

ELISE N. LOCKWOOD

Oregon State University
Department of Mathematics

Mailing address: 064 Kidder Hall, Corvallis, OR, 97331
Telephone: (541) 737-5164 Email: Elise.Lockwood@oregonstate.edu
Website: <http://combinatorialthinking.com>

PROFESSIONAL POSITIONS:

Associate Professor, Department of Mathematics, Oregon State University, Corvallis, OR.
September 2018 – present.

Assistant Professor, Department of Mathematics, Oregon State University, Corvallis, OR.
September 2013 – August 2018.

EDUCATION:

Postdoctoral Fellow, University of Wisconsin, Madison, WI. August 2011 – August 2013.
Funded through the IES Postdoctoral Training Program in Mathematical Thinking, Learning, and Instruction.
Advisers: Dr. Eric Knuth and Dr. Amy Ellis

Ph.D. in Mathematics Education, Portland State University, Portland, OR. July 2011.
Dissertation: *Student Approaches to Combinatorial Enumeration: The Role of Set-Oriented Thinking*.
Adviser: Dr. Sean Larsen

M.S.T. in Mathematics, Portland State University, Portland, OR. May 2006.
Project: *The Combinatorics and Pedagogy of Rook Polynomials*.
Adviser: Dr. John S. Caughman, IV

B.S. in Mathematics, Wheaton College, Wheaton, IL. May 2004.
Graduated Magna Cum Laude.

RESEARCH:

My primary research interest concerns the teaching and learning of combinatorics at the undergraduate level. My research has focused on students' combinatorial thinking, particularly the extent to which students draw upon sets of outcomes as they solve counting problems. My additional research on combinatorics education has leveraged the notion of actor-oriented transfer to identify student-generated connections among counting problems, investigated student reasoning about the multiplication principle, and examined the effects of listing on students' combinatorial activity. Through two NSF-funded grants, I am investigating students' generalizing activity as they solve advanced counting problems, and I am studying ways in which having students engage in computational activity can help them solve counting problems more successfully.

AWARDS & HONORS:

Promising Scholar Award. Annual University-wide award at Oregon State University that recognizes a junior faculty member based on outstanding scholarly merit. Fall 2019.

Fulbright U.S. Scholar Program Award Winner. Awards travel to scholars to facilitate international collaboration. Travel granted to Oslo, Norway in Fall 2019 for a project entitled Investigating the Role of Computing in Undergraduate Students' Learning of Mathematical Concepts. Fall 2019.

Dean's College of Science Early Career Impact Award Winner. Recognizes exceptional achievement in research and education by an early-career tenure-stream faculty member in the College of Science at Oregon State University. Fall 2018.

John and Annie Selden Prize Winner. Mathematical Association of America's prize for Research in Undergraduate Mathematics Education, honoring a researcher who has established a significant record of published research in undergraduate mathematics education and who has been in the field at most ten years. Fall 2018.

NSF CAREER Grant Award Winner. CAREER: Developing Undergraduate Combinatorial Curriculum in Computational Settings. 2017 – 2022.

Best Paper Award Winner. Lockwood, E. & Reed, Z. Students' meanings of a (potentially) powerful tool for generalizing in combinatorics. 19th Annual Conference for the SIGMAA on Research in Undergraduate Mathematics Education. Fall 2016.

Meritorious Citation Winner. Lockwood, E. & Schaub, B. 19th Reinventing the Multiplication Principle. Annual Conference for the SIGMAA on Research in Undergraduate Mathematics Education. Fall 2016.

Service, Teaching, and Research (STaR) Fellow. National Science Foundation funded mentorship project for early career mathematics education faculty. Service, Teaching, and Research. 2015 – 2016.

Association for Women in Mathematics Travel Award Winner. National prize given to women with PhDs in mathematics education for travel to mathematics conferences. Fall 2011, Fall 2014.

Best Paper Honorable Mention Award Winner. Lockwood, E., Ellis, A., & Knuth, E. Mathematicians' example-related activity when proving conjectures. 16th Annual Conference for the SIGMAA on Research in Undergraduate Mathematics Education. Fall 2013.

Best Paper Award Winner. Lockwood, E. A model of students' combinatorial thinking: The role of sets of outcomes. 15th Annual Conference for the SIGMAA on Research in Undergraduate Mathematics Education. Fall 2012.

Discovery Challenge Outstanding Poster Winner. Awarded best poster by the Wisconsin Alumni Research Found WARF during a poster section that facilitated interdisciplinary collaboration. Spring 2012.

SCHOLARSHIP & CREATIVE ACTIVITY

Refereed journal articles

- J1. **Lockwood, E.** (2011). Student connections among counting problems: An exploration using actor-oriented transfer. *Educational Studies in Mathematics*, 78(3), 307-322.
doi:10.1007/s10649-011-9320-7
- J2. **Lockwood, E.** (2013). A model of students' combinatorial thinking. *Journal of Mathematical Behavior*, 32, 251-265. doi:10.1016/j.jmathb.2013.02.008
- J3. **Lockwood, E.**, Johnson, E. M., & Larsen, S. (2013). Developing instructor support materials for an inquiry-oriented curriculum. *Journal of Mathematical Behavior*, 32(4), 776-790.
doi:10.1016/j.jmathb.2013.02.007
- J4. Larsen, S. & **Lockwood, E.** (2013). A local instructional theory for the guided reinvention of the quotient group concept. *Journal of Mathematical Behavior*, 32(4), 726-742.
doi:10.1016/j.jmathb.2013.02.010.
- J5. **Lockwood, E.** (2014a). A set-oriented perspective on solving counting problems. *For the Learning of Mathematics*, 34(2), 31-37.
- J6. **Lockwood, E.** (2014b). Both answers make sense! Using the set of outcomes to reconcile differing answers in counting problems. *Mathematics Teacher*, 108(4), 296-301.
- J7. Weber, E., & **Lockwood, E.** (2014). The duality between ways of thinking and ways of understanding: implications for learning trajectories in mathematics education. *Journal of Mathematical Behavior*, 35, 44-57. doi:10.1016/j.jmathb.2014.05.002.
- J8. **Lockwood, E.** & Knuth, E. (2014). A call for postdoctoral positions in mathematics education. *Journal for Research in Mathematics Education*, 45(5), 542-549.
- J9. **Lockwood, E.** & Weber, E. (2015). Connecting research to teaching: Ways of thinking and mathematical practices. *Mathematics Teacher*, 108(6), 461-465.
- J10. **Lockwood, E.**, Swinyard, C. A., & Caughman, J. S. (2015). Patterns, sets of outcomes, and combinatorial justification: Two students' reinvention of counting formulas. *International Journal of Research in Undergraduate Mathematics Education*, 1(1), 27-62.
doi:10.1007/s40753-015-0001-2.
- J11. **Lockwood, E.** (2015). The strategy of solving smaller, simpler problems in the context of combinatorial enumeration. *International Journal of Research in Undergraduate Mathematics Education*, 1(3), 339-362. doi:10.1007/s40753-015-0016-8.
- J12. **Lockwood, E.** & Caughman, J. S. (2016). Set partitions and the multiplication principle. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*, 26(2), 143-157.
doi:10.1080/10511970.2015.1072118.
- J13. **Lockwood, E.**, & Gibson, B. (2016). Combinatorial tasks and outcome listing: Examining productive listing among undergraduate students. *Educational Studies in Mathematics*, 91(2), 247-270. doi:10.1007/s10649-015-9664-5.
- J14. **Lockwood, E.**, Ellis, A. B., & Lynch, A. G. (2016). Mathematicians' example-related activity when exploring and proving conjectures. *International Journal of Research in Undergraduate Mathematics Education*, 2(2), 165-196. doi:10.1007/s40753-016-0025-2.
- J15. **Lockwood, E.** & Swinyard, C. A. (2016). An introductory set of activities designed to facilitate successful combinatorial enumeration for undergraduate students. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*, 26(10), 889-904.
doi:10.1080/10511970.2016.1194934.
- J16. **Lockwood, E.**, Reed, Z., & Caughman, J. S. (2017). An analysis of statements of the multiplication principle in combinatorics, discrete, and finite mathematics textbooks.

- International Journal of Research in Undergraduate Mathematics Education*, 3(3), 381-416. doi:10.1007/s40753-016-0045-y.
- J17. **Lockwood, E.** & Erickson, S. (2017). Undergraduate students' initial conceptions of factorials. *International Journal of Mathematical Education in Science and Technology*, 48(4), 499-519. doi:10.1080/0020739X.2016.1259517.
- J18. Ellis, A. B., Ozgur, Z., Vinsonhaler, R., Dogan, M. F., Carolan, T., **Lockwood, E.**, Lynch, A. G., Sabouri, P., Knuth, E., & Zaslavsky, O. (2017). Student thinking with examples: The criteria-affordances-purposes-strategies framework. Online first, *Journal of Mathematical Behavior*. doi:10.1016/j.jmathb.2017.06.003.
- J19. Lynch, A. G. & **Lockwood, E.** (2017). A comparison between mathematicians' and students' use of examples for conjecturing and proving. Online first, *Journal of Mathematical Behavior*. doi:10.1016/j.jmathb.2017.07.004.
- J20. **Lockwood, E.**, Wasserman, N. H., & McGuffey, W. (2018). Classifying combinations: Do students distinguish between different categories of combination problems? *International Journal of Research in Undergraduate Mathematics Education*, 4(2), 305-322. DOI: 10.1007/s40753-018-0073-x.
- J21. **Lockwood, E.** & Purdy, B. (2019). Two undergraduate students' reinvention of the multiplication principle. *Journal for Research in Mathematics Education* (50)3, 225-267.
- J22. **Lockwood, E.**, DeJarnette, A. F., & Thomas, M. (2019) Computing as a mathematical disciplinary practice. Online first in *Journal of Mathematical Behavior*. doi: 10.1016/j.jmathb.2019.01.004
- J23. **Lockwood, E.** & Purdy, B. (2019). An unexpected outcome: Students' focus on order in the multiplication principle. *International Journal of Research in Undergraduate Mathematics Education*. doi:10.1007/s40753-019-00107-3
- J24. **Lockwood, E.** & De Chenne, A. (2019). Using conditional statements in Python to reason about sets of outcomes in combinatorial problems. To appear in *International Journal of Research in Undergraduate Mathematics Education*. doi:10.1007/s40753-019-00108-2
- J25. **Lockwood, E.**, Caughman, J. S., & Weber, K. (In press). Multiple representation systems in binomial identities: Exploring proofs that explain. To appear in *Educational Studies in Mathematics*.
- J26. Odden, T. O. B., **Lockwood, E.**, & Caballero, M. D. (In press). Physics computational literacy: An exploratory case study using computational essays. *Physical Review Special Topics – Physics Education Research*.
- J27. **Lockwood, E.**, Reed, Z., & Erickson, S. Undergraduate students' combinatorial proof of binomial identities. Accepted with revision, *Journal for Research in Mathematics Education*.

Submitted refereed journal articles

- SJ1. Ellis, A., B., **Lockwood, E.**, Tillema, E., & Moore, K. C. Generalization across multiple mathematical areas: Relating, forming, and extending. Submitted.
- SJ2. **Lockwood, E.** & Reed, Z. Defining and demonstrating an equivalence way of thinking in enumerative combinatorics. Submitted.
- SJ3. Reed, Z. & **Lockwood, E.** Leveraging a categorization activity to facilitate productive generalizing activity and combinatorial reasoning. Submitted.
- SJ4. **Lockwood, E.** Computational representations in teaching counting problems. Submitted.
- SJ5. **Lockwood, E.**, Wasserman, N. H., & Tillema, E. S. A case for combinatorics: A research commentary. Submitted.

Non-Refereed (edited) journal articles

- NJ1. **Lockwood, E.** (2012). Counting using sets of outcomes. *Mathematics Teaching in the Middle School*, 18(3), 132-135.
- NJ2. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2017). What does active learning mean for mathematicians? *Notices of the American Mathematical Society*, 64(2), 124-129.
- NJ3. **Lockwood, E.** (2018). Students' combinatorial reasoning: Counting processes and sets of outcomes. *Notices of the American Mathematical Society*, 65(7), 821-823. doi: <http://dx.doi.org/10.1090/noti1705>.

Non-Refereed (edited) book and monograph chapters

- B1. **Lockwood, E.** & Reed, Z. (2018). Reinforcing mathematical concepts and developing mathematical practices through combinatorial activity. In E. W. Hart, E & J. Sandefur (Eds.), *Teaching and learning of discrete mathematics worldwide: Curriculum and research* (93-110). Cham, Switzerland: Springer.
- B2. Hauk, S., Infante, N., Rasmussen, C., **Lockwood, E.**, Zandieh, M., Brown, S., Lai, Y., & Hsu, P. (2018). Research in collegiate mathematics education. In A. Deines, D. Ferrero, E. Graham, M. S. Im, C. A. Manore, & C. Price (Eds.) *Advances in the mathematical sciences: AWM Research Symposium 2017. Association for Women in Mathematics Series Vol. 15* (245-268). Cham, Switzerland: Springer.
- B3. Cummings, J., **Lockwood, E.**, & Weber, K. (2019). Building a coherent research program that links abstract algebra to secondary mathematics pedagogy via disciplinary practices. To appear in N. Wasserman (Ed.) *Exploring advanced mathematics courses and content for secondary mathematics teachers*.
- B4. **Lockwood, E.** & Reed, Z. Using an actor-oriented perspective to explore one undergraduate student's repeated reference to a particular problem in a combinatorial context. To appear in C. Hohensee & J. Lobato (Eds.) *Transfer of learning: progressive perspectives for mathematics education and related fields*.

Refereed conference papers (* indicates submitted)

- RC1. **Lockwood, E.** (2012). A model of students' combinatorial thinking: The role of sets of outcomes. In S. Brown, S. Larsen, K. Marrongelle, and M. Oehrtman (Eds.), *Proceedings of the 15th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 1-15). Portland, OR: Portland State University. **Best Paper Award Winner**.
- RC2. Ellis, A. E., **Lockwood, E.**, Williams, C. C. W., Dogan, M. F., & Knuth, E. (2012). Middle school students' example use in conjecture exploration and justification. In L. R. Van Zoest, J. J. Lo, & J. L. Kratky (Eds.), *Proceedings of the 34th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 135-142). Kalamazoo, MI: Western Michigan University.
- RC3. **Lockwood, E.**, Ellis, A. E., Dogan, M. F., Williams, C. C. W., & Knuth, E. (2012). A framework for mathematicians' example-related activity when exploring and proving mathematical conjectures. In L. R. Van Zoest, J. J. Lo, & J. L. Kratky (Eds.), *Proceedings of the 34th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 151-158). Kalamazoo, MI: Western Michigan University.
- RC4. **Lockwood, E.**, Ellis, A., & Knuth, E. (2013). Mathematicians' example-related activity when proving conjectures. In S. Brown, G. Karakok, K. H. Roh, & M. Oehrtman (Eds.), *Proceedings of the 16th Annual Conference on Research on Undergraduate Mathematics*

- Education* (pp. 16-30). Denver, CO: Northern Colorado University. **Best Paper Honorable Mention.**
- RC5. **Lockwood, E.** (2013). Developing facility with sets of outcomes by solving smaller, simpler counting problems. In S. Brown, G. Karakok, K. H. Roh, & M. Oehrtman (Eds.), *Proceedings of the 16th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 323-337). Denver, CO: Northern Colorado University.
- RC6. Ellis, A. E., **Lockwood, E.**, Knuth, E., Dogan, M. F., & Williams, C. C. W. (2013). Choosing and using examples: How example activity can support proof insight. In A. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Annual Meeting of the International Group for the Psychology of Mathematics Education* (Vol. 2, pp. 265-272). Kiel, Germany.
- RC7. **Lockwood, E.**, Ellis, A. E., Knuth, E., Dogan, M. F., & Williams, C. C. W. (2013). Strategically chosen examples leading to proof insight: A case study of a mathematician's proving process. In M. Martinez & A. Castro Superfine (Eds.), *Proceedings of the 35th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 245-252). Chicago, IL: University of Illinois, Chicago.
- RC8. **Lockwood, E.** (2013). The Groups of Students problem: Insights about multiplication and implied order in combinatorial enumeration. In M. Martinez & A. Castro Superfine (Eds.), *Proceedings of the 35th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 409-416). Chicago, IL: University of Illinois, Chicago.
- RC9. **Lockwood, E.**, Swinyard, C., & Caughman, J. S. (2014). Examining students' combinatorial thinking through reinvention of basic counting formulas. In T. Fukawa-Connelly, G. Karakok, K. Keene, and M. Zandieh (Eds.), *Proceedings of the 17th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 169-184). Denver, CO: Northern Colorado University.
- RC10. Weber, E. & **Lockwood, E.** (2014). The duality principle and learning trajectories in mathematics education. In T. Fukawa-Connelly, G. Karakok, K. Keene, and M. Zandieh (Eds.), *Proceedings of the 17th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 351-366). Denver, CO: Northern Colorado University.
- RC11. **Lockwood, E.** & Gibson, B. (2014). Effects of systematic listing in correctly solving counting problems. In T. Fukawa-Connelly, G. Karakok, K. Keene, and M. Zandieh (Eds.), *Proceedings of the 17th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 153-168). Denver, CO: Northern Colorado University.
- RC12. Ellis, A. B., Weber, E., & **Lockwood, E.** (2014). The case for learning trajectories research. In P. Liljedahl, C. Nicol, S. Oesterle, & D. Allan (Eds.), *Proceedings of the 38th Annual Meeting of the International Group for the Psychology of Mathematics Education* (Volume 3, pp. 1-8). Vancouver, Canada.
- RC13. **Lockwood, E.**, Lynch, A. G., Ellis, A. B., & Knuth, E. (2014). Mathematicians' example-related activity in formulating conjectures. In P. Liljedahl, C. Nicol, S. Oesterle, & D. Allan (Eds.), *Proceedings of the 38th Annual Meeting of the International Group for the Psychology of Mathematics Education* (Volume 4, pp. 129-136). Vancouver, Canada.
- RC14. **Lockwood, E.**, Swinyard, C. A., & Caughman, J. S. (2015). Modeling outcomes in combinatorial problem solving: The case of combinations. In T. Fukawa-Connelly, N. Infante, K. Keene, and M. Zandieh (Eds.), *Proceedings of the 18th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 601-696). Pittsburgh, PA: West Virginia University.

- RC15. **Lockwood, E.** & Weber, E. (2015). Mathematicians' views of mathematical practice. In T. Fukawa-Connelly, N. Infante, K. Keene, and M. Zandieh (Eds.), *Proceedings of the 18th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 697-703). Pittsburgh, PA: West Virginia University.
- RC16. **Lockwood, E.**, Lynch, A. G., & Ellis, A. B. (2015). Exhaustive example generation: Mathematicians' uses of examples when developing conjectures. In T. Fukawa-Connelly, N. Infante, K. Keene, and M. Zandieh (Eds.), *Proceedings of the 18th Annual Conference on Research on Undergraduate Mathematics Education* (pp. 216-230). Pittsburgh, PA: West Virginia University.
- RC17. **Lockwood, E.**, Reed, Z., & Caughman, J. S. (2015). Categorizing statements of the multiplication principle. In Bartel, T. G., Bieda, K. N., Putnam, R. T., Bradfield, K., & Dominguez, H. (Eds.), *Proceedings of the 37th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, (pp. 80-87). East Lansing, MI: Michigan State University.
- RC18. **Lockwood, E.** & Reed, Z. (2016). Students' meanings of a (potentially) powerful tool for generalizing in combinatorics. In T. Fukawa-Connelly, N. Infante, M. Wawro, & S. Brown (Eds.), *Proceedings of the 19th Annual Conference on Research on Undergraduate Mathematics Education*, (pp. 1-16). Pittsburgh, PA: West Virginia University. **Best Paper Award Winner.**
- RC19. **Lockwood, E.** & Schaub, B. (2016). Reinventing the multiplication principle. In T. Fukawa-Connelly, N. Infante, M. Wawro, & S. Brown (Eds.), *Proceedings of the 19th Annual Conference on Research on Undergraduate Mathematics Education*, (pp. 31-45). Pittsburgh, PA: West Virginia University. **Meritorious Citation.**
- RC20. **Lockwood, E.** & Erickson, S. A. (2016). Students' conceptions of factorials prior to and within combinatorial contexts. In T. Fukawa-Connelly, N. Infante, M. Wawro, & S. Brown (Eds.), *Proceedings of the 19th Annual Conference on Research on Undergraduate Mathematics Education*, (pp. 1047-1054). Pittsburgh, PA: West Virginia University.
- RC21. **Lockwood, E.**, Wasserman, N., & McGuffey, W. (2016). Classifying combinations: Do students distinguish between different types of combination problems? In T. Fukawa-Connelly, N. Infante, M. Wawro, & S. Brown (Eds.), *Proceedings of the 19th Annual Conference on Research on Undergraduate Mathematics Education*, (pp. 296-309). Pittsburgh, PA: West Virginia University.
- RC22. **Lockwood, E.**, Asay, A., DeJarnette, A. F., & Thomas, M. (2016). Algorithmic thinking: An initial characterization of computational thinking in mathematics. In M. B. Wood, E. E. Turner, M. Civil, & J. A. Eli (Eds.), *Proceedings of the 38th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, (pp. 1588-1895). Tucson, AZ: The University of Arizona.
- RC23. Dorko, A. & **Lockwood, E.** (2016). What do students attend to when first graphing in R3? In M. B. Wood, E. E. Turner, M. Civil, & J. A. Eli (Eds.), *Proceedings of the 38th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, (pp. 565-572). Tucson, AZ: The University of Arizona.
- RC24. **Lockwood, E.** & Schaub, B. (2017). An unexpected outcome: Students' focus on order in the multiplication principle. In (Eds.). A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown, *Proceedings of the 20th Annual Conference on Research on Undergraduate Mathematics Education*, (pp. 715-722). San Diego, CA: San Diego State University.
- RC25. **Lockwood, E.** (2017). A preliminary investigation of the reification of "choosing" in counting problems. In (Eds.). A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S.

- Brown, *Proceedings of the 20th Annual Conference on Research on Undergraduate Mathematics Education*, (p. 1293-1298). San Diego, CA: San Diego State University.
- RC26. Ellis, A. B., Tillema, E., **Lockwood, E.**, & Moore, K. C. (2017). Generalization across domains: The relating-forming-extending generalization framework. To appear in the *Proceedings of the 39th Annual Meeting of the North American Chapter of the Psychology of Mathematics Education*. Indianapolis, IN: Indiana University.
- RC27. **Lockwood, E.**, Thomas, M. & DeJarnette, A. F. (2018). Computing as a mathematical disciplinary practice. In (Eds.). A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown, *Proceedings of the 21st Annual Conference on Research in Undergraduate Mathematics Education*, (pp. 458-465). San Diego, CA: San Diego State University
- RC28. **Lockwood, E.** & Reed, Z. (2018a). An initial exploration of students' reasoning about combinatorial proof. In (Eds.). A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown, *Proceedings of the 21st Annual Conference on Research in Undergraduate Mathematics Education*, (pp. 450-457). San Diego, CA: San Diego State University.
- RC29. **Lockwood, E.** & Reed, Z. (2018b). Leveraging specific contexts and outcomes to generalize in combinatorial settings. In the *Proceedings of the Second Conference of the International Network for Didactic Research in University Mathematics*, (pp. 244-253). Agder, Norway: University of Agder.
- RC30. Reed, Z. & **Lockwood, E.** (2018). Generalizing in combinatorics through categorization. In A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown (Eds.) *Proceedings of the 21st Annual Conference on Research in Undergraduate Mathematics Education*, (pp. 311-325). San Diego, CA: San Diego State University.
- RC31. **Lockwood, E.**, Caughman, J., & Weber, K. (In press). Multiple semantic representation systems in binomial identities: An exploration of proofs that explain and proofs that only convince. In Weinberg, A., Moore-Russo, D., Soto, H., & Wawro, M. (Eds.) *Proceedings of the 22nd Annual Conference on Research in Undergraduate Mathematics Education* (pp. 774-782). Oklahoma City, Oklahoma.
- RC32. **Lockwood, E.** (2019). Using a computational context to investigate student reasoning about whether “order matters” in counting problems. In Weinberg, A., Moore-Russo, D., Soto, H., & Wawro, M. (Eds.) *Proceedings of the 22nd Annual Conference on Research in Undergraduate Mathematics Education* (pp. 385-392). Oklahoma City, Oklahoma.
- RC33. **Lockwood, E.**, DeChenne, A., & Valdes-Fernandez, S. (2019). Affordances of solving counting problems in a computational environment. In Graven, M., Venkat, H., Essien, A. & Vale, P. (Eds). (2019). *Proceedings of the 43rd Conference of the International Group for the Psychology of Mathematics Education (Vol 3)* (pp. 41-48). Pretoria, South Africa: PME.
- RC34. Ellis, A., **Lockwood, E.**, & Lynch, A. G. Empirical re-conceptualization: Bridging from empirical patterns to insight and understanding. Accepted to the 23rd Annual Conference on Research in Undergraduate Mathematics Education.
- RC35. De Chenne, A. & **Lockwood, E.** Student verification practices for combinatorics problems in a computational environment. Accepted to the 23rd Annual Conference on Research in Undergraduate Mathematics Education.
- RC36. Erickson, S. & **Lockwood, E.** Investigating combinatorial provers' models of multiplication. Accepted to the 23rd Annual Conference on Research in Undergraduate Mathematics Education.
- RC37. Purdy, B. & **Lockwood, E.** An example of computational thinking in mathematics. Accepted to the 23rd Annual Conference on Research in Undergraduate Mathematics Education.

- RC38. **Lockwood, E.** & De Chenne, A. Preservice teachers' development of mathematical knowledge for teaching via combinatorial tasks in a computational setting. Accepted to the 14th International Congress on Mathematics Education.
- RC39. * Ellis, A. B., **Lockwood, E.**, & Lynch, A. G. Empirical re-conceptualization as a bridge to insight. Submitted to the International Conference of the Learning Sciences.

Non-refereed conference proceedings

- NRC1. Swinyard, C. A. & **Lockwood, E.** (2007). Research on students' reasoning about the formal definition of limit: An evolving conceptual analysis. *In the Electronic Proceedings for the 10th Annual Conference on Research on Undergraduate Mathematics Education*. San Diego, CA: San Diego State University.
- NRC2. Bartlo, J., Larsen, S., & **Lockwood, E.** (2008). Scaling up instructional activities: Lessons learned from a collaboration between a mathematician and mathematics education researcher. *In the Electronic Proceedings of the 11th Annual Conference on Research on Undergraduate Mathematics Education*. San Diego, CA: San Diego State University.
- NRC3. **Lockwood, E.** (2009). Investigating student approaches to counting problems: An exploration using the notion of actor-oriented transfer. *In the Electronic Proceedings for the 12th Annual Conference on Research on Undergraduate Mathematics Education*. Raleigh, NC: North Carolina State University.
- NRC4. **Lockwood, E.** (2010). An investigation of post-secondary students' understanding of two fundamental counting principles. *In the Electronic Proceedings for the 13th Annual Conference on Research on Undergraduate Mathematics Education*. Raleigh, NC: North Carolina State University.
- NRC5. **Lockwood, E.** & Strand, S. (2011). Student use of set-oriented thinking in combinatorial problem solving. In S. Brown, S. Larsen, K. Marrongelle, & M. Oehrtman (Eds.), *Proceedings of the 14th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 132-135). Portland, OR: Portland State University.
- NRC6. **Lockwood, E.**, Yeo, A., Crooks, N. M., Nathan, M. J. & Alibali, M. W. (2014). Teaching about confidence intervals: How instructors connect ideas using speech and gesture. In W. Penuel, S. A. Jurow, & K. O'Connor (Eds.), *Learning and Becoming in Practice: Proceedings of the Eleventh International Conference of the Learning Sciences* (pp. 1042-1046). Boulder, CO: University of Colorado.

Other written products (edited American Mathematics Society blog posts)

- O1. **Lockwood, E.** (2014). Striking the balance between examples and proof. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted July 2014. Editorially reviewed.
- O2. **Lockwood, E.** (2014). Some thoughts on the teaching and learning of mathematical practices. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted September 2014. Editorially reviewed.
- O3. **Lockwood, E.** (2014). Reading articles in mathematics education – it's not just for prospective teachers! American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted December 2014. Editorially reviewed.
- O4. **Lockwood, E.** (2015). Attending to precision: A need for characterizing and promoting careful mathematical work. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted June 2015. Editorially reviewed.

- O5. **Lockwood, E.** (2015). Let your students do some grading? Using peer assessment to help students understand key concepts. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted August 2015. Editorially reviewed.
- O6. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2015). Active learning in mathematics, Part I: The challenge of defining active learning. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted September 2015. Editorially reviewed.
- O7. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2015). Active learning in mathematics, Part II: Levels of cognitive demand. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted September 2015. Editorially reviewed.
- O8. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2015). Active learning in mathematics, Part III: Teaching techniques and environments. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted October 2015. Editorially reviewed.
- O9. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2015). Active learning in mathematics, Part IV: Personal reflections. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted October 2015. Editorially reviewed.
- O10. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2015). Active learning in mathematics, Part V: The role of “telling” in active learning. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted October 2015. Editorially reviewed.
- O11. Braun, B., Bremser, P., Duval, A., **Lockwood, E.**, & White, D. (2015). Active learning in mathematics, Part VI: Mathematicians’ training as teachers. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted November 2015. Editorially reviewed.
- O12. **Lockwood, E.** (2015). Don’t count them out – Helping students successfully solve combinatorial tasks. American Mathematical Society Blog *On Teaching and Learning Mathematics*. Posted December 2015. Editorially reviewed.

Additional conference presentations (not included among refereed or non-refereed conference papers, * denotes presenter)

- AC1. ***Lockwood, E.** “Here’s Rookin’ at You, Kid: Teaching Combinatorics Using Rooks on a Chessboard.” Annual spring meeting of the Pacific Northwest section of the Mathematical Association of America (MAA). Southern Oregon University. July 2006.
- AC2. ***Lockwood, E.** “Set-Oriented Thinking and the Evaluation of Alternative Solutions in Counting Problems.” Joint Mathematics Meetings. New Orleans, LA. January 2011.
- AC3. ***Lockwood, E.** “A Model of Students’ Combinatorial Thinking.” Joint Mathematics Meetings. Boston, MA. January 2012.
- AC4. ***Lockwood, E.** “A Model of Students’ Combinatorial Thinking: The Role of Sets of Outcomes.” Joint Mathematics Meetings (JMM). San Diego, CA. January 2013. **Invited talk.**
- AC5. *Ellis, A. B., **Lockwood, E.**, Williams, C. C., Dogan, M. F., & Knuth, E. “How Students Use Examples When Developing Proofs.” Presented in the Paper Session, “*Choosing and Using Examples: A Promising Road to Proof?*” at the Annual Meeting of the American Education Research Association (AERA). San Francisco, CA. April 2013.
- AC6. ***Lockwood, E.**, Ellis, A. B., Dogan, M. F., Williams, C. C., & Knuth, E. “Mathematicians’ Example-Related Activity When Exploring and Proving Mathematical Conjectures.” Presented in the Paper Session, “*Choosing and Using Examples: A Promising Road to Proof?*” at the Annual Meeting of the American Education Research Association (AERA). San Francisco, CA. April 2013.

- AC7. Ellis, A. E., **Lockwood, E.**, Knuth, E., Williams, C. C., & *Dogan, M. F. “How Does Example Use Influence Conjecturing and Proving?” Research Pre-Session of the 91st Annual Meeting of the National Council of Teachers of Mathematics (NCTM). Denver, CO. April 2013.
- AC8. ***Lockwood, E.** “Developing Instructor Support Materials in an Inquiry-Oriented Curriculum.” Invited Special Session of the Fall Southeastern Regional meeting of the American Mathematical Society (AMS). Louisville, KY. October 2013.
- AC9. ***Lockwood, E.** “Fostering the Development of Mathematical Practices.” Invited Panel at the Joint Mathematics Meetings (JMM). San Antonio, TX. January 2015. **Invited talk.**
- AC10. *Reed, Z. & **Lockwood, E.** “Examining Student Generalizing Activity in an Accessible Combinatorial Task.” Joint Mathematics Meetings (JMM). Seattle, WA. January 2016.
- AC11. ***Lockwood, E.** & *Schaub, B. “Student Interpretations of Textbook Statements of the Multiplication Principle.” Joint Mathematics Meetings (JMM). Seattle, WA. January 2016.
- AC12. *Erickson, S. A. & **Lockwood, E.** “Listing as a Potential Connection between Sets of Outcomes and Counting Processes.” Joint Mathematics Meetings (JMM). Seattle, WA. January 2016.
- AC13. *Caughman, J. C., **Lockwood, E.**, & Reed, Z. “Deconstructing and Reconstructing the Multiplication Principle.” Annual meeting of the Pacific Northwest section of the Mathematical Association of America (MAA). Oregon State University. April 2016.
- AC14. *Ellis, A. E., ***Lockwood, E.**, *Tillema, E., & *Moore, K. C. “Generalization Across Multiple Mathematical Areas.” Research Symposium presented at the Research Pre-Session of the 94th Annual Meeting of the National Council of Teachers of Mathematics (NCTM). San Francisco, CA. April 2016.
- AC15. ***Lockwood, E.** “Eliciting Student Understanding of Mathematical Aspects of the Multiplication Principle.” Presentation at the research Pre-Session of the 94th Annual Meeting of the National Council of Teachers of Mathematics (NCTM). San Francisco, CA. April 2016.
- AC16. ***Lockwood, E.** “Generalization in students’ combinatorial thinking.” 13th Annual International Congress on Mathematics Education. Hamburg, Germany. July 2016.
- AC17. ***Lockwood, E.** “Exploring Undergraduate Students’ Generalizing Activity: Two Contrasting Cases from a Combinatorial Context.” Oklahoma Research on Undergraduate Mathematics Education (OKRUME) conference. Stillwater, OK. August 2016. **Invited plenary.**
- AC18. ***Lockwood, E.** & Reed, Z. “Students’ Meanings of a (Potentially) Powerful Generalized Representation in a Combinatorial Setting.” Joint Mathematics Meetings. Atlanta, GA. January 2017. **Invited talk.**
- AC19. ***Lockwood, E.** “How to Help Your Students Prove Combinatorial Identities.” Joint Mathematics Meetings. Atlanta, GA. January 2017.
- AC20. ***Lockwood, E.** “Examining Students’ Combinatorial Reasoning: The Case of the Multiplication Principle.” Association for Women in Mathematics Research Symposium. Los Angeles, CA. April 2017.
- AC21. ***Lockwood, E.** & *Erickson, S. “Don’t Count Them Out! Helping Your Students Successfully Solve Counting Problems.” Northwest Mathematics Conference. Portland, OR. October 2017.
- AC22. ***Lockwood, E.** “Reinventing the Multiplication Principle.” Joint Mathematics Meetings. San Diego, CA. January 2018.

- AC23. ***Lockwood, E.** “Leveraging Computing to Teach Mathematical Content: The Case of Programming and Productive Combinatorial Thinking.” Annual American Mathematical Society (AMS) Spring Western Sectional Meeting. Portland State University. April 2018.
- AC24. ***Lockwood, E.** “Initial Conversations about Incorporating Computational Thinking and Activity into Mathematics Classrooms.” Working Group. The Inquiry Based Learning and Teaching in Mathematics Conference. Austin, TX. May 2018.
- AC25. ***Lockwood, E.** “An Initial Exploration into Undergraduate Students’ Computational Activity in a Combinatorial Setting.” Mathfest. Denver, CO. August 2018.
- AC26. *De Chenne, A. & **Lockwood, E.** “Student Verification Schemes for Combinatorial Problems in a Computational Setting.” Annual meeting of the Pacific Northwest section of the Mathematical Association of America (MAA). University of Portland. April 2019.
- AC27. ***Lockwood, E.** & Reed, Z. “Using a Categorization Activity to Develop Students’ Reasoning about Fundamental Counting Formulas.” Joint Mathematics Meetings. Denver, CO. January 2020.
- AC28. *De Chenne, A. & **Lockwood, E.** “Connecting Sets of Outcomes with Counting Processes: What is the m th Element?” Joint Mathematics Meetings. Denver, CO. January 2020.
- AC29. *Caughman, J. & **Lockwood, E.** “The Power of Nested Loops.” Joint Mathematics Meetings. Denver, CO. January 2020.
- AC30. ***Lockwood, E.** “Using a Computational Context to Investigate Student Reasoning About Whether “Order Matters” in Counting Problems.” Joint Mathematics Meetings. Denver, CO. January 2020. **Invited talk.**

Posters (not included among refereed or non-refereed conference papers or additional conference presentations, ^ indicates refereed poster)

- P1. **Lockwood, E.** “The Role of Sets of Outcomes in Students’ Combinatorial Thinking.” Poster presented at the University of Wisconsin – Madison’s Wisconsin Alumni Research Foundation (WARF) Discovery Challenge. Madison, WI. May 2012. **Best Poster Award.**
- P2. **Lockwood, E.** “The Role of Sets of Outcomes in Combinatorial Thinking.” Conference on Transforming Research in Undergraduate Stem Education (TRUSE). St. Paul, MN. June 2012.
- P3. ^**Lockwood, E.** “Students’ Uses of Smaller Problems when Counting.” 34th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Kalamazoo, MI: Western Michigan University. November 2012.
- P4. **Lockwood, E.** “What Role Do Examples Play in Exploring and Proving Conjectures? Making a Case for Sophisticated Example-Related Activity.” Wisconsin Center for Education Research (WCER) poster fair. Madison, WI. November 2012.
- P5. **Lockwood, E.** “Categorizing Student-Generated Connections from an Actor-Oriented Transfer Perspective.” Presented in the Poster Session, *The Transfer Showcase: Exciting Contemporary Advances About an Educationally Central Phenomenon* at the Annual Meeting of the American Education Research Association (AERA). San Francisco, CA. April 2013. **Invited Poster.**
- P6. ^Reed, Z. & **Lockwood, E.** “On the Variety of the Multiplication Principle’s Presentation in College Texts.” 19th Annual Conference on Research on Undergraduate Mathematics Education (RUME). Pittsburgh, PA: West Virginia University. February 2016.
- P7. ^McGee, S., Erickson, S., & **Lockwood, E.** “Student Attitudes, Beliefs, and Experiences Related to Counting Problems.” 20th Annual Conference on Research on Undergraduate

Mathematics Education (RUME). San Diego, CA: San Diego State University. February 2017.

- P8. **Lockwood, E.** “Combinatorial Thinking in Computational Settings: An Initial Theoretical Discussion.” Conference on Transforming Research in Undergraduate Stem Education (TRUSE). St. Paul, MN. July 2017.
- P9. **Lockwood, E.** “CAREER: Developing Undergraduate Combinatorial Curriculum in Computational Settings.” Joint Mathematics Meetings (JMM). San Diego, CA. January 2018.

Invited Colloquia and Presentations

- IC1. **Lockwood, E.** “Here’s Rookin’ at You, Kid: The Combinatorics and Pedagogy of Rook Polynomials.” Digipen Institute of Technology, Department of Mathematics. November 2006.
- IC2. **Lockwood, E.** “Here’s Rookin’ at You, Kid: The Combinatorics and Pedagogy of Rook Polynomials.” University of Portland, Department of Mathematics. October 2008.
- IC3. **Lockwood, E.** “Here’s Rookin’ at You, Kid: The Combinatorics and Pedagogy of Rook Polynomials.” Pacific University, Department of Mathematics. October 2008.
- IC4. **Lockwood, E.** “Here’s Rookin’ at You, Kid: The Combinatorics and Pedagogy of Rook Polynomials.” Linfield College, Department of Mathematics. February 2009.
- IC5. **Lockwood, E.** “Here’s Rookin’ at You, Kid: The Combinatorics and Pedagogy of Rook Polynomials.” Clackamas Community College, Department of Mathematics. May 2010.
- IC6. **Lockwood, E.** “Students’ Uses of a Set-Theoretic Perspective to Solve Counting Problems.” University of Wisconsin – Madison, Department of Curriculum and Instruction. March 2011. **Lockwood, E.** “Students’ Uses of a Set-Theoretic Perspective to Solve Counting Problems.” Arizona State University, Department of Mathematics. February 2011.
- IC7. **Lockwood, E.** “Students’ Uses of a Set-Theoretic Perspective to Solve Counting Problems.” University of New Hampshire, Department of Mathematics. February 2011.
- IC8. **Lockwood, E.** “Students’ Uses of a Set-Theoretic Perspective to Solve Counting Problems.” University of Wisconsin – Eau Claire, Department of Mathematics. February 2011.
- IC9. **Lockwood, E.** “Students’ Uses of a Set-Theoretic Perspective to Solve Counting Problems.” Salisbury University, Department of Mathematics. February 2011.
- IC10. **Lockwood, E.** “Students’ Uses of a Set-Theoretic Perspective to Solve Counting Problems.” University of Oklahoma, Department of Mathematics. February 2011.
- IC11. **Lockwood, E.** “A Model of Students’ Combinatorial Thinking: The Role of Sets of Outcomes.” Oregon State University, Department of Mathematics. February 2012.
- IC12. **Lockwood, E.** “You’re Close but You’re Off by a Million: Helping Students Solve Counting Problems.” University of Portland, Department of Mathematics. October 2013.
- IC13. **Lockwood, E.** “You’re Close but You’re Off by a Million: Helping Students Count Effectively.” University of Kentucky, Department of Mathematics. October 2013.
- IC14. **Lockwood, E.** “Examining Students’ Combinatorial Thinking through Reinvention of Basic Counting Formulas.” San Diego State University, Center for Research on Science and Mathematics Education (CRMSE). March 2014.
- IC15. **Lockwood, E.** “Examining Students’ Combinatorial Thinking through the Reinvention of Four Basic Counting Formulas.” University of Portland, Department of Mathematics. March 2014.

- IC16. **Lockwood, E.** “Here’s Rookin’ at You, Kid: Rook Polynomials as a Unifying Combinatorial Concept.” Pacific University, Department of Mathematics. September 2015.
- IC17. **Lockwood, E.** “You’re Close, but You’re Off by a Million: Helping Students Successfully Solve Counting Problems.” Virginia Tech, Department of Mathematics. February 2016.
- IC18. **Lockwood, E.** “Isn’t It Just Intuitive? Investigating Mathematical Subtleties of the Multiplication Principle.” Oklahoma State University, Department of Mathematics. August 2016.
- IC19. **Lockwood, E.** “Investigating Students’ Generalizing Activity: Two Contrasting Cases of Undergraduates in a Combinatorial Context.” University of Georgia, Mathematics Education Student Association. September 2016.
- IC20. **Lockwood, E.** “Investigating Undergraduate Students’ Generalizing Activity: Two Contrasting Cases from a Combinatorial Context.” University of California – Berkeley, Graduate School of Education. April 2017.
- IC21. **Lockwood, E.** “Investigating Subtleties of the Multiplication Principle.” Oregon State University, Mathematics Department. September 2017.
- IC22. **Lockwood, E.** “Computational Thinking in STEM Disciplines: Perspectives from a Mathematics Education Researcher.” Christmas Seminar, University of Oslo, Center for Computing in Science Education. December 2017.
- IC23. **Lockwood, E.** “A Model of Students’ Combinatorial Reasoning: A Case Study in Mathematics Education Research.” University of Oslo, Mathematics Department. December 2017.
- IC24. **Lockwood, E.** “Investigating Subtleties of the Multiplication Principle.” Michigan State University, Program in Mathematics Education. January 2018.
- IC25. **Lockwood, E.** “Leveraging Generalization in Instruction: Examples from Combinatorics and Real Analysis.” University of Oslo, Mathematics Department. April 2018.
- IC26. **Lockwood, E.** “Investigating Students’ Combinatorial Reasoning in a Computational Setting: Using Programming to Distinguish Four Fundamental Types of Counting Problems.” Texas State University, Mathematics Department. October 2018.
- IC27. **Lockwood, E.** “Investigating Students’ Combinatorial Reasoning in a Computational Setting: Using Programming to Distinguish Four Fundamental Types of Counting Problems.” University of Bridgeport, Mathematics Department. December 2018.
- IC28. **Lockwood, E.** “Computational Thinking and Activity in STEM Education: What Happens When Math Students Engage with Python Code.” Yale University, STEM Education Seminar Series. December 2018.
- IC29. **Lockwood, E.** “Investigating Students’ Combinatorial Reasoning in a Computational Setting: Using Programming to Distinguish Fundamental Types of Counting Problems.” University of Oslo, Mathematics Department. March 2019.
- IC30. **Lockwood, E.** “Investigating Students’ Combinatorial Reasoning in a Computational Setting: Using Programming to Distinguish Fundamental Types of Counting Problems.” Clackamas Community College, STEM Talk Seminar Series. April 2019.
- IC31. **Lockwood, E.** “Integrating Computing in Mathematics Education: Why Should We Do It, and How Can We Start?” Norwegian University of Science and Technology (NTNU), Department of Mathematical Sciences. Trondheim, Norway. November 2019.

Other Presentations

- OP1. **Lockwood, E.** “Matchings Polynomials are the Coolest Things Ever!” Invited lecture for the Graph Portland Area Lecture Series. November 2006.

- OP2. **Lockwood, E.** “The Role of Examples in Proving: Implications for Courses on Mathematical Proof and Proving.” Invited lecture and discussion session at a workshop for courses in Mathematical Proof and Proving. New York University. May 2013.
- OP3. **Lockwood, E.** “Reinventing Permutations and Combinations.” Mathematics Education Seminar. Oregon State University. February 2014.
- OP4. **Lockwood, E.** “Here’s Rookin’ at You, Kid: Rook Polynomials as a Unifying Combinatorial Concept.” Discrete mathematics seminar, Portland State University. February 2015.
- OP5. **Lockwood, E.** “Celebrating Individual Success.” Mentoring Partnerships for Women in RUME (MPWR). Invited presentation. Pittsburgh, PA. February 2015.
- OP6. **Lockwood, E.** “Actor-Oriented Transfer in Combinatorial Tasks.” Mathematics Education Seminar. Washington State University. March 2016.
- OP7. **Lockwood, E.** “Giving Students Opportunities to Explore Examples in the Classroom.” Challenge Workshop for Portland State University. Invited presentation. Portland, OR. March 2016.
- OP8. **Lockwood, E.** “Subtleties of the Multiplication Principle.” Discrete mathematics seminar, Portland State University. May 2016.
- OP9. **Lockwood, E.** “Investigating Mathematical Subtleties of the Multiplication Principle.” Research Experience in Undergraduate Colloquia Series. Oregon State University. July 2016.
- OP10. **Lockwood, E.** “Algorithmic Thinking: An Initial Characterization of Computational Thinking in Mathematics.” Mathematics Education Seminar. Oregon State University. November 2016.
- OP11. **Lockwood, E.** “Leveraging Computing to Teach Mathematical Content: The Case of Programming and Productive Combinatorial Thinking.” Research Experience in Undergraduate Colloquia Series. Oregon State University. July 2018.
- OP12. **Lockwood, E.** “Investigating Students’ Combinatorial Reasoning in a Computational Setting: Using Programming to Distinguish Four Fundamental Types of Counting Problems.” Mathematics Education Seminar. Oregon State University. October 2018.
- OP13. **Lockwood, E.** “Investigating undergraduate students’ generalizing activity: two contrasting cases from a combinatorial context.” Mathematics Education Seminar. Texas State University. October 2018.

RESEARCH SUPPORT:

Co-Principal Investigator, *Generalization Across Multiple Mathematical Areas – Classrooms and Teaching Areas* [in collaboration with Amy B. Ellis (Principal investigator), University of Georgia, Kevin Moore (Co-principal investigator), University of Georgia, and Erik Tillema (Co-principal investigator), IUPUI]. Oregon State University. \$1,499,857. Sub-award to OSU is \$293,992. National Science Foundation EHR Core – 1920538. 2019 – 2022.

Co-Principal Investigator, *Integrating CS Education into Teacher Education and K-12 Mathematics* [in collaboration with Jennifer Parham-Mocello (Principal investigator) and Rebekah Elliott (Co-principal investigator)], Oregon State University. \$141,800. Google. 2019 – 2020.

Project Member. *International Partnership for Computing in Science Education*. INTPART (funded in Norway). Morten Hjorth-Jensen, Principle Investigator. Travel partnership grant for

travel between the University of Oslo, Michigan State University, and Oregon State University. 4.5 million Norwegian Kroner (~\$529,000 USD) over three years. 2019 – 2022.

Principal Investigator, *CAREER: Developing Undergraduate Combinatorial Curriculum In Computational Settings*. \$803,354. National Science Foundation Department of Undergraduate Education (DUE) – 1650943. 2017 – 2022.

Co-Principal Investigator, *Generalization Among Multiple Mathematical Areas* [in collaboration with Amy B. Ellis (Principal investigator), UW-Madison, Kevin Moore (Co-principal investigator), University of Georgia, and Erik Tillema (Co-principal investigator), IUPUI]. \$1,499,908. Sub-award to OSU is \$336,377. National Science Foundation Research on Education and Learning (REAL) – 1419973. 2014 – 2017.

Co-Principal Investigator, *Improving Understanding of Student Combinatorial and Statistical Concept Learning Using Machine Learning* [in collaboration with Bryan R. Gibson, UW-Madison]. \$5,000. Sub-award is \$2,500. Wisconsin Alumni Research Foundation. 2012 – 2013.

Undergraduate Research, Scholarship and the Arts (URSA) Engage Award. \$250 for research funds to work with an undergraduate student. The student, Caitlin Pellerin, receives a \$1,000 scholarship for her contributions to the work.

L.L. Stewart Faculty Development Award. \$1700 awarded for faculty development. Oregon State University. Winter 2014.

OTHER AWARDS AND HONORS:

Faculty Release Time Award. University-wide award at Oregon State University for release from teaching a course. Spring 2015.

President's Commission on the Status of Women Travel Award. \$500 University-wide travel award. Oregon State University. Fall 2013.

Brose Memorial Scholarship. Awarded to select graduate students based on academic achievements and potential. Mathematics Department, Portland State University. 2010 – 2011.

Academically Controlled Auxiliary Activities Travel Award. Awarded to select PSU graduate students. Portland State University. Spring 2010.

Marie Brown Travel Award. Awarded to select PSU graduate students. Portland State University. Spring 2009.

Award for Excellence in Teaching. ITT Technical Institute, Portland, OR. Spring 2008.

TEACHING EXPERIENCE:

COURSES TAUGHT AT OREGON STATE UNIVERSITY:

- **Elements of Discrete Mathematics** (Math 231). Fall 2017.

- **Calculus II – Integral Calculus** (Math 251). Winter 2017.
- **Discrete Mathematics** (Math 355). Winter 2014, Fall, 2015.
- **Linear Algebra** (Math 341). Fall 2014.
- **Algebra and Geometric Transformations I, II, III** (Math 4/591, 4/592, 4/593). Fall 2014, Winter 2015. Fall 2016, Winter 2017. Fall 2018, Winter 2019, Spring 2019.
- **Introduction to Combinatorial Mathematics** (Math 4/599). Spring 2019.
- **Teaching and Learning Probability and Statistics** (Math 682). Winter 2014.
- **Computers and Mathematics** (Math 684). Winter 2018.
- **Advanced Problem Solving** (Math 685). Fall 2013. Fall 2015.
- **Topics in Mathematics Education – Advanced Combinatorics** (Math 689). Spring 2014.
- **Topics in Mathematics Education – Introduction to Research on Undergraduate Mathematics Education** (Math 689). Winter 2016.
- **Topics in Mathematics Education – Introduction to Research in Mathematics Education** (Math 689). Fall 2017.

COURSES TAUGHT AT PORTLAND STATE UNIVERSITY:

- **Elementary College Mathematics** (Math 070). Fall 2007.
- **Excursions in Mathematics** (Math 105). Winter 2008, Winter 2010.
- **Introductory College Mathematics I and II** (Math 111, 112). Fall 2005 (I), Fall 2006 (I), Winter 2006 (II), Fall 2006 (I), Winter 2007 (II), Spring 2007 (I).
- **Foundations of Elementary Mathematics I and II** (Math 211, 212). Summer 2006 (I), Summer 2007 (I), Spring 2008 (II), Summer 2008 (I), Fall 2008 (I), Summer 2008 (I), Fall 2010 (I).
- **Calculus I, II, and III** (Math 251, 252, 253). Spring 2006 (I), Spring 2009 (I), Fall 2009 (II), Spring 2011 (I), Winter 2010 (III), Spring 2010 (III).
- **Discrete Mathematics** (Math 356). Winter 2009, Summer 2010.
- **Introduction to Combinatorial Analysis** (Math 487/587). Summer 2008.

COURSES TAUGHT AT MULTNOMAH UNIVERSITY:

- **Contemporary Mathematics** (Math 110). Spring 2009.

COURSES TAUGHT AT ITT TECHNICAL INSTITUTE:

- **Problem Solving** (Math GE-184). Spring 2008.

STUDENTS SUPERVISED:

Major adviser (PhD)

Adaline De Chenne (PhD, Mathematics Department, Expected Spring 2022)

Branwen Purdy (PhD, Mathematics Department, Expected Spring 2021)

Sarah Erickson (PhD, Mathematics Department, Expected Spring 2020)

Zackery Reed (PhD, Mathematics Department, Summer 2018). Dissertation:

Undergraduate Students' Generalizing Activity in Real Analysis: Constructing a General Metric.

Allison Dorko (PhD, College of Education, Spring 2017). Dissertation: *Students'*

Generalization of Function from Single to Multivariable Settings.

Committee Member (PhD)

Leah Sturman (PhD, Mathematics Department, Expected Spring 2022)
Sylvia Valdes-Fernandez (PhD, College of Education, Expected Spring 2021)
Erin Glover (PhD, College of Education, Fall 2019)
Claire Gibbons (PhD, Mathematics Department, Spring 2019)
Michael Renne (PhD, Mathematics Department, Spring 2019)
Cecilia Tomcal (PhD, College of Education, 2018-2019)
Ally Stacy (PhD, Mathematics Department, 2018-2019)

External Dissertation Committee Member

Elisha VanMeenen (PhD, Department of Education, Illinois State University, Expected Spring 2020)
Michael Hicks (PhD, Department of Mathematics, Texas State University, Expected Spring 2021)
Odd Petter Sand (PhD, Department of Physics, University of Oslo, Expected Spring 2021)
Christian Woods (PhD, Department of Education, Rutgers University, Expected Spring 2021)

External Dissertation Reader

Michael Tallman (PhD, Mathematics Department, Arizona State University, July 2015)

Major adviser (Master's)

Adaline De Chenne (MS, Mathematics Department, Expected Winter 2020)
Samantha McGee (MS, Mathematics Department, Summer 2017). Thesis: *Student Affect Towards Mistakes in the Context of Counting*.
Kevin Cramer (MS, Mathematics Department, Spring 2017). Expository paper: *Amazing Graze: Milking the Cow Problem for Insights about Parametric Integration*.
Sarah Erickson (MS, Mathematics Department, Fall 2015). Thesis: *Listing as a Potential Connection Between Sets of Outcomes and Counting Processes*.
Kathryn Williams (MS, Mathematics Department, Spring 2014). Expository paper: *Function Transformation: A Triple Threat Approach*.

Committee Member (Master's)

Jonathan Alfson (MS, Physics Department, Expected Spring 2019)
Amanda Petty (MS, Mathematics Department, Summer 2019)
Mesa Walker (MS, Mathematics Department, Spring 2019)
Leah Sturman (MS, Mathematics Department, Spring 2019)
Nick Ingalls (MS, College of Education, Spring 2018)
Bryant Rominger (MS, College of Education, Spring 2018)
Kate Stevens (MS, College of Education, Spring 2018)
Bin Zhang (MS, Mathematics Department, Summer 2017)
Chris Watkins (MS, Mathematics Department, Winter 2017)
Sharon Green (MS, Mathematics Department, Summer 2016)
Raven Dean (MS, Mathematics Department, Winter 2016)
Zackery Reed (MS, Mathematics Department, Fall 2015)
Evan Hedlund (MS, Mathematics Department, Fall 2015)
Eric Fleming (MS, Mathematics Department, Fall 2015)
Matthew Keeling (MS, Mathematics Department, Fall 2015)
Candice Ruscher (MS, College of Education, Spring 2015)
Kaylee Roderick (MS, College of Education, Spring 2015)
Brandon Johnson (MS, College of Education, Spring 2015)
Zac Hervey (MS, College of Education, Spring 2014)

Kyle May (MS, College of Education, Spring 2014)
Krista Foltz (MS, Mathematics Department, Spring 2014)
Allan Boone (MS, Mathematics Department, Spring 2014)

External Master's Thesis Co-adviser

Konrad Thoresen (MS, Mathematics Department, University of Oslo, June 2019)
Anna Katrine Bækkelie (MS, Mathematics Department, University of Oslo, June 2019)

External Master's Thesis Committee Member

Jalini Srisgantharajah (MS, Mathematics Department, University of Oslo, June 2018)

Major adviser (Undergraduate)

Michael Aimonetto (Honor's Thesis, College of Science, Spring 2019)
Cheyenne Gordon (Honors Thesis, College of Science, Spring 2019)
Caitlin Pellerin (Honor's Thesis, College of Engineering, 2015-2016)

Committee Member (Undergraduate)

Josey Sechrist (Honor's Thesis, Mathematics Department, Spring 2016)
Sarah Kerrigan (Honor's Thesis, Mathematics Department, Spring 2015)

OTHER EXPERIENCE:

UNIVERSITY SERVICE

SciRIS II Proposal Reviewer. Responsibilities include reviewing proposals for the College of Science's SciRIS program. Winter 2019.

Learning Innovation Grant Reviewer. Responsibilities include reviewing proposals for the University's Learning Innovation Grant program. 2018 – 2019.

Search Committee Member. Responsibilities include regular meetings and review of candidates for a Mathematics Education Hire in the College of Education. 2018 – 2019.

SURE Science Proposal Reviewer. Responsibilities include reviewing proposals for the College of Science's SURE Science Program. Spring 2016.

DEPARTMENTAL SERVICE

Department Advisory Committee Member. Elected position on an advisory committee, which serves as a means of communication between the department and the department head. 2018 – 2019.

Graduate Committee Member. Responsibilities include reviewing applications and selecting incoming graduate students, addressing graduate student matters that arise, making decisions about petitions or special circumstances related to graduate students, and discussing graduate curriculum issues. The committee meets regularly (weekly or bi-weekly) throughout the academic year. 2013 – 2019.

Math Club Faculty Adviser. Responsibilities include regular (approximately monthly) meetings with members of the Math Club, attending and supporting social events put on by the

club, helping with elections, and generally providing support to the officers and to the Club. 2013 – 2018.

Student Competition Coordinator. Responsibilities include recruiting, planning for, and proctoring two national mathematics competitions (the Putnam Exam and the Virginia Tech Regional Mathematics Competition). In 2014 – 2015 organized and ran a one-hour Student Competition study session was held in the fall term. 2013 – 2016.

Student Organizations and Clubs Committee Chair. Responsibilities include delegating and overseeing faculty advising of Math Club, SIAM, Pi Mu Epsilon, Student Competitions, and the Association for Women in Mathematics. 2015 – 2016.

Association for Women in Mathematics Faculty Adviser. Responsibilities include working with student representatives of the Association for Women in Mathematics. 2015 – 2018.

Local Organizing Committee Member for the 2016 Meeting of the Pacific Northwest Chapter of the Mathematical Association of America (PNWMAA). Responsibilities include working with other local organizers to manage details of the conference planning. Specifically, this has involved coordinating student volunteers, planning student activities, and managing catering details. 2015 – 2016.

Graduate Teaching Assistant (GTA) Workshop and Orientation Committee Member. Responsibilities include planning and running the 3-day orientation workshop before the start of the fall term. This involves facilitating teaching demonstrations, making presentations, evaluating teaching episodes, and generally providing support and input. GTA 2013 – 2019.

Undergraduate Advising Committee Member. Responsibilities include biannual meetings with approximately 15 secondary education mathematics majors and helping to schedule their upper-division coursework. 2014 – 2015.

Teaching Committee Contributor. Responsibilities include observing instructors, filling out an observation report, and meeting with the observed instructor. This occurs approximately 1-2 times per year. 2014 – 2019.

PROFESSIONAL SERVICE

Chair of Topic Study Group on Discrete Mathematics at the quadrennial International Congress on Mathematics Education (ICME) to be held in Shanghai, China in 2020. Responsibilities include providing a written description of the TSG, inviting speakers, reviewing abstracts, and running the session in Shanghai. 2018 – present.

Editorial Board Member for the *Journal of Mathematical Behavior* (JMB). Responsibilities include reviewing several manuscripts per year and engaging in strategic discussions about directions for the journal. Two-year term beginning January 2019.

Editorial Board Member for the *International Journal on Research in Undergraduate Mathematics Education* (IJRUME). Responsibilities include reviewing several manuscripts per year. Three-year term beginning April 2016.

Founding Contributing Editor for the American Mathematical Society (AMS) blog “On Teaching and Learning Mathematics.” Responsibilities include writing and recruiting 6 posts a year and overseeing organizational matters. March 2014 – July 2016.

Treasurer for the Special Interest Group of the Mathematical Association of America on Research on Mathematics Education (SIGMAA on RUME). Elected as treasurer for the Special Interest Group of the MAA on Research on Undergraduate Mathematics Education. February 2015 – present.

Program Committee Member for the Conference on Research on Mathematics Education (RUME). Responsibilities include participation in in-person and virtual planning meetings and reviewing conference proposals. 2012 – 2019.

Special Session Organizer (National Conference). Co-organizing (with John Caughman, Art Duval, Oscar Levin) a special session for the Mathematical Association of America at the 2017, 2018, 2019, and 2020 Joint Mathematics Meetings. Session entitled *Discrete Mathematics in the Undergraduate Curriculum – Ideas and Innovations for Teaching*. Responsibilities include proposing and organizing the session, reviewing and accepting abstracts, and running the session at the JMM. 2016 – 2020.

Special Session Organizer (Regional Conference). Organized a special session for the 2016 Annual Meeting of the Pacific Northwest Chapter of the Mathematical Association of America (PNWMAA) in Corvallis, OR. Session entitled *Research on Undergraduate Mathematics Education*. Responsibilities include proposing, organizing, and running the session and reviewing and accepting abstracts. Spring 2016.

Special Session Organizer (Regional Conference). Co-organizing (with Natalie Hobson) a special session for the 2018 Annual Regional Meeting of the American Mathematics Society held in Portland, OR. Session entitled *Teaching and Learning Undergraduate Mathematics*. Responsibilities include proposing and organizing the session, inviting speakers, and reviewing and accepting abstracts. Spring 2018.

Special Session Organizer (Regional Conference). Organized a special session for the 2019 Annual Meeting of the Pacific Northwest Chapter of the Mathematical Association of America (PNWMAA) in Portland, OR. Session entitled *Topics in Undergraduate Mathematics Education*. Responsibilities include proposing, organizing, and running the session and reviewing and accepting abstracts. Spring 2019.

Advisory Board Member for Institute of Education Sciences (IES) grant *How Dynamic Gestures and Directed Actions Contribute to Mathematical Proof Practices*. Mitchell Nathan (Principal investigator), Peter Steiner (Co-Principal investigator), Candace Walkington (Co-Principal investigator). 2016 – 2019.

Member of the Mathematical Association of America Committee on Invited Addresses. Responsibilities include virtually meeting during 2017 to select invited addresses for the 2019 Joint Mathematics Meetings. 2017.

Probability and Statistics Strand Leader for the 2017 Conference of the North American chapter of the International Group of the Psychology of Mathematics Education (PME-NA). Responsibilities included assigning reviewers and making recommendations for conference proposals related to probability and statistics. 2016 – 2017.

National Science Foundation Panelist. Reviewed proposals for the National Science Foundation in Alexandria, VA. 2018.

Referee

Reviewed articles for the following journals:

Journal for Research in Mathematics Education

Educational Studies in Mathematics

Mathematical Thinking and Learning

Journal of Mathematical Behavior

International Journal of Research in Undergraduate Mathematics Education

International Journal of Mathematical Education in Science and Technology

Zentralblatt für Didaktik der Mathematik (now The International Journal on Mathematics Education)

Problems, Resources, and Issues in Mathematics Undergraduate Studies

Elementary School Journal

Mathematics Teacher

Mathematics Teaching in the Middle School

Association for Women in Mathematics Springer Mathematics Education Volume

Reviewed conference proposals for the following conferences:

Conference on Research on Undergraduate Mathematics Education (RUME)

*Annual Meeting of the Psychology of Mathematics Education –
North America (PME-NA)*

American Education Research Association (AREA)

OTHER RESEARCH WORK

Research assistant on NSF Grant 0814829 – Justification in Algebra: Growing Understanding of Algebraic Reasoning (JAGUAR). Sean Larsen, PI. Duties included collecting videotape data in middle school classrooms. Fall 2009 and Winter 2010.

Research assistant on NSF Grant 0412553 – Oregon Math Leadership Institute Partnership (OMLI). Tom Dick, PI. Duties included collecting and organizing videotape data, and other miscellaneous duties. Summer 2006 and Summer 2007. Additional work included conducting numerous classroom observations in K-12 classrooms. Fall 2006 – Spring 2009.

FURTHER INFORMATION:

Professional Affiliations: Member of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM).

Technological Experience: Knowledge of LaTeX, TI graphing technology, Derive, Geometer's Sketchpad, Python, Excel, PowerPoint, Word, and video editing/transcribing software.

Languages: English.

Hobbies and Interests: Running (including four marathons), cooking, trying local restaurants, watching movies, enjoying my two Ragdoll cats (Nicodemus and Sebastian), collecting Rocket Raccoon comics, and cheering for the Portland Trail Blazers.

Citizenship: United States.

REFERENCES:

Dr. John S. Caughman
Professor of Mathematics, Portland State University
caughman@pdx.edu
(503) 725-3634

Dr. Amy B. Ellis
Professor of Mathematics Education, University of Georgia
amyellis@uga.edu

Dr. Eric Knuth
Professor of Mathematics Education, University of Texas – Austin
eric.knuth@austin.utexas.edu
(512) 232-9683

Dr. Sean Larsen
Associate Professor of Mathematics Education, Portland State University
slarsen@pdx.edu
(503) 725-3633

Dr. Knut Martin Mørken
Professor of Mathematics, University of Oslo
knutm@math.uio.no
+47-22855025