Overview of Physics Education Research and physics research in problem solving:

- McDermott, L. C., & Redish, E. F. (1999). Resource letter: PER-1: Physics education research. *American Journal of Physics*, 67(9), 755-767.
- Hsu, L., Brewe, E., Foster, T. M., & Harper, K. A. (2004). Resource letter RPS-1: Research in problem solving. *American Journal of Physics*, 72(9), 1147-1156.
- Maloney, D.P. (1993). Research on problem solving: Physics. In D.L. Gabel (Ed.) *Handbook* of research on science teaching and learning (pp. 327-356). New York: Macmillan.
- Redish, E. F. (2003). *Teaching physics with the physics suite*. Hoboken, NJ: Johns Wiley & Sons, Inc.

Problem solving research at the University of Minnesota:

- Blue, J. M. (1997). Sex differences in physics learning and evaluations in an introductory course. Unpublished doctoral dissertation, University of Minnesota, Twin Cities. [scoring rubric pp. 32-33, 176-179]
- Foster, T. (2000). *The development of students' problem-solving skills from instruction emphasizing qualitative problem-solving*. Unpublished doctoral dissertation, University of Minnesota, Twin Cities. [coding rubric pages 66-71]
- Heller, K., & Heller, P. (2000). *The competent problem solver for introductory physics*. Boston: McGraw-Hill.
- Heller, P., & Heller, K. (1999). *Cooperative group problem solving in physics*. <u>http://groups.physics.umn.edu/physed/Research/CGPS/GreenBook.html</u>
- Heller, P., Keith, R., & Anderson, S. (1992). Teaching problem solving through cooperative grouping. Part 1: Group versus individual problem solving. *American Journal of Physics*, 60(7), 627-636. [scoring criteria page 331]
- Henderson, C. (2002). *Faculty conceptions about the teaching and learning of problem solving in introductory calculus-based physics*. Unpublished doctoral dissertation, University of Minnesota, Twin Cities.
- Henderson, C., Yerushalmi, E., Kuo, V.H., Heller, P., & Heller, K. (2004). Grading student problem solutions: The challenge of sending a consistent message. *American Journal of Physics*, 72(2), 164-169.
- Huffman, D. (1997). Effect of explicit problem solving instruction on high school students' problem-solving performance and conceptual understanding of physics. *Journal of Research in Science Teaching*, *34*(6), 551-570. [scoring rubric page 559]
- Kuo, V. (2004). An explanatory model of physics faculty conceptions about the problemsolving process. Unpublished doctoral dissertation, University of Minnesota, Twin Cities.

Historically Important Books/Articles about Problem Solving (widely cited):

- Chase, W.G., & Simon, H.A. (1973). Perception in chess. Cognitive Psychology, 4, 55-81.
- Chi, M.T.H., Feltovich, P. & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science*, *5*, 121-152.
- de Jong, T., & Ferguson-Hessler, M.G.M. (1986). Cognitive structures of good and poor novice problem solvers in physics. *Journal of Educational Psychology*, *78*(4), 279-288.
- de Jong, T., & Ferguson-Hessler, M.G.M. (1991). Knowledge of problem situations in physics: A comparison of good and poor novice problem solvers. *Learning and Instruction*, *1*, 289-302.
- Finegold, M., & Mass, R. (1985). Differences in the process of solving physics problems between good problem solvers and poor problem solvers. *Research in Science and Technology Education*, *3*, 59-67.
- Flavell, J.H. (1979). Metacognition and cognitive monitoring: A new area of cognitivedevelopmental inquiry. *American Psychologist*, *34*(10), 906-911.
- Gick, M.L. (1986). Problem-solving strategies. Educational Psychologist, 21(1 & 2), 99-120.
- Hayes, J.R. (1989). *The complete problem solver* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Heller, J. I., & Reif, F. (1984). Prescribing effective human problem-solving processes: Problem description in physics. *Cognition and Instruction*, *1*(2), 177-216.
- Larkin, J. H. (1979). Processing information for effective problem solving. *Engineering Education*, 70(3), 285-288.
- Larkin, J.H. (1983). The role of problem representation in physics. In D. Gentner & A.L. Stevens (Eds.), *Mental models* (pp. 75-98). Hillsdale, NJ: Lawrence Erlbaum.
- Larkin, J.H. (1985). Understanding, problem representations, and skill in physics. In S.F. Chipman, J.W. Segal, & R. Glaser (Eds.), *Thinking and learning skills vol. 2: Research and open questions* (pp. 141-159). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Larkin, J.H., McDermott, J., Simon, D.P., & Simon, H.A. (1980a). Expert and novice performance in solving physics problems. *Science*, 208(4450), 1335-1342.
- Larkin, J.H., McDermott, J., Simon, D.P., & Simon, H.A. (1980b). Models of competence in solving physics problems. *Cognitive Science*, *4*, 317-345.
- Mayer, R.E. (1992). *Thinking, problem solving, cognition* (2nd ed.). New York: W.H. Freeman and Company.
- Newell, A., & Simon, H.A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall, Inc.
- Pólya, G. (1957). How to solve it (2nd ed.). Princeton, NJ: Princeton University Press.
- Reif, F., & Heller, J.I. (1982). Knowledge structure and problem solving in physics. *Educational Psychologist*, 17(2), 102-127.

- Reif, F., Larkin, J.H., & Brackett, G.C. (1976). Teaching general learning and problem-solving skills. *American Journal of Physics*, 44(3), 212-217.
- Schoenfeld, A. (1979). Explicit heuristic training as a variable in problem solving performance. *Journal for Research in Mathematics Education*, *10*, 173-187.
- Schoenfeld, A.H. (1985). Mathematical problem solving. Orlando, FL: Academic Press, Inc.
- Sternberg, R.J. (1994). Thinking and problem solving. San Diego: Academic Press, Inc.
- Simon, H.A. (1981). *The sciences of the artificial* (2nd ed.). Cambridge, Massachusetts: MIT Press.
- Simon, D.P., & Simon, H.A. (1979). A tale of two protocols. In J. Lochhead & J.S. Clement (Eds.), *Cognitive process instruction: Research on teaching thinking skills* (pp. 119-132). Philadelphia: Franklin Institute Press.
- Simon, D.P., & Simon, H.A. (1989). Individual differences in solving physics problems. In H.A. Simon (Ed.), *Models of thought vol. 2* (pp. 215-231). New Haven: Yale University Press. (Reprinted from *Children's thinking: What develops?*, pp. 325-361, by R.S. Siegler, Ed., 1978, Hillsdale, NJ: Erlbaum)
- Sweller, J. (1988). Cognitive load during problem solving: effects on learning. *Cognitive Science*, *12*, 257-285.

(Newer) References pertinent to this project:

- Davidson, J. E., & Sternberg, R. J. (Eds.). (2003). *The psychology of problem solving*. Cambridge, UK: Cambridge University Press.
- Harper, K.A. (2001). *Investigating the development of problem solving skills during a freshman physics sequence*. Unpublished doctoral dissertation, The Ohio State University.
- Leonard, W.J., Gerace, W.J., & Dufresne, R.J. (2002). Analysis-based problem solving: Making analysis and reasoning the focus of physics instruction. *Science Teaching*, *20*, 387-400.
- Martinez, M. E. (1998). What is problem solving? Phi Delta Kappan, 79(8), 605-609.
- Mayer, R.E. (1998). Cognitive, metacognitive, and motivational aspects of problem solving. *Instructional Science*, *26*, 49-63.
- Murthy, S. (2007). Peer-assessment of homework using rubrics. *Proceedings of the 2007 Physics Education Research Conference* (pp. 156-159). Melville, NY: American Institute of Physics.
- Ogilvie, C.A. (2007). Moving students from simple to complex problem solving. In D.H. Jonassen (Ed.), *Learning to solve complex scientific problems* (pp. 159-185). New York: Lawrence Erlbaum Associates Taylor Francis Group, LLC.
- Priest, A.G., & Lindsay, R.O. (1992). New light on novice-expert differences in physics problem solving. *British Journal of Psychology*, *83*(3), 389-405.

- Redish, E.F. (2005). Problem solving and the use of math in physics courses. *Proceedings of the conference World View on Physics Education in 2005: Focusing on Change, Delhi, August 21-26, 2005.*
- Sherin, B.L. (2001). How students understand physics equations. *Cognition and Instruction*, 19(4), 479-541.
- Tuminaro, J., & Redish, E.F. (2007). Elements of a cognitive model of physics problem solving: Epistemic games. *Physical Review Special Topics: Physics Education Research*, *3*(2), 020101.
- Van Heuvelen, A. (1991a). Learning to think like a physicist: A review of research-based instructional strategies. *American Journal of Physics*, *59*(10), 891-897.
- Van Heuvelen, A. (1991b). Overview, case study physics. *American Journal of Physics*, *59*(10), 898-907.
- Woods, D.R. (1987a). Problem solving in practice. In D. Gabel (Ed.) *What research says to the science teacher. Vol. 5: Problem solving,* (pp. 97-121). Washington, D.C.: National Science Teachers Association.

Validity & Reliability:

- American Educational Research Association, American Psychological Association, & National Council on Measurement in Education (1999). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.
- Banerjee, M., Capozzoli, M., McSweeney, L., & Sinha, D. (1999). Beyond kappa: A review of interrater agreement measures. *The Canadian Journal of Statistics*, 27(1), 3-23.
- Cohen, J. (1968). Weighted kappa: Nominal scale agreement with provision for scaled disagreement or partial credit. *Psychological Bulletin*, 70(4), 213-220.
- Howell, D.C. (2002). *Statistical methods for psychology* (5th ed.). Pacific Grove, CA: Thomson Learning, Inc.
- Kane, M.T. (2001). Current concerns in validity theory. *Journal of Educational Measurement*, 38(4), 319-342.
- Messick, S. (1994). The interplay of evidence and consequences in the validation of performance assessments. *Educational Researcher*, *23*(2), 13-23.
- Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, *50*(9), 741-749.
- Moss, P.A. (1992). Shifting conceptions of validity in educational measurement: Implications for performance assessment. *Review of Educational Research*, *62*(3), 229-258.