Mathematics and Statistics, Miami University, Oxford, OH
2001 - 2003	Secondary Mathematics Teacher, Institut auf dem Rosenberg, St. Gallen, Switzerland
2000 - 2001	Art and Secondary Mathematics Teacher, Portsmouth East High School, Portsmouth, OH

AWARDS AND RECOGNITIONS

- *Presidential Early Career Award for Scientists and Engineers (PECASE)* recipient, 2019
- *National Science Foundation CAREER Award* through STEM Education Directorate, 2015-2022
- *Affiliate Faculty*, Virginia Tech School of Education Faculty of Teaching and Learning, 2014-present
- *Virginia Tech Thank-a-Teacher* note recipient, 2022, 2023
- *Best Paper Award* for the 16th Annual Conference on Research in Undergraduate Mathematics Education (RUME) with David Plaxco, 2013
- *STaR (Service, Teaching, and Research) Fellow,* a mentoring program for new faculty, 2012

GRANTS

- US National Science Foundation EDU Core Research, *Student Understanding of Linear Algebra across Quantum Information Science* (DRL-2500569), M. Wawro (PI), 2025-2028, Total award $499,502.
- National Science Foundation Improving Undergraduate STEM Education, *Collaborative Research: Extending Inquiry-Oriented Linear Algebra* (DUE-1915156, 1914841, 1914793), M. Wawro (lead PI), M. Zandieh and C.

Andrews-Larson (PIs), D. Plaxco (co-PI), 2019-2023, Total award $618,430.

- National Science Foundation Faculty Early Career Development Program, *CAREER: An Interdisciplinary Study of Learning: Student Understanding of Linear Algebra in Physics* (DUE-1452889), Megan Wawro (PI), 2015-2022, $779,686.
- National Science Foundation, *MPWR 2016 and Beyond: Fostering Sustainable Networks for Women in RUME* (DUE-1553278); J. Ellis (PI), S. Musgrave (co-PI), M. Wawro and E. Thanheiser (senior personnel), 2016-2020, $199,992. Serving as PI (DUE-1938495) for 2019-2022, $77,437.
- National Science Foundation Innovations in Undergraduate STEM Education, *MATH: EAGER Building a mathematical toolkit and motivation for success in the physical and quantitative sciences* (DUE-1544225), J. Sible (PI); K. Drezek, S. Lewis, M. Pleimling, A. Robinson (co-PIs), J. Simonetti, M. Wawro (senior personnel), 2015-2017, $296,996.
- National Science Foundation Transforming Undergraduate Education in STEM, *Collaborative Research: Developing Inquiry-Oriented Instructional Materials for Linear Algebra* (DUE-1245673, 1245796, and 1246083), M. Wawro (lead PI), M. Zandieh and C. Rasmussen (PIs), 2013-2017, Total award $179,949.
- National Science Foundation Transforming Undergraduate Education in STEM, *MPWR II: Mentoring and Partnerships for Women in RUME* (DUE-1457785), Jessica Ellis (PI); M. Wawro, E. Thanheiser, and S. Musgrave (senior personnel), 2014-2015, $49,986.
- National Science Foundation Transforming Undergraduate Education in STEM, *MPWR: Mentoring and Partnerships for Women in RUME* (DUE-1352990), M. Wawro (PI), J. Ellis and H. Soto-Johnson (senior personnel), 2013-2014, $44,148.
- National Science Foundation Robert Noyce Teach Scholarship, *Virginia Teach, Phase II: A Community-Based Approach to Serving Mathematics Students in Need* (DUE-1339947), C. Ulrich (PI), J. Wilkins, B. Kreye, A. Norton, and M. Wawro (co-PIs), 2013-2019, $800,000.
- National Science Foundation Robert Noyce Teach Scholarship, *Virginia Teach: Serving Mathematics Students in Need* (DUE-0832992), A. Norton (PI), J. Wilkins, B. Kreye, M. Wawro, C. Ulrich (co-PIs), 2008-2015, $890,307.
- Virginia Tech Office of the Provost, Faculty Writing Group Grant: *WRITE* (*Writers Researching, Innovating, and Teaching Each other*), T. Drape (convener), K. Carmichael, E. Johnson, C. S. Ovink, A. Reed, S. Tomer, & M. Wawro, 2024-2025, $2000.
- Virginia Tech Office of the Provost, Faculty Writing Group Grant: *WRITE* (*Writers Researching, Innovating, and Teaching Each other*), A. Reed (convener), K. Carmichael, T. Drape, E. Johnson, C. Labuski, S. Ovink, C. Robbins, S. Tomer, & M. Wawro, 2022-2023, $2000.
- Virginia Tech Office of the Provost, Faculty Writing Group Grant: *WRITE* (*Writers Researching, Innovating, and Teaching Each other*), E. Meitner (convener), S. Adams, K. Carmichael, C. Catalano, T. Drape, E. Johnson, C. Labuski, T. Lane, S. Ovink, A. Reed, C. Robbins, S. Tomer, & M. Wawro, 2020-2022, $2000.
- Virginia Tech Office of the Provost, Faculty Writing Group Grant: *WRITE (Women Researching, Innovating, and Teaching Each other*), K. Carmichael, T. Drape, E. Johnson, C. Labuski, E. Meitner, S. Ovink (convener), A. Reed, C. Robbins, S. Tomer, & M. Wawro (convener), 2018-2020, $4000.
- Virginia Tech Center for Innovation in Learning, *Innovation in Undergraduate Mathematics Education: Supporting Student-Centered Instruction*, M. Wawro (PI) and D. Plaxco (co-PI), 2013-2014, $10,000.
- Virginia Tech International Travel Supplement Grant: $2,000, 2015 (Czech Republic), 2012 (South Korea);

$1,700: 2018 (Norway), 2017 (Ireland), 2016 (France).

- Association for Women in Mathematics (AWM), AWM-NSF Travel Grant, 2013, $1500.
- Virginia Tech Mentoring Grant, 2011, $1,500.

PUBLICATIONS

Refereed journal articles

- Wawro, M., & Serbin, K. S. (2025). "What makes it eigen-esque-ish?": A form-function analysis of the development of eigentheory concepts in a quantum mechanics course. *Educational Studies in Mathematics, 119,* 287–310. https://doi.org/10.1007/s10649-025-10390-4
- Wawro, M., Pina, A., Thompson, J. R., Topdemir, Z., & Watson, K. (2025). Student interpretations of eigenequations in linear algebra and quantum mechanics. *International Journal of Research in Undergraduate Mathematics Education, 11,* 314–342. https://doi.org/10.1007/s40753-024-00241-7
- Serbin, K. S., & Wawro, M. (2024). Pedagogical moves related to analogy that support a unified understanding of eigentheory concepts in a quantum mechanics class. *Physical Review Physics Education Research, 20*(2), 020137. https://doi.org/10.1103/PhysRevPhysEducRes.20.020137
- Rasmussen, C., Wawro, M., & Zandieh, M. (2024). Integrated methodological approach for documenting individual and collective mathematical progress: Reinventing the Euler method algorithmic tool. *Education Sciences, 14*(3), 335. https://doi.org/10.3390/educsci14030335
- Mauntel, M., Wawro, M., & Plaxco, D. (2024). An inquiry-oriented approach to determinants. *PRIMUS,* 1–20. https://doi.org/10.1080/10511970.2024.2315134
- Serbin, K.S., & Wawro, M. (2024). The inextricability of students' mathematical and physical reasoning in quantum mechanics problems. *International Journal of Research in Undergraduate Mathematics Education, 10,* 57–86. https://doi.org/10.1007/s40753-022-00174-z
- Stewart, S., Axler, S., Beezer, R., Boman, E., Catral, M., Harel, G., McDonald, J., Strong, D., & Wawro, M. (2022). The Linear Algebra Curriculum Study Group (LACSG 2.0) recommendations. *Notices of the American Mathematical Society,* 69(5), 813–820. https://www.ams.org/notices/202205
- Serbin, K.S., Wawro, M., & Storms, R. (2021). Characterizations of student, instructor, and textbook discourse related to basis and change of basis in quantum mechanics. *Physical Review Physics Education Research, 17,* 010140. https://doi.org/10.1103/PhysRevPhysEducRes.17.010140
- Robinson, A., Simonetti, J.H., Richardson, K.L., & Wawro, M. (2021). Positive attitudinal shifts and a narrowing gender gap: Do expertlike attitudes correlate to higher learning gains for women in the physics classroom? *Physical Review Physics Education Research, 17,* 010101. https://doi.org/10.1103/PhysRevPhysEducRes.17.010101
- Serbin, K.S., Sanchez-Robayo, B.J., Truman, J., Watson, K., & Wawro, M. (2020). Characterizing quantum physics students' conceptual and procedural knowledge of the characteristic equation. *Journal of Mathematical Behavior, 58,* 100777. https://doi.org/10.1016/j.jmathb.2020.100777
- Wawro, M., Watson, K., & Christensen, W. (2020). Students' metarepresentational competence with matrix notation and Dirac notation in quantum mechanics. *Physical Review Physics Education Research, 16*, 020112. https://doi.org/10.1103/PhysRevPhysEducRes.16.020112
- Wawro, M., Watson, K., & Zandieh, M. (2019). Student understanding of linear combinations of eigenvectors.

ZDM Mathematics Education, 51, 1111–1123. https://doi.org/10.1007/s11858-018-01022-8

- Andrews-Larson, C., Wawro, M., & Zandieh, M. (2017). A hypothetical learning trajectory for conceptualizing matrices as linear transformations. *International Journal of Mathematical Education in Science and Technology, 48*(6), 809–829. https://doi.org/10.1080/0020739X.2016.1276225
- Zandieh, M., Wawro, M., & Rasmussen, C. (2017). An example of inquiry in linear algebra: The roles of symbolizing and brokering. *PRIMUS, 27*(1), 96–124. https://doi.org/10.1080/10511970.2016.1199618
- Wawro, M. (2015). Reasoning about solutions in linear algebra: The case of Abraham and the Invertible Matrix Theorem. *International Journal of Research in Undergraduate Mathematics Education, 1*(3), 315–338. https://doi.org/10.1007/s40753-015-0017-7
- Plaxco, D., & Wawro, M. (2015). Analyzing student understanding in linear algebra through mathematical activity. *Journal of Mathematical Behavior, 38*, 87–100. https://doi.org/10.1016/j.jmathb.2015.03.002
- Rasmussen, C., Wawro, M., & Zandieh, M**.** (2015). Examining individual and collective level mathematical progress. *Educational Studies in Mathematics, 88*(2), 259–281.https://doi.org/10.1007/s10649-014-9583-x
- Selinski, N., Rasmussen, C., Wawro, M., & Zandieh, M. (2014). A methodology for using adjacency matrices to analyze the connections students make between concepts: The case of linear algebra. *Journal for Research in Mathematics Education, 45*(5), 550–583. https://doi.org/10.5951/jresematheduc.45.5.0550
- Wawro, M. (2014). Student reasoning about the invertible matrix theorem in linear algebra. *ZDM Mathematics Education, 46*(3), 389–406. https://doi.org/10.1007/s11858-014-0579-x
- Wawro, M., Rasmussen, C., Zandieh, M, Sweeney, G., & Larson, C. (2012). An inquiry-oriented approach to span and linear independence: The case of the Magic Carpet Ride sequence. *PRIMUS, 22*(8), 577–599. https://doi.org/10.1080/10511970.2012.667516
- Becker, N., Rasmussen, C., Sweeney, G., Wawro, M., Towns, M., & Cole, R. (2012). Reasoning using particulate nature of matter: An example of a sociochemical norm in a university-level physical chemistry class. *Chemistry Education Research and Practice*, *14*, 81–94. https://doi.org/10.1039/C2RP20085F
- Cole, R., Becker, N., Towns, M., Sweeney, G., Wawro, M., & Rasmussen, C. (2012). Adapting a methodology from mathematics education research to chemistry education research: Documenting collective activity. *International Journal of Science and Mathematics Education, 10*(1), 193–211. https://doi.org/10.1007/s10763-011-9284-1
- Nemirovsky, R., Rasmussen, C., Sweeney, G., & Wawro, M. (2012). When the classroom floor becomes the complex plane: addition and multiplication as ways of bodily navigation. *Journal of the Learning Sciences, 21*(2), 287–323. https://doi.org/10.1080/10508406.2011.611445
- Wawro, M., Sweeney, G., & Rabin, J. M. (2011). Subspace in linear algebra: Investigating students' concept images and interactions with the formal definition. *Educational Studies in Mathematics, 78*(1), 1–19. https://doi.org/10.1007/s10649-011-9307-4

Refereed book chapters

- Wawro, M., Andrews-Larson, C., Zandieh, M., & Plaxco, D. (2022). Inquiry-Oriented Linear Algebra: Connecting design-based research and instructional change theory in curriculum design. In R. Biehler, M. Liebendörfer, G. Gueudet, C. Rasmussen, & C. Winsløw (Eds.), *Practice-Oriented Research in Tertiary Mathematics Education: New Directions* (pp. 329–348), Springer. https://doi.org/10.1007/978-3-031-14175-1_16

- Plaxco, D., & Wawro, M. (2022). Argumentation in the context of tertiary mathematics: A case study of classroom argumentation and the role of instructor moves. In K. Bieda, A.M. Connor, C. Kosko, & M. Staples (Eds.), *Conceptions and Consequences of Argumentation, Justification, and Proof* (pp. 219–237), Springer. https://doi.org/10.1007/978-3-030-80008-6
- Winsløw, C., Biehler, R., Jaworski, B., Rønning, F., & Wawro, M. (2021). Education and professional development of university mathematics teachers. In V. Durand-Guerrier, R. Hochmuth, E. Nardi, & C. Winsløw (Eds.), *Research and Development in University Mathematics Education: Overview produced by the International Network for Research on Didactics of University Mathematics* (pp. 59–79), Routledge. https://doi.org/10.4324/9780429346859-6
- Plaxco, D., Zandieh, M., & Wawro, M. (2018). Stretch directions and stretch factors: A sequence intended to support guided reinvention of eigenvector and eigenvalue. In S. Stewart, C. Andrews-Larson, A. Berman, & M. Zandieh (Eds.), *Challenges in Teaching Linear Algebra* (pp. 175–192), ICME-13 Monographs. Springer, Cham. https://doi.org/10.1007/978-3-319-66811-6_8
- Rasmussen, C., & Wawro, M. (2017). Post-calculus research in undergraduate mathematics education. In J. Cai, (Ed.), *The compendium for research in mathematics education* (pp. 551–579). NCTM.
- Wawro, M. (2016). Finding synergy among research, teaching, and service: An example from mathematics education research. In J. Dewar, P. Hsu, & H. Pollatsek (Eds.), *Mathematics Education: A Spectrum of Work in Mathematical Sciences Departments* (pp. 135–145). Springer. https://doi.org/10.1007/978-3-319-44950-0_10
- Wawro, M., Rasmussen, C., Zandieh, M., & Larson, C. (2013). Design research within undergraduate mathematics education: An example from introductory linear algebra. In T. Plomp, & N. Nieveen (Eds.), *Educational design research – Part B: Illustrative cases* (pp. 905–925). SLO.
- Rasmussen, C., Zandieh, M., & Wawro, M. (2009). How do you know which way the arrows go? The emergence and brokering of a classroom mathematics practice. In W.-M. Roth (Ed.), *Mathematical representation at the interface of body and culture* (pp. 171–218). Information Age Publishing.

Other refereed publications (expository pieces and book reviews)

- Boman, E., Axler, S., Beezer, R. A., Catral, M., McDonald, J., Stewart, S., Strong, D., Vega, O., & Wawro, M. (2023). Curriculum guide to majors in the mathematical sciences: Linear algebra course area report. maa.org/wp-content/uploads/2024/06/Linear-Algebra-Course-Area-Report-Aug-17-2023.pdf
- Wawro, M. (2019). Book review: Proceedings of INDRUM 2018, second conference of the international network for didactic research in university mathematics. *International Journal of Research in Undergraduate Mathematics Education, 5*(3), 424–429. https://doi.org/10.1007/s40753-019-00103-7
- Trigueros, M., & Wawro, M. (2019). Linear algebra teaching and learning. In S. Lerman (Ed.), *Encyclopedia of Mathematics Education.* Springer. https://doi.org/10.1007/978-3-319-77487-9_100021-1
- Wawro, M., Ellis, J., & Soto-Johnson, H. (2014). MPWR: Mentoring and partnerships for women in RUME. *Association for Women in Mathematics Newsletter, 44*(5), 20–23.

Open Educational Resources

- Wawro, M., Zandieh, M., Rasmussen, C., & Andrews-Larson, C. (2013). Inquiry oriented linear algebra: Course materials. Available at http://iola.math.vt.edu. This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

Refereed conference papers

- Wawro, M., Zandieh, M., & Bettersworth, Z. (in press). An inquiry-oriented approach to least squares in linear algebra. Paper presented at the Congress on European Research in Mathematics Education (CERME), Bolzano, Italy. *Proceedings of the Fourteenth Congress of European Research Society in Mathematics Education (CERME14)*. Free University of Bozen-Bolzano and ERME.
- Serbin, K. S., & Wawro, M. (2025). Pedagogical moves related to analogy that support a unified understanding of eigenequations in a quantum mechanics class. In S. Cook, B.P. Katz, & K. Melhuish (Eds.), *Proceedings of the 27th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 132–140). SIGMAA on RUME.
- Fukawa-Connelly, T., Weinberg, A., Wawro, M., & Johnson, E. (2025). Why are YOU in the RUME? In S. Cook, B.P. Katz, & K. Melhuish (Eds.), *Proceedings of the 27th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 371–378). SIGMAA on RUME.
- Truman, J., & Wawro, M. (2025). Student meanings for $\hbar/2$ in a quantum mechanics expectation value problem. In S. Cook, B.P. Katz, & K. Melhuish (Eds.), *Proceedings of the 27th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 608–615). SIGMAA on RUME.
- Plaxco, D., Le, L., Wawro, M., & Mauntel, M. (2025). Students' generalizing activity while using determinant applets. In S. Cook, B.P. Katz, & K. Melhuish (Eds.), *Proceedings of the 27th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 634–643). SIGMAA on RUME.
- Wawro, M. & Serbin, K. S. (2024). Form-function relations for eigentheory in quantum mechanics. In A. S. González-Martín, G. Gueudet, I. Florensa, & N. Lombard (Eds.), *Proceedings of the 5th Conference of the International Network for Didactic Research in University Mathematics* (p. 350–359). Escola Univeristària Salesiana de Sarrià – Univ. Autònoma de Barcelona and INDRUM.
- Fleischmann, Y., & Wawro, M. (2024). TWG 2: Teaching and learning of linear and abstract algebra. In A. S. González-Martín, G. Gueudet, I. Florensa, & N. Lombard (Eds.), *Proceedings of the 5th Conference of the International Network for Didactic Research in University Mathematics* (p. 235–239). Escola Univeristària Salesiana de Sarrià – Univ. Autònoma de Barcelona and INDRUM.
- Wawro, M., Mauntel, M., & Plaxco, D. (2023). Student reasoning about determinants with GeoGebra. In P. Drijvers, C. Csapodi, H. Palmér, K. Gosztonyi, & E. Kónya (Eds.), *Proceedings of the Thirteenth Congress of European Research Society in Mathematics Education* (pp. 2567–2568). Alfréd Rényi Institute of Mathematics; ERME.
- Biza, I., Viirman, O., Bašić, M., Florensa, I., Gueudet, G., Hitier, M., Kontorovich, I., Thoma, A., & Wawro, M. (2023). An introduction to TWG14: University mathematics education. In P. Drijvers, C. Csapodi, H. Palmér, C. Gosztonyi, & E. Kónya (Eds.), *Proceedings of the Thirteenth Congress of European Research Society in Mathematics Education* (pp. 2243–2250). Alfréd Rényi Institute of Mathematics; ERME.
- Wawro, M., Mauntel, M., & Plaxco, D. (2023). "The shape will have no volume": Relationships students observed about determinants in a dynamic geometric applet. In S. Cook, B. Katz, and D. Moore-Russo (Eds.), *Proceedings of the 25th Annual Conference on Research in Undergraduate Mathematics Education* (p. 403–411). SIGMAA on RUME.
- Wawro, M., Park, M., Zandieh, M., Bettersworth, Z., & Lee, I. (2023). Student reasoning about the least-squares problem in inquiry-oriented linear algebra. In S. Cook, B. Katz, and D. Moore-Russo (Eds.), *Proceedings*

of the 25th Annual Conference on Research in Undergraduate Mathematics Education (p. 643–651). SIGMAA on RUME.

- Wawro, M., & Serbin, K. (2023). "What makes it eigen-esque-ish?": Eigentheory development in a quantum mechanics course. In S. Cook, B. Katz, and D. Moore-Russo (Eds.), *Proceedings of the 25th Annual Conference on Research in Undergraduate Mathematics Education* (p. 991–998). SIGMAA on RUME.
- Schermerhorn, B. P., & Wawro, M. (2022). Students' conceptual understanding of normalization of vectors from $\mathbb{R}^2$ and $\mathbb{C}^2$. In S. S. Karunakaran & A. Higgins (Eds.), *Proceedings of the 24th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 546–553). SIGMAA on RUME.
- Serbin, K. S., & Wawro, M. (2022). Ways that student reasoning about linear algebra concepts can support flexibility in solving quantum mechanics problems. In S. S. Karunakaran & A. Higgins (Eds.), *Proceedings of the 24th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 554–562). SIGMAA on RUME.
- Lee., I., Bettersworth, Z., Zandieh, M., Wawro, M., & Quinlan, I. (2022). Student thinking in an inquiry-oriented approach to teaching least squares. In S. S. Karunakaran & A. Higgins (Eds.), *Proceedings of the 24th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 349–356). SIGMAA on RUME.
- Rasmussen, C., Wawro, M., & Zandieh, M. (2022). Student reinvention of Euler's method: An integrated analysis of one small group's individual and collective mathematical progress. In J. Hodgen, E. Geraniou, G. Bolondi & F. Ferretti (Eds.), *Proceedings of the Twelfth Congress of European Research Society in Mathematics Education (CERME12)* (pp.1–9). Free University of Bozen-Bolzano and ERME.
- Serbin, K. S. & Wawro, M. (2021). Students' understanding of linear algebra concepts underlying a procedure in a quantum mechanics task. In A.I. Sacristán, J.C. Cortés-Zavala, & P.M. Ruiz-Arias (Eds.), *Mathematics education across cultures: Proceedings of the 42nd Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1218–1222). Cinvestav / AMIUTEM / PME-NA. https:/doi.org/10.51272/pmena.42.2020
- Wawro, M., Thompson, J., & Watson, K. (2020). Student meanings for eigenequations in mathematics and in quantum mechanics. In S.S. Karunakaran, Z. Reed, & A. Higgins (Eds.), *Proceedings of the 23rd Annual Conference on Research in Undergraduate Mathematics Education* (pp. 629–636). SIGMAA on RUME.
- Serbin, K.S., Storms, R., & Wawro, M. (2020). Students' language about basis and change of basis in a quantum mechanics problem. In S.S. Karunakaran, Z. Reed, & A. Higgins (Eds.), *Proceedings of the 23rd Annual Conference on Research in Undergraduate Mathematics Education* (pp. 520–528). SIGMAA on RUME.
- Wawro, M., Watson, K., & Christensen, W. (2019). Student reasoning about eigenvectors and eigenvalues from a Resources perspective. In A. Weinberg, D. Moore-Russo, H. Soto, & M. Wawro (Eds.), *Proceedings of the 22nd Annual Conference on Research in Undergraduate Mathematics Education* (pp. 654–662). SIGMAA on RUME.
- Serbin, K., Sanchez-Robayo, B., Watson, K., Truman, J., Jiang, S., & Wawro, M. (2019). Characterizing conceptual and procedural knowledge of the characteristic equation. In A. Weinberg, D. Moore-Russo, H. Soto, & M. Wawro (Eds.), *Proceedings of the 22nd Annual Conference on Research in Undergraduate Mathematics Education* (pp. 541–548). SIGMAA on RUME.
- Wawro, M., Zandieh, M., & Watson, K. (2018). Delineating aspects of understanding eigentheory through assessment development. In V. Durand-Guerrier, R. Hochmuth, S. Goodchild, & N.M. Hogstad (Eds.),

Proceedings of the 2nd conference of the international network for didactic research in university mathematics (INDRUM, 5-7 April 2018) (pp. 275–284). University of Agder and INDRUM.

- Wawro, M., Watson, K., & Christensen, W. (2017). Meta-representational competence with linear algebra in quantum mechanics. In A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, & S. Brown (Eds.), *Proceedings of the 20th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 326–337). SIGMAA on RUME.
- Watson, K., Wawro, M., Zandieh, M., & Kerrigan, S. (2017). Knowledge about student understanding of eigentheory: Information gained from multiple choice extended assessment. In A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, & S. Brown (Eds.), *Proceedings of the 20th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 311–325). SIGMAA on RUME.
- Wawro, M., Watson, K., & Christensen, W. (2017). Meta-representational competence with linear algebra in quantum mechanics. Paper presented at the 10th Congress of European Research in Mathematics Education, Dublin, Ireland. In T. Dooley & G. Gueudet (Eds.), *Proceedings of the 10th Congress of the European Society for Research in Mathematics Education* (pp. 2282–2289). DCU Institute of Education and ERME.
- Zandieh, M., Wawro, M., & Rasmussen, C. (2016). Symbolizing and brokering in an inquiry-oriented linear algebra classroom. In T. Fukawa-Connelly, N. Infante, M. Wawro, & S. Brown (Eds.), *Proceedings of the 19th Annual Conference on Research in Undergraduate Mathematics Education* (1475–1483). SIGMAA on RUME.
- Jaworski, B., Potari, D., Rasmussen, C., Oates, G., Kwon, O.N., Ellis, J., … Zachariades, T. (2016). Mathematics learning and teaching at university level. In C. Csíkos, A. Rausch, & J. Szitányi (Eds.), *Proceedings of the 40th Conference of the International Group for the Psychology of Mathematics Education, Vol. 1*, pp. 375–404. PME.
- Rasmussen, C., Wawro, M., & Zandieh, M. (2015). Examining individual and collective level mathematical progress. In T. Fukawa-Connelly, N. Infante, K. Keene, & M. Zandieh (Eds.), *Proceedings of the 18th Annual Conference on Research in Undergraduate Mathematics Education* (896–903). SIGMAA on RUME.
- Zandieh, M., Plaxco, D., Wawro, M., Rasmussen, C., Milbourne, H., & Czeranko, K. (2015). Extending multiple choice format to document student thinking. In T. Fukawa-Connelly, N. Infante, K. Keene, & M. Zandieh (Eds.), *Proceedings of the 18th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 1079–1085). SIGMAA on RUME.
- Wawro, M., & Plaxco, D. (2015). Student understanding of linear independence of functions. *Proceedings of the 9th Congress of European Research on Mathematics Education,* Prague, Czech Republic. In K. Krainer & N. Vondrová (Eds.), *Proceedings of the 9th Congress of the European Society for Research in Mathematics Education (CERME9, 4-8 February 2015)* (pp. 2297–2298). Charles University in Prague, Faculty of Education and ERME.
- Plaxco, D., Wawro, M., & Zietsman, L. (2014). Student understanding of linear independence of functions. In T. Fukawa-Connelly, G. Karakok, K. Keene, & M. Zandieh (Eds.), *Proceedings of the 17th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 992–998). SIGMAA on RUME.
- Larson, C., Wawro, M., Zandieh, M., Rasmussen, C., Plaxco, D., & Czeranko, K. (2014). *Implementing inquiry-oriented instructional materials in undergraduate mathematics.* In T. Fukawa-Connelly, G. Karakok, K. Keene, & M. Zandieh (Eds.), *Proceedings of the 17th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 797–802). SIGMAA on RUME.
- Wawro, M., & Plaxco, P. (2013). Utilizing types of mathematical activities to facilitate characterizing student understanding of span and linear independence. In S. Brown, G. Karakok, K. H. Roh, & M. Oehrtman

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- Wawro, M. (2012). Expanding Toulmin's Model: The development of four expanded argumentation schemes from analysis in linear algebra. In S. Brown, S. Larsen, K. Marrongelle, & M. Oehrtman (Eds.), *Proceedings of the 15th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 2-242–2-250). SIGMAA on RUME.
- Wawro, M., Larson, C., Zandieh, M., & Rasmussen, C. (2012). A hypothetical collective progression for conceptualizing matrices as linear transformations. In S. Brown, S. Larsen, K. Marrongelle, & M. Oehrtman (Eds.), *Proceedings of the 15th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 1-465–1-479). SIGMAA on RUME.
- Wawro, M. (2011). Individual and collective analysis of the genesis of student reasoning regarding the Invertible Matrix Theorem in linear algebra. In S. Brown, S. Larsen, K. Marrongelle, & M. Oehrtman (Eds.), *Proceedings of the 14th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 3-179–3-184). SIGMAA on RUME.
- Wawro, M., Zandieh, M., Sweeney, G., Larson, C., & Rasmussen, C. (2011). Using the emergent model heuristic to describe the evolution of student reasoning regarding span and linear independence. In S. Brown, S. Larsen, K. Marrongelle, & M. Oehrtman (Eds.), *Proceedings of the 14th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 3-185–3-189). SIGMAA on RUME.
- Rasmussen, C., Trigueros, M., Zandieh, M., Possani Espinosa, E., Wawro, M, Sweeney, G., et al. (2010). Building on students' current ways of reasoning to develop more formal or conventional ways of reasoning: The case of linear algebra. In P. Brosnan, D. B. Erchick, & L. Flevares (Eds.), *Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1577–1587). The Ohio State University.
- Rasmussen, C., Zandieh, M., & Wawro, M. (2010). Brokering as a mechanism for the social production of meaning. In P. Brosnan, D. B. Erchick, & L. Flevares (Eds.), *Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 427–434). The Ohio State University.
- Schwarz, B., Hershkowitz, R., Atzmon, S., Rasmussen, C., Stahl, G., Wawro, M., et al. (2010). Symposium: Social construction of mathematical meaning through collaboration and argumentation. In K. Gomez, L. Lyons, & J. Radinsky (Eds.), *Learning in the disciplines: Proceedings of the 9th International Conference of the Learning Sciences (ICLS 2010): Volume 2, Short Papers, Symposia, and Selected Abstracts* (pp. 29–36). International Society of the Learning Sciences.
- Cole, R., Towns, M., Rasmussen, C., Becker, N., Wawro, M., & Sweeney, G. (2010). Adapting a methodology for documenting collective growth to an undergraduate physical chemistry class. *Proceedings of the 13th Annual Conference on Research in Undergraduate Mathematics Education*. SIGMAA on RUME.
- Henderson, F., Rasmussen, C., Sweeney, G., Wawro, M, & Zandieh, M. (2010). Symbol sense in linear algebra. *Proceedings of the 13th Annual Conference on Research in Undergraduate Mathematics Education*. SIGMAA on RUME.
- Wawro, M., Sweeney, G., & Rabin, J. M. (2010). Subspace in linear algebra: Investigating students' concept images and interactions with the formal definition. *Proceedings of the 13th Annual Conference on Research in Undergraduate Mathematics Education.* SIGMAA on RUME.

- Wawro, M. (2009). Task design: Towards promoting a geometric conceptualization of linear transformation and change of basis. *Proceedings of the 12th Annual Conference on Research in Undergraduate Mathematics Education*. SIGMAA on RUME.

Editor for Conference Proceedings

- Weinberg, A., Moore-Russo, D., Soto, H., Wawro, M. (Eds.). (2019). Proceedings of the 22nd *annual conference on research in undergraduate mathematics education.* SIGMAA on RUME.
- Weinberg, A., Rasmussen, C., Rabin, J., Wawro, M., & Brown, S. (Eds.). (2018). Proceedings of the 21st *annual conference on research in undergraduate mathematics education.* SIGMAA on RUME.
- Weinberg, A., Rasmussen, C., Rabin, J., Wawro, M., & Brown, S. (Eds.). (2017). Proceedings of the 20th *annual conference on research in undergraduate mathematics education.* SIGMAA on RUME.
- Fukawa-Connelly, T., Engelke Infante, N., Wawro, M., & Brown, S. (Eds.). (2016). Proceedings of the 19th *annual conference on research in undergraduate mathematics education.* SIGMAA on RUME.

Dissertation

- Wawro, M. J. (2011). *Individual and collective analyses of the genesis of student reasoning regarding the Invertible Matrix Theorem in linear algebra* (Doctoral dissertation, UC San Diego).

OPEN EDUCATIONAL RESOURCES

Lead developer for the NSF-funded *Inquiry-Oriented Linear Algebra* (IOLA) curriculum materials for introductory linear algebra. Task sequences and associated instructional implementation support materials maintained and available to interested instructors at http://iola.math.vt.edu.

INVITED TALKS

- Wawro, M. (2025, March). *Engaging with students' reasoning in mathematics and beyond.* Plenary speaker, 27th Conference on Research in Undergraduate Mathematics Education, Alexandria, VA.
- Wawro, M. (2024, August). *Research on the learning and teaching of linear algebra.* Colloquium, Virginia Tech Mathematics Department, Blacksburg, VA.
- Wawro. M. (2023, October). *The Inquiry-Oriented Linear Algebra Project.* Colloquium, Colorado School of Mines Department of Applied Mathematics & Statistics, Golden, CO. [virtual]
- Wawro, M. (2023, January). *Student reasoning about linear algebra in quantum mechanics.* Invited talk, Workshop on Quantum Education for Quantum Workforce Development, Arlington, VA.
- Wawro, M. (2022, September). *The Inquiry-Oriented Linear Algebra Project.* Seminar series speaker, Online Seminar on Undergraduate Mathematics Education (OLSUME). [virtual]
- Wawro, M. (2022, April). *Student understanding of linear combinations of eigenvectors.* Colloquium, Colorado State University Department of Mathematics, Math Education Seminar, Fort Collins, CO.
- Axler, S., Boman, E., Catral., M., Harel, G., McDonald, J., Stewart, S., Strong, D., & Wawro, M. (2021, May). *Linear Algebra Curriculum Study Group (LACSG 2.0) recommendations.* Panelist, "Transforming Learning and Teaching: Precalculus, Calculus, and Linear Algebra," MAA Virtual Programs. [virtual]
- Wawro, M. (2021, April). *Inquiry-Oriented Linear Algebra.* Seminar series speaker, Seoul National University Center for Research in Mathematics Education Webinar Series, Seoul, South Korea. [virtual]
- Wawro, M. (2021, April). *Student understanding of linear combinations of eigenvectors.* Seminar series speaker,

Seoul National University Center for Research in Mathematics Education Webinar Series, Seoul, South Korea. [virtual]

- Wawro, M. (2021, April). *Inquiry-Oriented Linear Algebra*. Colloquium, Cornell University Department of Mathematics Teaching Seminar, Ithaca, NY. [virtual]
- Wawro, M. (2019, September). *Student reasoning about linear algebra in quantum physics*. Colloquium, Montana State University Department of Mathematical Sciences, Bozeman, MT.
- Wawro, M., Thompson, J., & Watson, K. (2019, July). *Student meanings for eigenequations in mathematics and in quantum mechanics.* Invited talk, Annual Physics Education Research Conference (Parallel Session on Representing student reasoning about math in physics), Provo, UT.
- Wawro, M. (2019, March). *Exploring teaching and learning through Inquiry-Oriented Linear Algebra*. Colloquium, University of Oslo Department of Mathematics, Oslo, Norway.
- Wawro, M. (2019, January). *Student reasoning about linear algebra in quantum physics*. Colloquium, University of Auckland Department of Mathematics, Auckland, New Zealand.
- Wawro, M. (2018, November). *Exploring teaching and learning through Inquiry-Oriented Linear Algebra*. Colloquium, Northern Illinois University Department of Mathematical Sciences, DeKalb, IL.
- Wawro, M. (2018, November). *Student reasoning about linear algebra in quantum physics*. Colloquium, Northern Illinois University Department of Mathematical Sciences, DeKalb, IL.
- Wawro, M. (2018, October). *Inquiry-Oriented Linear Algebra.* Workshop leader, Linear Algebra Workshop on National Pedagogical Initiatives in Linear Algebra, University of Oklahoma, Norman, OK.
- Wawro, M. (2018, May). *Discovering definitions in Inquiry-Oriented Linear Algebra*. Facilitator for a Live Classroom Session, Inquiry-Based Learning and Teaching Conference, Austin, TX.
- Wawro, M. (2018, April). *Education and professional development of university mathematics teachers.* Plenary panelist, International Network for Didactic Research in University Mathematics (INDRUM), Kristiansand, Norway.
- Wawro, M. (2018, March). *Student reasoning about linear algebra in quantum physics*. Colloquium, Yale University, Yale STEM Center for Teaching and Learning Seminar Series, New Haven, CT.
- Wawro, M. (2018, March). *Exploring teaching and learning through Inquiry-Oriented Linear Algebra*. Workshop, University of Bridgeport, Yale STEM Center for Teaching and Learning Seminar Series, Bridgeport, CT.
- Wawro, M. (2018, February). *Student reasoning about eigenvectors and eigenvalues.* Colloquium, James Madison University Department of Mathematics and Statistics, Harrisonburg, VA.
- Wawro, M. (2017, November). *An inquiry-oriented approach to the teaching and learning of linear algebra*. Plenary speaker, *Wisconsin Section NExT Meeting*. Baraboo, WI.
- Wawro, M. (2017, July). *Student understanding and symbolization of eigentheory.* Plenary speaker, Physics Education Research Conference, Cincinnati, OH.
- Wawro, M. (2017, July). *Student understanding at the intersection of linear algebra and quantum physics.* Plenary speaker, Transforming Research in Undergraduate STEM Education Conference, St. Paul, MN.
- Wawro, M. (2017, February). *How to support each other in being successful.* Plenary panelist, Mentoring and Partnerships for Women in RUME (MPWR) Conference, San Diego, CA.
- Borum, V., Lovin, L., Wawro, M., & White, N. (2017, January). *Highlighting contributions to mathematics education from members of departments of mathematics sciences.* Panelist, Joint Mathematics Meetings, MAA

COMET and AWM session, Atlanta, GA.

- Wawro, M. (2016, September). *Research on the learning and teaching of diagonalization and eigentheory.* Colloquium, University of Maine, Maine Center for Research in STEM Education**,** Orono, ME.
- Wawro, M. (2016, April). *Research on the teaching and learning of linear algebra.* Colloquium, West Virginia University Mathematics Department, Morgantown, WV
- Wawro, M. (2016, March). *Research on the teaching and learning of linear algebra.* Colloquium, University of Delaware Department of Mathematical Sciences, Newark, DE.
- Wawro, M. (2015, August). *Research on the teaching and learning of linear algebra.* Colloquium, Virginia Tech Mathematics Department, Blacksburg, VA.
- Wawro, M. (2014, December). *An inquiry-oriented approach to the teaching and learning of linear algebra.* Colloquium, Colorado State University Department of Mathematics, Ft. Collins, CO.
- Wawro, M. (2014, April). *Transitioning from doctoral student to faculty member.* Panelist, NCTM Research Conference, Graduate Student, Junior Faculty, and Researcher Mentoring Session, New Orleans,.
- Wawro, M., & Plaxco, D. (2014, January). *Utilizing types of mathematical activities to facilitate characterizing student understanding of span and linear independence.* Invited talk, Joint Mathematics Meetings, SIGMAA on RUME Session, Baltimore, MD.
- Wawro, M. (2013, July). *Analyzing student understanding in linear algebra through mathematical activity.* Invited talk, Summer Meeting of the American Association of Physics Teachers [Research in Undergraduate Mathematics Education session], Portland, OR.
- Wawro, M. (2013, April). *Analyzing student understanding in linear algebra through mathematical activity.* Colloquium, University of North Carolina Charlotte Department of Mathematics and Statistics, Charlotte, NC.
- Wawro, M., Sweeney, G., Zandieh, M., & Larson, C. (2011, August). *Designing instruction that builds on students' ways of reasoning in linear algebra.* Workshop, MathFest, SIGMAA on RUME session, Lexington, KY.
- Rasmussen, C., & Wawro, M. (2009). *The role of brokers in the reinvention process.* Workshop, Second Realistic Mathematics Education Conference, Boulder, CO.

SELECTED PRESENTATIONS AT PROFESSIONAL MEETINGS (since 2015 only)

Speakers are noted in bold.

- **Wawro, M.,** Serbin, K. S., & **Lineberry, J.** (2025, June). *Developing aspects of the wave function in quantum mechanics through analogical activity: A textbook analysis.* Poster presented at the Learning and Teaching of Calculus Across Disciplines 2 Conference, Milan Italy.
- **Truman, J**., & **Wawro, M**. (2025, March). *Student meanings for ħ/2 in a quantum mechanics expectation value problem.* Paper presented at the 27th Conference on Research in Undergraduate Mathematics Education, Alexandria, VA.
- **Plaxco, D**., Le, L., Wawro, M., & Mauntel, M. (2025, March). *Students' generalizing activity while using determinant applets.* Paper presented at the 27th Conference on Research in Undergraduate Mathematics Education, Alexandria, VA.
- **Fukawa-Connelly, T**., Weinberg, A., Wawro, M., & Johnson, E. (2025, March). *Why are YOU in the RUME?* Paper presented at the 27th Conference on Research in Undergraduate Mathematics Education, Alexandria, VA.

- **Serbin, K. S.**., & Wawro, M. (2025, February). *Pedagogical moves related to analogy that support a unified understanding of eigenequations in a quantum mechanics class.* Paper presented at the 27th Conference on Research in Undergraduate Mathematics Education, Alexandria, VA.
- **Wawro, M.**, Zandieh, M., & Bettersworth, Z. (2025, February). *An inquiry-oriented approach to least squares in linear algebra.* Paper presented at the Congress on European Research in Mathematics Education (CERME), Bolzano, Italy.
- **Wawro, M**., & **Serbin, K. S**. (2024, June). *Form-function relations for eigentheory in quantum mechanics.* Paper presented at the 5th Conference of the International Network for Didactic Research in University Mathematics (INDRUM), Barcelona, Spain.
- **Wawro, M**., Mauntel, M., & Plaxco, D. (2023, July). *Student reasoning about determinants with GeoGebra.* Poster presented at the Congress for European Research in Mathematics Education, Budapest, Hungary.
- **Plaxco, D**., Wawro, M., & Mauntel, M. (2023, May). *An inquiry-oriented task sequence for teaching determinants.* Presentation at the Third International Conference on Applications of Mathematics to Nonlinear Sciences (AMNS-2023), Pokhara, Nepal.
- **Wawro, M**., Mauntel, M., & **Plaxco, D**. (2023, February). *"The shape will have no volume": Relationships students observed about determinants in a dynamic geometric applet.* Paper presented at the 25th Conference on Research in Undergraduate Mathematics Education, Omaha, NE.
- **Wawro, M**., Park, M., Zandieh, M., Bettersworth, Z., & **Lee, I**. (2023, February). *Student reasoning about the least-squares problem in inquiry-oriented linear algebra.* Paper presented at the 25th Conference on Research in Undergraduate Mathematics Education, Omaha, NE.
- **Wawro, M**., & **Serbin, K**. (2023, February). *"What makes it eigen-esque-ish?": Eigentheory development in a quantum mechanics course.* Paper presented at the 25th Conference on Research in Undergraduate Mathematics Education, Omaha, NE.
- **Mauntel, M.**, **Wawro, M.**, & Plaxco, D. (2023, January). *Inquiry-Oriented Linear Algebra: Exploring determinants.* Workshop presented as part of the Joint Mathematics Meetings, Boston, MA.
- **Wawro, M.**, & Thompson, J. (2022, October). *Recognizing matrix equations as eigenequations or not: Examples of student reasoning in quantum mechanics.* Poster presented at 4th Conference of the International Network for Didactic Research in University Mathematics. Hannover, Germany.
- **Mauntel, M.**, Wawro, M., Zandieh, M., Andrews-Larson, C., & Plaxco, D. (2022, August). *Collaborative Research: Extending Inquiry-Oriented Linear Algebra (IOLA-X).* Poster presented at the MAA MathFest. Philadelphia, PA.
- Wawro, M., Zandieh, M., Andrews-Larson, C., & **Plaxco, D.** (2022, August). *Collaborative Research: Extending Inquiry-Oriented Linear Algebra (IOLA-X).* Poster presented at the 2022 Improving Undergraduate Education (IUSE) Summit, National Science Foundation and American Association for the Advancement of Science, Washington, DC.
- **Wawro, M**. (2022, June). *Student reasoning about linear algebra in quantum mechanics.* Presentation given at the 24th Conference of the International Linear Algebra Society, Galway, Ireland.
- **Wawro, M**. (2022, April). *Selected outcomes and reflections from the project: An Interdisciplinary Study of Learning: Student Understanding of Linear Algebra in Physics.* Presentation given at the Joint Mathematics Meetings, NSF Special Session on Outcomes and Innovations from NSF Undergraduate Education Programs in the Mathematical Sciences. [virtual conference]

- **Mauntel, M.**, Plaxco, D., & Wawro, M. (2022, April). *Determining the determinant: Using GeoGebra to visualize and measure spatial distortion.* Presentation given at the Joint Mathematics Meetings of the Mathematical Association of America and the American Mathematical Society, AMS Session on Innovative and Effective Ways to Teach Linear Algebra. [virtual conference]
- **Schermerhorn, B.**, & Wawro, M. (2022, February). *Students' conceptual understanding of normalization of vectors from* $\mathbb{R}^2$ and $\mathbb{C}^2$. Paper presented at the 24th Conference on Research in Undergraduate Mathematics Education, SIGMAA on RUME, Boston, MA.
- **Serbin, K. S.**, & **Wawro, M.** (2022, February). *Ways that student reasoning about linear algebra concepts can support flexibility in solving quantum mechanics problems.* Paper presented at the 24th Conference on Research in Undergraduate Mathematics Education, SIGMAA on RUME, Boston, MA.
- **Bergman, A. M.**, Bresock, K., & **Wawro, M.** (2022, February). *Education research at the interface of mathematics and science: Graphical reasoning across and within the disciplines.* Working group organized at the 24th Conference on Research in Undergraduate Mathematics Education, SIGMAA on RUME, Boston.
- **Lee., I.**, **Bettersworth, Z.**, Zandieh, M., Wawro, M., & Quinlan, I. (2022, February). *Student thinking in an inquiry-oriented approach to teaching least squares.* Paper presented at the 24th Conference on Research in Undergraduate Mathematics Education, SIGMAA on RUME, Boston, MA.
- **Kerrigan, S.**, Wawro, M., Plaxco, D., Mauntel, M., & Quinlan, I. (2022, February). *Exploring student generalizations about 2x2 determinants from using a GeoGebra applet.* Poster presented at the 24th Conference on Research in Undergraduate Mathematics Education, SIGMAA on RUME, Boston, MA.
- **Rasmussen, C.**, Wawro, M., & Zandieh, M. (2022, February). *Student reinvention of Euler's method: An integrated analysis of one small group's individual and collective mathematical progress.* Paper presented at the 12th Congress of European Research in Mathematics Education, Bolzano, Italy. [virtual conference]
- **Wawro, M.**, Thompson, J., & Watson, K. (2021, July). *Student reasoning about eigenequations in mathematics and quantum mechanics.* Paper presented at the 14th International Congress on Mathematical Education, Shanghai, China. [presented virtually]
- **Serbin, K. S.**, & Wawro, M. (2021, June). *Students' understanding of linear algebra concepts underlying a procedure in a quantum mechanics task.* Paper presented at the 42nd annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Mazatlán, Mexico. [presented virtually]
- **Wawro, M.** (2021, May). *Inquiry-Oriented Linear Algebra.* Invited presentation given in the "Linear Algebra Education for the Modern World" mini-symposium, SIAM Conference on Applied Linear Algebra. [virtual conference]
- Plaxco, D., Wawro, M., Zandieh, M., & Andrews-Larson, C. (2020, August). *An Inquiry-Oriented Approach to Determinants: New Materials from the IOLA Project.* Workshop accepted to be part of MathFest, Philadelphia, PA. [conference canceled]
- **Wawro, M.**, **Thompson, J.**, & Watson, K. (2020, February). *Student meanings for eigenequations in mathematics and in quantum mechanics.* Paper presented at the 23rd Annual Conference on Research in Undergraduate Mathematics Education, Boston, MA.
- **Serbin, K. S.**, Storms, R., & **Wawro, M.** (2020, February). *Students' language about basis and change of basis in a quantum mechanics problem.* Paper presented at the 23rd Annual Conference on Research in Undergraduate Mathematics Education, Boston, MA.

- **Wawro, M.**, Zandieh, M., Andrews-Larson, C. & Plaxco, D. (2020, January). *Promoting inquiry in linear algebra with student videos, reflections, and portfolios.* Presentation given at the Joint Mathematics Meetings [MAA Session on Inquiry-Based Learning and Teaching], Denver, CO.
- **Hagman, J.**, & Wawro, M. (2020, January). *MPWR 2016 and beyond: Fostering sustainable networks for women in RUME.* Poster presented at the Joint Mathematics Meetings [MAA Poster Session: Projects Supported by the NSF Division of Undergraduate Education], Denver, CO.
- **Wawro, M.** (2019, August). *Using videos, reflections, and portfolios to promote inquiry.* Talk given at MathFest, Cincinnati, OH.
- **Wawro, M.**, Hagman, J.E., & Musgrave, S. (2019, August). *The MPWR Seminar: Mentoring and Partnerships for Women in RUME.* Poster presented at MathFest, Cincinnati, OH.
- **Wawro, M.**, **Christensen, W.**, & Watson, K. (2019, July). *Student reasoning about eigenvectors and eigenvalues from a resources perspective.* Juried Talk given at the Annual Physics Education Research Conference, Provo, UT.
- **Wawro, M.**, Thompson, J., & Watson, K. (2019, July). *Student Interpretation of Eigenequations in Mathematics and in Quantum Mechanics.* Talk given at the Summer Meeting of the American Association of Physics (PER Session: Student Content Understanding, Problem-solving and Reasoning), Provo, UT.
- **Wawro, M.**, **Watson, K.**, & **Christensen, W.** (2019, February). *Student reasoning about eigenvectors and eigenvalues from a resources perspective.* Paper presented at the 22nd Annual Conference on Research in Undergraduate Mathematics Education, Oklahoma City, OK.
- **Serbin, K. S.**, **Sanchez-Robayo, B.**, **Watson, K.**, **Truman, J.**, Jiang, S., & Wawro, M. (2019, February). *Characterizing conceptual and procedural knowledge of the characteristic equation.* Paper presented at the 22nd Annual Conference on Research in Undergraduate Mathematics Education, Oklahoma City, OK.
- **Serbin, K.S.**, Storms, R., & Wawro, M. (2019, February). *Student reasoning about basis and change of basis in a quantum mechanics problem.* Poster presented at the 22nd Annual Conference on Research in Undergraduate Mathematics Education, Oklahoma City, OK.
- **Wawro, M.**, Watson, K., & Christensen, W. (2018, August). *Student reasoning about eigenvectors and eigenvalues from a resources perspective.* Poster presented at the Annual Physics Education Research Conference, Washington, DC.
- **Christensen, W.**, Watson, K., & Wawro, M., (2018, August). *Student reasoning about eigenvectors and eigenvalues from a resources perspective.* Contributed talk given at the American Association of Physics Teachers Summer Meeting, Washington, DC.
- **Robinson, A.**, Simonetti, J. H., Richardson, K. L., Esmaeili, S., Grimes, M., Lewis, S. N., McConnell, K. D., Pleimling, M. J., Sible, J., Sorenson, K. J., Vengrin, C., & Wawro, M. (2018, August). *Positive attitudinal gains and reduced gender gap in a first year physics experience.* Poster presented at the Annual Physics Education Research Conference, Washington, DC.
- **Simonetti, J.**, Robinson, A., Richardson, K. L., Esmaeili, S., Grimes, M., Lewis, S. N., McConnell, K. D., Pleimling, M. J., Sible, J., Sorenson, K. J., Vengrin, C. & Wawro, M. (2018, August). *A first-year experience program in physics.* Poster presented at the 2018 Summer Meeting of the American Association of Physics Teachers, Washington, DC.

- **Wawro, M.**, **Zandieh, M.**, & Watson, K. (2018, April). *Delineating aspects of understanding eigentheory through assessment development.* Paper presented at the International Network for Didactic Research in University Mathematics (INDRUM), Kristiansand, Norway.
- **Esmaeili, S.**, Richardson, K. L., Lewis, S. N., Vengrin, C., Sible, J. C., Robinson, A., Pleimling, M., Simonetti, J., Sorenson, K., & Wawro, M. (2018, April.) *The effectiveness of a summer bridge program in integrating math into science instruction.* Poster presented at the 102nd meeting of the American Educational Research Association, New York, NY.
- **Esmaeili, S.**, Richardson, K. L., Simonetti, J. H., Robinson, A., Sorenson, K., Vengrin, C., Wawro, M., Pleimling, M., & Sible, J. C. (2018, February). *Math, problem solving, and SCALE-UP in an integrated science curriculum and a physics first-year experience program.* Paper presented at the 41st meeting of the Eastern Educational Research Association, Clearwater, FL.
- **Wawro, M.**, Watson, K., & Zandieh, M. (2018, February). *Student understanding of linear combinations of eigenvectors.* Paper presented at the 21st Conference on Research in Undergraduate Mathematics Education, San Diego, CA.
- **Wawro, M.**, Watson, K., & Christensen, W. (2018, February). *Quantum physics students' reasoning about eigenvectors and eigenvalues.* Poster presented at the 21st Conference on Research in Undergraduate Mathematics Education, San Diego, CA.
- **Musgrave, S.**, Hagman, J.E., Melhuish, K., Thanheiser, E., & Wawro, M. (2018, February). *MPWR-ing women in RUME: Continuing support.* Poster presented at the 21st Conference on Research in Undergraduate Mathematics Education, San Diego, CA.
- **Robinson, A.**, Simonetti, J. H., Richardson, K. L., Esmaeili, S., Grimes, M., Lewis, S. N., McConnell, K. D., Pleimling, M., Sible, J. C., Sorenson, K., Vengrin, C., & Wawro, M. (2018, January). *A study of learning and attitudinal gains in a first-year physics experience.* Poster presented at the 2018 meeting of the American Association of Physics Teachers, San Diego, CA.
- **Wawro, M.**, Zandieh, M., & Plaxco, D. (2017, November). *An inquiry-oriented approach to the guided reinvention of eigentheory.* Paper presented at the 11th Southern Hemisphere Conference on the Teaching and Learning of Undergraduate Mathematics and Statistics (DELTA), Gramado, Brazil.
- **Wawro, M.**, Watson, K., & **Christensen, W.** (2017, July). *Investigating students' meta-representational competence with matrix notation and Dirac notation.* Paper presented at the Physics Education Research Conference, Cincinnati, OH.
- **Wawro, M.** (2017, July). *Inquiry-Oriented Linear Algebra (IOLA): An overview and an example.* Presentation given at the Meeting of the International Linear Algebra Society, Ames, IA.
- **Wawro, M.**, **Watson, K.**, & **Christensen, W.** (2017, February). *Meta-representational competence with linear algebra in quantum mechanics.* Paper presented at the 20th Conference on Research in Undergraduate Mathematics Education, San Diego, CA.
- **Watson, K.**, Wawro, M., Zandieh, M., & **Kerrigan, S.** (2017, February). *Knowledge about student understanding of eigentheory: Information gained from multiple choice extended assessment.* Paper presented at the 20th Conference on Research in Undergraduate Mathematics Education, San Diego, CA.
- **Ellis, J.**, Musgrave, S., Melhuish, K., Thanheiser, E., & Wawro, M. (2017, February). *Empowered women in RUME: We have we been up to?* Poster presented at the 20th Conference on Research in Undergraduate Mathematics Education, San Diego, CA.

- **Wawro, M.**, Watson, K., & Christensen, W. (2017, February). *Meta-representational competence with linear algebra in quantum mechanics.* Paper presented at the 10th Congress of European Research in Mathematics Education, Dublin, Ireland.
- **Ellis, J.**, Musgrave, S., Wawro, M., Thanheiser, E., & Melhuish, K. (2017, January). *MPWR 2016 and Beyond: Fostering sustainable networks for women in RUME.* Poster presented at the Joint Mathematics Meetings, Atlanta, GA.
- **Wawro, M.**, & Watson, K. (2017, January). *An interdisciplinary study of learning: Student understanding of linear algebra in physics.* Poster presented at the Joint Mathematics Meetings, Atlanta, GA.
- **Wawro, M.**, & **Zandieh, M.**, & Rasmussen, C. (2016, July). *Symbolizing and brokering in fostering inquiry.* Paper presented at the 13th International Congress on Mathematical Education, Hamburg, Germany.
- **Rasmussen, C.**, & **Wawro, M.** (2016, August). *Coordinating analyses of individual and collective mathematical progress.* Paper presented in the "Mathematics Learning and Teaching at University Level" Research Forum at the Psychology of Mathematics Education 40th Annual Conference, Szeged, Hungary.
- **Wawro, M.**, & Zandieh, M. (2016, April). *An inquiry-oriented task sequence for eigentheory and diagonalization in linear algebra.* Poster presented at the First Conference of the International Network for Didactic Research in University Mathematics (INDRUM), Montpellier, France.
- **Zandieh, M.**, Wawro, M., & Rasmussen, C. (2016, February). *Symbolizing and brokering in an inquiry-oriented linear algebra classroom.* Paper presented at the Nineteenth Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA.
- **Watson, K.**, Wawro, M., & Zandieh, M (2016, February). *Assessing students' understanding of eigenvectors and eigenvalues in linear algebra.* Poster presented at the Nineteenth Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA.
- **Wawro, M., Ellis, J.**, & Soto-Johnson, H. (2015, April). *Lessons learned from mentioning and partnerships for women in research in undergraduate mathematics education.* Poster presented at the American Educational Research Association (AERA) Annual Meeting, Chicago, IL.
- **Wawro, M.**, Zandieh, M., Rasmussen, C., & Andrews-Larson, C. (2015, February). *An RME-based instructional sequence for change of basis and eigentheory.* Poster presented at the Eighteenth Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA.
- **Christensen, W.**, & **Wawro, M.** (2015, February). *Education research at the interface of mathematics and physics.* Working group organized at the Sixteenth Conference on Research in Undergraduate Mathematics Education, Denver, CO.
- **Rasmussen, C.**, Wawro, M., & Zandieh, M. (2015, February). *Examining individual and collective level mathematical progress.* Paper presented at the Eighteenth Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA.
- **Zandieh, M.**, Plaxco, D., Wawro, M., Rasmussen, C., **Milbourne, H.**, & Czeranko, K. (2015, February). *Extending multiple choice format to document student thinking.* Paper presented at the Eighteenth Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA.
- **Wawro, M.**, & Plaxco, D. (2015, February). *Student understanding of linear independence of functions.* Poster presented at the 9th Congress of European Research on Mathematics Education, Prague, Czech Republic.

- **Wawro, M.**, Zandieh, M., & Plaxco, D. (2015, January). *An instructional sequence for change of basis and eigentheory.* Paper presented at the Joint Mathematics Meetings [MAA Session on Innovative and Effective Teaching of Linear Algebra], San Antonio, TX.
- **Zandieh**, M., Wawro, M., & Plaxco, D. (2015, January). *Inquiry-Oriented Linear Algebra (IOLA): An RME-based instructional sequence for change of basis and eigentheory.* Paper presented at the Joint Mathematics Meetings [SIGMAA on RUME Session on Research on the Teaching and Learning of Undergraduate Mathematics], San Antonio, TX.

GRADUATE STUDENT SUPERVISION

- Matt Park (co-chair with Anderson Norton), Ph.D., Mathematics, Virginia Tech, expected 2026
  Dissertation title: *Thinking Real and Doing Complex in the Case of Exponents and Logarithms*
- Kevin Watson (chair), Ph.D., Virginia Tech, Mathematics, 2020 (awarded posthumously)
  Dissertation Title: *Students' Conceptions of Normalization*
- George Kuster (chair), Ph.D., Virginia Tech, Mathematics, 2016
  Dissertation Title: *On the Role of Student Understanding of Function and Rate of Change in Learning Differential Equations.* Current position: Associate Professor, Christopher Newport University
- David Plaxco (chair), Ph.D., Virginia Tech, Mathematics, 2015
  Dissertation Title: *Relating Understanding of Inverse and Identity to Engagement in Proof in Abstract Algebra.* Current position: Lecturer, University of Georgia
- Jacob Lineberry (advisor), Virginia Tech, Mathematics, 2024-current
- Ph.D. committee member: Andi Pina, University of Maine, Physics, 2024; Kyle Flanigan, Virginia Tech, Mathematics, 2023; Sarah Kerrigan, Virginia Tech, Mathematics, 2022; Congze Xu, Virginia Tech, Curriculum and Instruction, 2022; Kaitlyn Serbin, Virginia Tech, Mathematics, 2021; Ahsan Chowdhury, Virginia Tech, Mathematics, 2021; Rachel Rupnow, Virginia Tech, Mathematics, 2019; Janet Sipes, Arizona State University, Mathematics, 2019; Steven Boyce, Virginia Tech, Mathematics, 2014
- PhD external evaluator: Inyoung Lee, Arizona State University, Mathematics, 2024; Vera Baumgartner, ETH Zürich, Learning Sciences, 2023; Odd Petter Sand, University of Oslo, 2021
- M.S. (Virginia Tech, Mathematics) committee member: Marilin Kelley, 2020; Corinne Mitchell, 2023; Adam Bradie, 2024; Ben Bruncati, 2025
- M.A.Ed. (Virginia Tech, Curriculum and Instruction, Mathematics Education), many students since 2012

REVIEWER FOR PROFESSIONAL JOURNALS

International Journal of Research in Undergraduate Mathematics Education (editorial board member since 2016); Educational Studies in Mathematics; Physical Review Physics Education Research; Journal for Research in Mathematics Education; Journal of Mathematical Behavior; ZDM - Mathematics Education; Cognition and Instruction; Mathematics Education Research Journal; Canadian Journal for Science, Mathematics, and Technology Education; PRIMUS.

REVIEWER FOR PROFESSIONAL CONFERENCES

Annual Conference of the Special Interest Group of the Mathematical Association of America on Research in

Undergraduate Mathematics Education (RUME); Congress for European Research in Mathematics Education (CERME); International Network for Didactic Research in University Mathematics (INDRUM); International Congress of Mathematics Education (ICME); Joint Mathematics Meetings; MathFest; International Group for the Psychology of Mathematics Education (PME), North American Chapter Annual Conference (PME-NA)

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

European Society for Research in Mathematics Education (ERME); Mathematical Association of America (MAA); Special Interest Group of the MAA on Research in Undergraduate Mathematics Education (SIGMAA on RUME); International Linear Algebra Society (ILAS); Association for Women in Mathematics (AWM)

SELECTED SERVICE TO THE RESEARCH COMMUNITY

- Local Organizing Co-Chair, *27th and 28th Annual Conferences on Research in Undergraduate Mathematics Education*, Alexandria, VA, 2024-2026
- Local Organizing Committee, *27th Conference of the International Linear Algebra Society,* Blacksburg, VA, 2025-2026
- International Program Committee, *International Network for Didactic Research in University Mathematics* (*INDRUM*) *Conference*, Dubrovnik, Croatia, 2025-2026
- Program Chair (elected position) of the Executive Committee, SIGMAA on RUME, 2016-2020
- Planning Committee, *Conference on Research in Undergraduate Mathematics Education*, 2012-24
- Scientific Committee, *International Network for Didactic Research in University Mathematics* (*INDRUM*) *Conferences*, 2018-present
- Invited Address Committee, *MAA MathFest*, 2020
- Association for Women in Mathematics (AWM) Hay Award Selection Committee, 2021-2023
- Advisory Board and consultant, NSF DUE, *Collaborative Research: Collaborating with Mathematicians to Enhance Teaching (COMET)* (#2315058, 2315056, 2315057), K. Weber (Rutgers, lead PI), E. Johnson (Virginia Tech, PI), T. Fukawa-Connelly (Temple, PI), L. Carbone (Rutgers, co-PI), $399,324, 2023-2026.
- Advisory Board, NSF ECR DBER DCL, *Investigating Undergraduate Chemistry Students' Reasoning and Conceptual Change Related to Graphs of Particulate-Level Variability* (# 1954861), N. Becker (University of Iowa, PI), $496,573, 2021-2024.
- Advisory Board, NSF *Collaborative Research: Beyond Procedures: A research-based approach to teaching mathematical methods in physic*s (PHY #1912152, 1912660, 1912087), W. Christensen (North Dakota State University, lead PI), M. Loverude (Cal State Fullerton, PI), J. Thompson (University of Maine, PI), $938,387, 2019-2024.
- Consultant, NSF Innovations in Undergraduate STEM Education, *Simulation-Based Inquiry-Oriented Linear Algebra* (#1712524); M. Zandieh (PI), A. Amresh, D. Plaxco (co-PIs), $299,999, 2017-20.
- Curriculum Advisory Board, NSF Innovations in Undergraduate STEM Education, *Collaborative Research: Teaching Inquiry-Oriented Mathematics: Establishing Supports* (#143195, 1431641, 1431393), E. Johnson (PI); K. Keene, C. Andrews-Larson (co-PIs), $999,773, 2014-2017.
- Executive Committee, NSF Innovations in Undergraduate STEM Education *Pedagogical Initiatives in Linear Algebra* project (#1822247); S. Stewart (University of Oklahoma, PI), $49,286, 2018-2020.

- Executive Committee, NSF Transforming Research in Undergraduate STEM Education (DUE #151038); W. Christensen (PI), C. Rasmussen, J. Thompson, M. Towns, (co-PIs), $49,994, 2015.
- Co-organizer of the *Mentoring and Partnerships for Women in RUME (MPWR)* Seminar, a one-day seminar that occurred before the Annual RUME Conference in February, 2013-2020
- Co-organizer (with David Strong, Pepperdine University; Sepideh Stewart, University of Oklahoma; Gil Strang, MIT) of the *Innovative and Effective Ways to Teach Linear Algebra* session at the Joint Mathematics Meetings (sponsored by ILAS in 2023-present, AMS in 2022, and MAA in 2014-2020)
- Co-organizer (with Elena Nardi, University of East Anglia, UK) of the *Workshop for early career researchers*, INDRUM Hannover (2022), Barcelona (2024), and Dubrovnik (2026)
- Co-leader (with Yael Fleischmann, Norwegian University of Science and Technology) of the *Thematic Working Group on Teaching and Learning of Linear and Abstract Algebra,* INDRUM Barcelona, 2024
- Co-organizer of the Math-Science Working Group, Annual Conference on Research in Undergraduate Mathematics Education, 2013, 2015, 2022
- Co-organizer (with Rachel Quinlan, National University of Ireland, Galway) of the Mathematics Education mini symposium at the Annual Meeting of the International Linear Algebra Society, 2017
- Panel reviewer for various grant submissions to the EDU Directorate, US National Science Foundation

SELECTED SERVICE TO THE UNIVERSITY

- College of Science Collegiate Faculty and Professor of Practice Promotion Committee, 2018–2025
- University Council, College of Science representative, 2020-2022
- Mathematics Department Executive Committee, 2019-2021, 2023-2025
- Mathematics Department Undergraduate Program Committee, 2013-2016, 2017-2018, 2022-2024
- Mathematics Department Mathematics Education Program Committee, 2011-present
- College of Science, search committee chair for Center for Science Education Associate Director, 2024
- Mathematics Department, member of various tenure-track search committees, 2012, 2016, 2022, 2024
- Led the development of the course *MATH 5634 Research in Undergraduate Mathematics Education,* first offered Spring 2012 and made permanent in 2013
- Worked with department colleagues to develop the course *MATH 2114 Introduction to Linear Algebra,* first offered and made permanent in Fall 2014

COURSES TAUGHT AT VIRGINIA TECH

MATH 1114H Elementary Linear Algebra for Honors; MATH 2114 Introduction to Linear Algebra; MATH 3144 Linear Algebra I; MATH 4625 Mathematics for Secondary Teachers; MATH 4626 Mathematics for Secondary Teachers; MATH 4664 Senior Mathematics Education Seminar; MATH 5634 Research in Undergraduate Mathematics Education