

- Amos, N., & Heckler, A.F. (2018). Mediating relationship of differential products in understanding integration in introductory physics. *Physical Review Physics Education Research*, 14(1), 010105.
- Blackwell L S, Trzesniewski K H and Dweck C S 2007 Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition: A Longitudinal Study and an Intervention *Child Dev.* 78 246–63
- Block, J. H., & Burns, R. B. (1976). 1: Mastery learning. *Review of research in education*, 4(1), 3-49.
- Booth, J. L., Lange, K. E., Koedinger, K. R., & Newton, K. J. (2013). Using example problems to improve student learning in algebra: Differentiating between correct and incorrect examples. *Learning and Instruction*, 25, 24-34.
- Badeau, R., White, D. R., Ibrahim, B., Ding, L., & Heckler, A. F. (2017). What works with worked examples: Extending self-explanation and analogical comparison to synthesis problems. *Physical Review Physics Education Research*, 13(2), 020112.
- Bing, T. J., & Redish, E. F. (2009). Analyzing problem solving using math in physics: Epistemological framing via warrants. *Physical Review Special Topics-Physics Education Research*, 5(2), 020108.
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). How people learn: Brain, mind, and school. *Washington, DC: National Research Council.*
- Bransford, J. D., & Schwartz, D. L. (1999). Chapter 3: Rethinking transfer: A simple proposal with multiple implications. *Review of research in education*, 24(1), 61-100.
- W. Canfield (2001). ALEKS: A Web-based intelligent tutoring system, *Mathematics and Computer Education* 35, 152.
- Dorko, A., & Speer, N. (2015). Calculus students' understanding of area and volume units. *Investigations in Mathematics Learning*, 8(1), 23-46.
- Dray, T., & Manogue, C. A. (1999). The Vector Calculus Gap: Mathematics= Physics. *Primus*, 9, 21-28.
- Dray, T., & Manogue, C. A. (2003). Using differentials to bridge the vector calculus gap. *The College Mathematics Journal*, 34(4), 283-290.
- Dray, T., and C. A. Manogue. (2004). Bridging the gap between mathematics and physics. *APS Forum on Education Newsletter*, Spring, 13-14.
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14(1), 4-58.
- Dweck C S and Leggett E L 1988 A social-cognitive approach to motivation and personality. *Psychol. Rev.* 95 256–73
- Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological review*, 100(3), 363.

- Fyfe, E. R., McNeil, N. M., Son, J. Y., & Goldstone, R. L. (2014). Concreteness fading in mathematics and science instruction: A systematic review. *Educational psychology review*, 26(1), 9-25.
- Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge university press.
- Gentner, D., Loewenstein, J., & Thompson, L. (2003). Learning and transfer: A general role for analogical encoding. *Journal of Educational Psychology*, 95(2), 393.
- Gire, E., & Price, E. (2013, January). Arrows as anchors: Conceptual blending and student use of electric field vector arrows. In *AIP Conference Proceedings* (Vol. 1513, No. 1, pp. 150-153). AIP.
- Goldstone, R. L., Landy, D. H., & Son, J. Y. (2010). The education of perception. *Topics in Cognitive Science*, 2(2), 265-284.
- Goldstone, R. L., Marghetis, T., Weitnauer, E., Ottmar, E. R., & Landy, D. (2017). Adapting perception, action, and technology for mathematical reasoning. *Current Directions in Psychological Science*, 26(5), 434-441.
- Gupta, A., & Elby, A. (2011). Beyond Epistemological Deficits: Dynamic explanations of engineering students' difficulties with mathematical sense-making. *International Journal of Science Education*, 33(18), 2463-2488.
- Gutmann, B., Gladding, G., Lundsgaard, M., & Stelzer, T. (2018). Mastery-style homework exercises in introductory physics courses: Implementation matters. *Physical Review Physics Education Research*, 14(1), 010128.
- Harackiewicz J M, Canning E A, Tibbetts Y, Priniski S J and Hyde J S 2016 Closing achievement gaps with a utility-value intervention: Disentangling race and social class. *J. Pers. Soc. Psychol.* **111** 745–65
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of educational research*, 77(1), 81-112.
- Heckler, A. F. (2010, June). Concrete vs. abstract problem formats: a disadvantage of prior knowledge. In *Proceedings of the 9th International Conference of the Learning Sciences-Volume 1* (pp. 365-371). International Society of the Learning Sciences.
- Heckler, A.F., & Bogdan, A.M. (2018). Reasoning with alternative explanations in physics: The cognitive accessibility rule. *Physical Review Physics Education Research*, 14(1), 010120.
- Heckler, A.F., & Mikula, B. D. (2016) Factors Affecting Learning of Vector Math from Computer-Based Practice: Feedback Complexity and Prior Knowledge. *Physical Review Physics Education Research*, 12, 010134.
- Heckler, A. F., Mikula, B., & Rosenblatt, R. (2013). Student accuracy in reading logarithmic plots: the problem and how to fix it. *2013 IEEE Frontiers in Education Conference Proceedings*, 1066-1071.
- Heckler, A. F., & Scaife, T. M. (2015). Adding and subtracting vectors: The problem with the arrow representation. *Physical Review Special Topics—Physics Education Research*, 11, 010101.

- Ivanjek, L., Susac, A., Planinic, M., Andrasevic, A., & Milin-Sipus, Z. (2016). Student reasoning about graphs in different contexts. *Physical Review Physics Education Research*, 12(1), 010106.
- Kaminski, J. A., Sloutsky, V. M., & Heckler, A. F. (2008). The advantage of abstract examples in learning math. *Science*, 320(5875), 454-455.
- Kaminski, J. A., Sloutsky, V. M., & Heckler, A. F. (2013). The cost of concreteness: The effect of nonessential information on analogical transfer. *Journal of Experimental Psychology: Applied*, 19(1), 14.
- Kellman, P. J., & Massey, C. M. (2013). Perceptual learning, cognition, and expertise. In *Psychology of learning and motivation* (Vol. 58, pp. 117-165). Academic Press.
- Kellman, P. J., Massey, C. M., & Son, J. Y. (2010). Perceptual learning modules in mathematics: Enhancing students' pattern recognition, structure extraction, and fluency. *Topics in Cognitive Science*, 2(2), 285-305.
- Kieran, C. (1992). The Learning and Teaching of School Algebra. *Handbook of Research on Mathematics Teaching and Learning*, 390-419.
- Knight, R. D. (1995). The vector knowledge of beginning physics students. *The Physics Teacher*, 33(2), 74-77.
- Koedinger, K. R., Corbett, A. T., & Perfetti, C. (2012). The Knowledge-Learning-Instruction framework: Bridging the science-practice chasm to enhance robust student learning. *Cognitive science*, 36(5), 757-798.
- Koenka A C, Yu S L, Kim Y, Lafranconi H and Heckler A F What predicts success in undergraduate physics? The importance of belonging and the complexity of cost. *Paper to be presented at the Annual Meeting of the American Educational Research Association*. (San Antonio, Texas)
- Kullberg, A., Kempe, U. R., & Marton, F. (2017). What is made possible to learn when using the variation theory of learning in teaching mathematics?. *ZDM*, 49(4), 559-569.
- Lin, S. Y., & Singh, C. (2011). Using isomorphic problems to learn introductory physics. *Physical Review Special Topics-Physics Education Research*, 7(2), 020104.
- Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gains in physics: A possible "hidden variable" in diagnostic pretest scores. *American journal of physics*, 70(12), 1259-1268.
- Meltzer, D.E. (2018). Investigating and Addressing Students' Mathematical Difficulties in Introductory Physics Courses. Invited talk at the 2018 Winter Meeting of the American Association of Physics Teachers, San Diego, California, January 8, 2018.
- Meltzer, D.E., & King, D.M. (2018). Some Mathematical Aspects of Physics Students' Problem-Solving Difficulties. Contributed talk at the 2018 Summer Meeting of the American Association of Physics Teachers, Washington, D.C., July 30, 2018.
- Midgley C, Maehr M L, Hruda L Z, Anderman E, Anderman L, Freeman K E, Gheen M, Kaplan A, Kumar R, Middleton M J, Nelson J, Roeser R and Urda T 2000 *Manual for the Patterns of Adaptive Learning Scales (PALS)* (Ann Arbor, MI: University of Michigan)

Mikula, B. D., & Heckler, A. F. (2013). The effectiveness of brief, spaced practice on student difficulties with basic and essential engineering skills. *2013 IEEE Frontiers in Education Conference Proceedings*, 1059-1065.

Mikula, B. D., & Heckler, A. F. (2017). Framework and implementation for improving physics essential skills via computer-based practice: Vector math. *Physical Review Physics Education Research*, 13(1), 010122.

National Research Council. (2013). *Adapting to a changing world: Challenges and opportunities in undergraduate physics education*. National Academies Press.

Nguyen, N. L., & Meltzer, D. E. (2003). Initial understanding of vector concepts among students in introductory physics courses. *American journal of physics*, 71(6), 630-638.

Porter C D, Bogdan A, Heckler A F, (2016) Student understanding of potential and wavefunctions in hydrogen in graduate-level quantum mechanics 1–4

Porter C D, Bogdan A . and Heckler A F (2017) Prelecture Questions and Conceptual Testing in Undergraduate Condensed Matter Courses *AIP Conference Proceedings - PERC* (Cincinnati, OH).

Rau, M. A., Aleven, V., Rummel, N., & Rohrbach, S. (2012, June). Sense making alone doesn't do it: Fluency matters too! ITS support for robust learning with multiple representations. In *International Conference on Intelligent Tutoring Systems* (pp. 174-184). Springer, Berlin, Heidelberg.

Redish, E. F., & Kuo, E. (2015). Language of physics, language of math: Disciplinary culture and dynamic epistemology. *Science & Education*, 24(5-6), 561-590.

Rittle-Johnson, B., Loehr, A. M., & Durkin, K. (2017). Promoting self-explanation to improve mathematics learning: A meta-analysis and instructional design principles. *ZDM*, 49(4), 599-611.

Rittle-Johnson, B., & Star, J. R. (2009). Compared with what? The effects of different comparisons on conceptual knowledge and procedural flexibility for equation solving. *Journal of Educational Psychology*, 101(3), 529.

Rittle-Johnson, B., Star, J. R., & Durkin, K. (2009). The importance of prior knowledge when comparing examples: Influences on conceptual and procedural knowledge of equation solving. *Journal of Educational Psychology*, 101(4), 836.

Rodriguez, J. M. G., Bain, K., Towns, M. H., Elmgren, M., & Ho, F. M. (2019). Covariational reasoning and mathematical narratives: investigating students' understanding of graphs in chemical kinetics. *Chemistry Education Research and Practice*.

Rodriguez, J. M. G., Santos-Diaz, S., Bain, K., & Towns, M. H. (2018). Using Symbolic and Graphical Forms To Analyze Students' Mathematical Reasoning in Chemical Kinetics. *Journal of Chemical Education*.

Rohrer, D., & Pashler, H. (2010). Recent research on human learning challenges conventional instructional strategies. *Educational Researcher*, 39(5), 406-412.

Sawtelle V, Brews E and Kramer L H 2012 Exploring the relationship between self-efficacy and retention

in introductory physics *J. Res. Sci. Teach.* **49** 1096–121

Sherin, B. L. (2001). How students understand physics equations. *Cognition and instruction*, *19*(4), 479-541.

Sweller, J., Van Merriënboer, J. J., & Paas, F. G. (1998). Cognitive architecture and instructional design. *Educational psychology review*, *10*(3), 251-296.

Torigoe, E., & Gladding, G. (2007a). Same to us, different to them: Numeric computation versus symbolic representation. In *AIP Conference Proceedings* (Vol. 883, No. 1, pp. 153-156). AIP.

Torigoe, E., & Gladding, G. (2007b). Symbols: Weapons of math destruction. In *AIP Conference Proceedings* (Vol. 951, No. 1, pp. 200-203). AIP.

Torigoe, E. T., & Gladding, G. E. (2011). Connecting symbolic difficulties with failure in physics. *American Journal of Physics*, *79*(1), 133-140.

Van der Kleij, F. M., Feskens, R. C., & Eggen, T. J. (2015). Effects of feedback in a computer-based learning environment on students' learning outcomes: A meta-analysis. *Review of educational research*, *85*(4), 475-511.

Van Merriënboer, J. J., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational psychology review*, *17*(2), 147-177.

Vollmeyer, R., & Rheinberg, F. (2000). Does motivation affect performance via persistence?. *Learning and Instruction*, *10*(4), 293-309.

Wieman, C. E., Adams, W. K., & Perkins, K. K. (2008). PhET: Simulations that enhance learning. *Science*, *322*(5902), 682-683.

Wigfield A and Eccles J S 2000 Expectancy–Value Theory of Achievement Motivation *Contemp. Educ. Psychol.* **25** 68–81

Wolters, C. A. (2004). Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *Journal of Educational Psychology*, *96*, 236-250. doi: 10.1037/0022-0663.96.2.236

Young, N.T., & Heckler, A.F. (2018). Observed hierarchy of student proficiency with period, frequency, and angular frequency. *Physical Review Physics Education Research*, *14*(1), 010104.