## **Appendix G:**

## Research Inventory

- Part 1: Studies cited in *Organizing Instruction and Study to Improve Student Learning:* A *Practice Guide* and additional studies that postdate publication of the practice guide and are of comparable caliber.
  - (Additional studies are listed in bold)
- Thanks to Dr. Art Graesser, Dr. Richard Mayer, Dr. Katherine Rawson, and Dr. Melody Wiseheart for providing information on more recent studies.
- Ainsworth, S., Bibby, P., & Wood, D. (2002). Examining the effects of different multiple representational systems in learning primary mathematics. *The Journal of the Learning Sciences*, 11, 25–61.
- Aleven, V., & Koedinger, K. R. (2002). An effective metacognitive strategy: Learning by doing and explaining with a computer-based cognitive tutor. *Cognitive Science*, *26*, 147-179.
- Amadieu, F., van Gog, T., Paas, F., Tricot, A., & Marine, C. (2009). Effects of prior knowledge and concept-map structure on disorientation, cognitive load and learning. *Learning & Instruction*, 19(5), 376-386.
- Amaya, M. M., Uttal, D. H., & DeLoache, J. S. (2007). *Procedural knowledge in two-digit subtraction: Comparing concrete and abstract.* Manuscript submitted for publication.
- American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1999). Standards for educational and psychological testing. Washington, DC: AERA Publications.
- American Psychological Association. (2002). Criteria for practice guideline development and evaluation. *American Psychologist*, 57, 1048-1051.
- Amlund, J. T., Kardash, C. A. M., & Kulhavy, R. W. (1986). Repetitive reading and recall of expository text. *Reading Research Quarterly*, *21*, 49-58.
- Arguel, A., & Jarnet, E. (2009). Using video and static pictures to improve learning of procedural contents. *Computers in Human Behavior*, 25, 354-359.
- Ausubel, D. P., & Youssef, M. (1965). The effect of spaced repetition on meaningful retention. *The Journal of General Psychology*, 73, 147-150.
- Baddeley, A. D., & Longman, D. J. A. (1978). The influence of length and frequency of training session on the rate of learning to type. *Ergonomics*, *21*, 627-635.
- Bahrick, H. P., Bahrick, L. E., Bahrick, A. S., & Bahrick, P. E. (1993). Maintenance of foreign language vocabulary and the spacing effect. *Psychological Science*, *4*, 316-321.
- Beck, I. L., McKeown, M. G., Hamilton, R. L., & Kucan, L. (1997). Questioning the author: An approach for enhancing student engagement with text. Delaware: International Reading Association.
- Berger, S. A., Hall, L. K., & Bahrick, H. P. (1999). Stabilizing access to marginal and submarginal knowledge. *Journal of Experimental Psychology: Applied*, 5, 438-447.

- Biswas, G., Jeong, H., Kinnebrew, J., Sulcer, B., & Roscoe, R. (2010). Measuring self-regulated learning skills through social interactions in a teachable agent environment. Research and Practice in Technology-Enhanced Learning, 5, 123-152.
- Bjork, E. L., Little, J. L., & Storm, B. C. (2014). Multiple-choice testing as a desirable difficulty in the classroom. Journal of Applied Research in Memory and Cognition, 3, 165-170
- Bjork, R. A. (1988). Retrieval practice and the maintenance of knowledge. In M.M. Gruneberg, P.E. Morris, & R.N. Sykes (Eds.), *Practical aspects of memory II* (pp. 396-401). New York: Wiley.
- Bjork, R. A., & Bjork, E. L. (2006). Optimizing treatment and instruction: Implications of a new theory of disuse. In L.-G. Nilsson and N. Ohta (Eds.), *Memory and society: Psychological perspectives* (pp. 116-140). New York: Psychology Press.
- Bloom, B. S. (1956). Taxonomy of educational objectives Book I: Cognitive domain. New York: David McKay Publications.
- Bloom, K. C., & Shuell, T. J. (1981). Effects of massed and distributed practice on the learning and retention of second-language vocabulary. *Journal of Educational Research*, 74, 245-248.
- Bottge, B. A. (1999). Effects of contextualized math instruction on problem solving of average and below-average achieving students. *Journal of Special Education*, 33, 81-92.
- Bottge, B. A., Heinrichs, M., Chan, S., & Serlin, R. (2001). Anchoring adolescents' understanding of math concepts in rich problem solving environments. *Remedial and Special Education*, *22*, 299-314.
- Bottge, B. A., Heinrichs, M., Mehta, Z. D., & Hung, Y. H. (2002). Weighting the benefits of anchored math instruction for students with disabilities in general education classes. *Journal of Special Education*, *35*, 186-200.
- Bottge, B. A., Rueda, E., & Skivington, M. (2006). Situating math instruction in rich problem-solving contexts: Effects on adolescents with challenging behaviors. *Behavioral Disorders*, *31*, 394-407.
- Bottge, B. A., Rueda, E., LaRoque, P. T., Serlin, R. C., & Kwon, J. (2007). Integrating reform-oriented math instruction in special education settings. *Learning Disabilities Research & Practice*, *22*, 96-109.
- Bottge, B. A., Rueda, E., Serlin, R., Hung, Y.-H., & Kwon, J. (2007). Shrinking achievement differences with anchored math problems: Challenges and possibilities. *Journal of Special Education*, 41, 31-49.
- Butcher, K. R., & Aleven, V. (2007). Integrating visual and verbal knowledge during classroom learning with computer tutors. In D. S. McNamara & I G. Trafton (Eds.), *Proceedings of the 29th Annual Cognitive Science Society* (pp. 137-142). Austin, TX: Cognitive Science Society
- Butcher, K. R., & Aleven, V. (2008). Diagram interaction during intelligent tutoring in geometry: Support for knowledge retention and deep understanding. In B. C. Love, K. McRae & V. M. Sloutsky (Eds.), Proceedings of the 30th Annual Conference of the Cognitive Science (pp. 1736-1741). Austin, TX: Cognitive Science Society.
- Butcher, K. R., & Aleven, V. (2013). Using student interactions to foster rule-diagram mapping during problem solving in an intelligent tutoring system. *Journal of Educational Psychology*, 105(4), 988.
- Butcher, K. R., & de la Chica, S. (2010). Supporting student learning with adaptive technology: Personalized conceptual assessment and remediation. In M. Banich & D. Caccamise (Eds.), *Generalization of Knowledge: Multidisciplinary Perspectives* (pp. 297-330). New York: Taylor & Francis.

- Butcher, K. R., & Kintsch, W. (2012). Text comprehension and discourse processing. In A. F. Healy & R. W Proctor (Eds.), *Handbook of psychology*, *volume 4*, *experimental psychology* (2d. ed.). Hoboken, NJ: Wiley.
- Butcher, K. R., & Sumner, T. (2011). Self-directed learning and the sensemaking paradox. *Human-Computer Interaction*, 26(1), 123-159. dx.doi.org/I0.1080/0737 0024.2011.556552.
- Butler, A. C. (2010). Repeated testing produces superior transfer of learning relative to repeated studying. Journal of Experimental Psychology: Learning, Memory, & Cognition, 36, 1118-1133.
- Butler, A. C., & Roediger, H. L. (2007). Testing improves long-term retention in a simulated classroom setting. *European Journal of Cognitive Psychology*, 19, 514-527.
- Butterfield, B., & Metcalfe, J. (2001). Errors committed with high confidence are hypercorrected. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 27*, 1491-1494.
- Carpenter, S. K., Cepeda, N. J., Rohrer, D., Kang, S. H. K., & Pashler, H. (2012). Using spacing to enhance diverse forms of learning: Review of recent research and implications for instruction. *Educational Psychology Review*, 24, 369-378.
- Carpenter, S. K., Pashler, H., & Cepeda, N. J. (2009). Using tests to enhance 8th grade students' retention of U. S. history facts. *Applied Cognitive Psychology*, 23, 760-771.
- Carpenter, S. K., Pashler, H., Cepeda, N. J., & Alvarez, D. (2007). Applying the principles of testing and spacing to classroom learning. In D.S. McNamara and J.G. Trafton (Eds.), *Proceedings of the 29th Annual Cognitive Science Society* (p. 19). Nashville, TN: Cognitive Science Society.
- Carpenter, S. K., Pashler, H., Wixted, J. T., & Vul, E. (2008). The effects of tests on learning and forgetting. *Memory & Cognition*, 36(2), 438-448.
- Carrier, M., & Pashler, H. (1992). The influence of retrieval on retention. Memory & Cognition, 20, 632-642.
- Catrambone, R. (1996). Generalizing solution procedures learned from examples. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22,* 1020-1031.
- Catrambone, R. (1998). The subgoal learning model: Creating better examples so that students can solve novel problems. *Journal of Experimental Psychology: General, 127,* 355-376.
- Cawley, J., Parmar, R., Foley, T. E., Salmon, S., & Roy, S. (2001). Arithmetic performance of students: Implications for standards and programming. *Exceptional Children*, *67*, 311-328.
- Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin*, *132*, 354-380.
- Chi, M. T. H. (2000). Self-explaining: The dual processes of generating and repairing mental models. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 161-238). Mahwah, NJ: Erlbaum.
- Chi, M. T. H., Bassok, M., Lewis, M., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science*, *13*, 145-182.
- Chi, M. T. H., de Leeuw, N., Chiu, M., & LaVancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science*, 18, 439-477.

- Chi, M. T. H., Siler, S., Jeong, H., Yamauchi, T., & Hausmann, R. (2001). Learning from human tutoring. *Cognitive Science*, 25, 471-533.
- Clark, R. C., & Mayer, R. E. (2003). e-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia Learning. San Francisco: Jossey-Bass.
- Cohen, P. A., Kulik, J. A., & Kulik, C. C. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American Educational Research Journal*, 19, 237-248.
- Cooper, G., & Sweller, J. (1987). The effects of schema acquisition and rule automation on mathematical problem-solving transfer. *Journal of Educational Psychology*, 79, 347–362.
- Craig, S. D., Gholson, B., Brittingham, J. K., Williams, J. L., & Shubeck, K. T. (2012). Promoting vicarious learning of physics using deep questions with explanations. *Computers & Education*, *58*(4), 1042-1048.
- Craig, S. D., Sullins, J., Witherspoon, A., & Gholson, B. (2006). The deep-level-reasoning-question effect: The role of dialogue and deep-level-reasoning questions during vicarious learning. *Cognition and Instruction*, *24*, 565-591.
- Cromley, J. G., Snyder-Hogan, L. E., & Luciw-Dubas, U. A. (2010). Cognitive activities in complex science text and diagrams. *Contemporary Educational Psychology*, 35, 59-74.
- Delaney, P. F., Verkoeijen, P. P. J. L., & Spirgel, A. (2010). Spacing and testing effects: A deeply critical, lengthy, and at times discursive review of the literature. *Psychology of Learning and Motivation*, 53, 63-147.
- Dempster, F. N. (1987). Effects of variable encoding and spaced presentations on vocabulary learning. *Journal of Educational Psychology*, 79, 162-170.
- Dempster, F. N. (1996). Distributing and managing the conditions of encoding and practice. In E.L. Bjork and R.A. Bjork (Eds.), *Handbook of perception and cognition, volume 10, memory* (pp. 317-344). San Diego, CA: Academic Press.
- Dempster, F. N., & Perkins, P. G. (1993). Revitalizing classroom assessment: Using tests to promote learning. *Journal of Instructional Psychology*, 20, 197–203.
- Dillon, T. J. (1988). Questioning and teaching: A manual of practice. New York: Teachers College Press.
- Donovan, J. J., & Radosevich, D. J. (1999). A meta-analytic review of the distribution of practice effect. *Journal of Applied Psychology*, 84, 795-805.
- Driscoll, D., Craig, S. D., Gholson, B., Ventura, M., & Graesser, A. (2003). Vicarious learning: Effects of overhearing dialog and monologue-like discourse in a virtual tutoring session. *Journal of Educational Computing Research*, 29, 431-450.
- Dufresne, A., & Kobasigawa, A. (1989). Children's spontaneous allocation of study time: Differential and sufficient aspects. *Journal of Experimental Child Psychology, 47, 274-296.*
- Dunlosky, J., & Nelson, T. O. (1992). Importance of the kind of cue for judgments of learning (JOL) and the delayed-JOL effect. *Memory & Cognition*, 20, 374-380.
- Dunlosky, J., & Nelson, T. O. (1994). Does the sensitivity of judgments of learning (JOLs) to the effects of various study activities depend on when the JOLs occur? *Journal of Memory and Language*, *33*, 545-565.
- Dunlosky, J., Hertzog, C., Kennedy, M., & Thiede, K. (2005). The self-monitoring approach for effective learning. Cognitive Technology, 10, 4-11.

- Dunlosky, J., Rawson, K. A., & McDonald, S. L. (2002). Influence of practice tests on the accuracy of predicting memory performance for paired associates, sentences, & text material. In T.J. Perfect & B.L. Schwartz (Eds.), *Applied metacognition* (pp. 68-92). Cambridge, UK: Cambridge University Press.
- Dunlosky, J., Rawson, K. A., & Middleton, E. L. (2005). What constrains the accuracy of metacomprehension judgments? Testing the transfer-appropriate-monitoring and accessibility hypotheses. *Journal of Memory and Language Special Issue: Metamemory*, *52*, 551-565.
- Dzikovska, M., Steinhauser, N., Farrow, E., Moore, J., & Campbell, G. (2014). BEETLE II: Deep natural language understanding and automatic feedback generation for intelligent tutoring in basic electricity and electronics. *International Journal of Artificial Intelligence in Education*, 24, 284-332.
- Easterday, M. W, Aleven, V., Scheines, R., & Carver, S. M. (2009). Constructing causal diagrams to learn deliberation. *International Journal of Artificial Intelligence in Education*, 19(4), 425-445.
- Ferrara, L., & Butcher, K. R. (2011). Visualizing feedback: using graphical cues to promote self-regulated learning. In *Proceedings of the Thirty-third Annual Conference of the Cognitive Science Society*. Boston: Cognitive Science Society.
- Festinger, L. (1957). A theory of cognitive dissonance. Evanston, IL: Row, Peterson.
- Field, M. J., & Lohr, K. N. (Eds.). (1990). *Clinical practice guidelines: Directions for a new program*. Washington, DC: National Academy Press.
- Gates, A. I. (1917). Recitation as a factor in memorizing. Archives of Psychology, 6(40), 104.
- Gholson, B., & Craig, S. D. (2006). Promoting constructive activities that support vicarious learning during computer-based instruction. *Educational Psychology Review, 18*, 119-139
- Gholson, B., Witherspoon, A., Morgan, B., Brittingham, J. K., Coles, R., Graesser, A. C., Sullins, J., & Craig, S. D. (2009). Exploring the deep-level reasoning questions effect during vicarious learning among eighth to eleventh graders in the domains of computer literacy and Newtonian physics. *Instructional Science*, 37, 487-493.
- Gingerich, K. J., Bugg, J. M., Doe, S. R., Rowland, C. A., Richards, T. L., Tompkins, S. A., & McDaniel, M. A. (2014) Active Processing via Write-to-Learn Assignments: Learning and Retention Benefits in Introductory Psychology. *Teaching of Psychology October*, 41, 303-308.
- Glenberg, A. M., & Lehmann, T. S. (1980). Spacing repetitions over 1 week. *Memory & Cognition*, 8, 528-538.
- Goettl, B. P., Yadrick, R. M., Connolly-Gomez, C., Regian, W., & Shebilske, W. L. (1996). Alternating task modules in isochronal distributed training of complex tasks. *Human Factors*, *38*, 330-346.
- Goldstone, R. L, & Son, J. Y. (2005). The transfer of scientific principles using concrete and idealized simulations. *The Journal of the Learning Sciences*, 14, 69-110.
- Goldstone, R. L., & Sakamoto, Y. (2003). The transfer of abstract principles governing complex adaptive systems. *Cognitive Psychology*, 46, 414-466.
- Graesser, A. C., & McMahen, C. L. (1993). Anomalous information triggers questions when adults solve quantitative problems and comprehend stories. *Journal of Educational Psychology*, *85*, 136-151.

- Graesser, A. C., & Olde, B. A. (2003). How does one know whether a person understands a device? The quality of the questions the person asks when the device breaks down. *Journal of Educational Psychology*, 95, 524-536.
- Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal*, 31, 104-137.
- Graesser, A. C., Li, H., & Forsyth, C. (2014). Learning by communicating in natural language with conversational agents. *Current Directions in Psychological Science*, 23, 374-380.
- Graesser, A. C., Lu, S., Jackson, G. T., Mitchell, H., Ventura, M., Olney, A., & Louwerse, M. M. (2004). AutoTutor: A tutor with dialogue in natural language. *Behavioral Research Methods, Instruments, and Computers*, *36*, 180-193.
- Griffin, S., Case, R., & Siegler, R. S. (1994). Rightstart: Providing the central conceptual prerequisities for first formal learning of arithmetic to students at risk for school failure. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and the classroom* (pp. 25-50). Cambridge, MA: MIT Press.
- Gurlitt, J., & Renkl, A. (2008). Are high-coherent concept maps better for prior knowledge activation? Differential effects of concept mapping tasks on high school vs. university students. *Journal of Computer Assisted Learning*, 24, 407-419.
- Gurlitt, J., & Renkl, A. (2010). Prior knowledge activation: How different concept mapping tasks lead to substantial differences in cognitive processes, learning outcomes, and perceived self-efficacy. *Instructional Science*, 38, 417-433.
- Hausmann, R. G. M., & VanLehn, K. (in press). Explaining self-explaining: A contrast between content and generation. 13th International Conference on Artificial Intelligence in Education, Marina del Rey, CA.
- Hegarty, M., Canham, M. S., & Fabrikant, S. J. (2010). Thinking about the weather: How display salience and knowledge affect performance in a graphic inference task. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 36(1), 37-53.*
- Hertzog, C., Kidder, D., Moman-Powell, A., & Dunlosky, J. (2002). Monitoring associative learning: What determines the accuracy of metacognitive judgments. Psychology and Aging, 17, 209-225.
- Hirsch, E. D., Jr. (1987). Cultural literacy: What every American needs to know. Boston: Houghton Mifflin.
- Homer, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: A meta-analysis, *Learning* and *Instruction*, 17(6), 722-738.
- Hunt, E., & Minstrell, J. (1996). A collaborative classroom for teaching conceptual physics. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and the classroom* (pp. 51-74). Cambridge, MA: MIT Press.
- Imhof, B., Scheiter, K., Edelmann, J., & Gerjets, P. (2012). How temporal and spatial aspects of presenting visualizations affect learning about locomotion patterns. *Learning & Instruction*, 22, 193-205.
- Issa, N., Schuller, M., Santacaterina, S., Shapiro, M., Wang, E., Mayer, R. E., & DaRosa, D. D. (2011). Applying multimedia design principles enhances learning in medical education. *Medical Education*, 45, 818-826.
- Jang, Y., & Nelson, T. O. (2005). How many dimensions underlie judgments of learning and recall? Evidence from state-trace methodology. *Journal of Experimental Psychology: General*, 134, 308-326.

- Kalchman, M., & Koedinger, K. R. (2005). Teaching and learning functions. In S. Donovan and J. Bransford (Eds.), *How students learn: History, mathematics and science in the classroom* (pp. 351-396). Washington, DC: National Academy Press.
- Kalchman, M., Moss, J., & Case, R. (2001). Psychological models for development of mathematical understanding: Rational numbers and functions. In S. Carver and D. Klahr (Eds.), *Cognition and instruction: Twenty-five years of progress* (pp. 1-38). Mahwah, NJ: Erlbaum.
- Kalyuga, S., Chandler, P., & Sweller, J. (2001). Learner experience and efficiency of instructional guidance. Educational Psychology, 21, 5–23.
- Kalyuga, S., Chandler, P., Tuovinen, J., & Sweller, J. (2001). When problem solving is superior to studying worked examples. *Journal of Educational Psychology*, 93, 579–588.
- Kaminiski, J. A., Sloutsky, V. M., & Heckler, A. F. (2006a). Do children need concrete instantiations to learn an abstract concept? In R. Sun and N. Miyake (Eds.), *Proceedings of the 28th Annual Conference of the Cognitive Science Society* (pp. 411-416). Mahwah, NJ: Erlbaum.
- Kaminiski, J. A., Sloutsky, V. M., & Heckler, A. F. (2006b). Effects of concreteness on representation: An explanation for differential transfer. In R. Sun and N. Miyake (Eds.), *Proceedings of the 28th Annual Conference of the Cognitive Science Society* (pp. 1581-1586). Mahwah, NJ: Erlbaum.
- Kapler, I. V., Weston, T., & Wiseheart, M. (2015). Spacing in a simulated undergraduate classroom: Long-term benefits for factual and higher-level learning. *Learning and Instruction*, *36*, 38-45.
- Karpicke, J. D. (2007). Students' use of self-testing as a strategy to enhance learning. Unpublished doctoral dissertation, Washington University, St. Louis, MO.
- King, A. (1992). Comparison of self-questioning, summarizing, and notetaking-review as strategies for learning from lectures. *American Educational Research Journal*, *29*, 303-323.
- King, A. (1994). Guiding knowledge construction in the classroom: Effects of teaching children how to question and how to explain. *American Educational Research Journal*, 31, 338-368.
- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41, 75–86.
- Kopp, K., Britt, A., Millis, K., & Graesser, A. (2012). Improving the efficiency of dialogue in tutoring. *Learning and Instruction*, 22(5), 320-330.
- Koriat, A. (1997). Monitoring one's knowledge during study: A cue-utilization framework to judgments of learning. *Journal of Experimental Psychology: General*, 126, 349-370.
- Kornell, N. (2009). Optimizing learning using flashcards: Spacing is more effective than cramming. *Applied Cognitive Psychology*, 23, 1297-1317.
- Krug, D., Davis, T. B., & Glover, J. (1990). Massed versus distributed repeated reading: A case of forgetting helping recall? *Journal of Educational Psychology, 82*, 366-371.

- Leppink, J., Paas, F., van Gog, T., van der Vleuten, C. P. M., & van Merrienboer, J. J. G. (2014). Effects of pairs of problems and examples on task performance and different types of cognitive load. *Learning and Instruction*, 30, 32-42.
- Lindsey, R. V., Shroyer, J. D., Pashler, H., & Mozer, M. C. (2014). Improving students' long-term knowledge retention through personalized review. *Psychological Science*, 25, 639-647.
- Lockl, K., & Schneider, W. (2002). Developmental trends in children's feeling-of-knowing judgements. *International Journal of Behavioral Development*, *26*, 327-333.
- Mace, C. A. (1932). The psychology of study. London: Methuen.
- Masur, E. F., McIntyre, C. W., & Flavell, J. H. (1973). Developmental changes in apportionment of study time among items in a multitrial free recall task. *Journal of Experimental Child Psychology*, 15, 237-246.
- Mayer, R. E. (2001). Multimedia learning. New York: Cambridge University Press.
- Mayer, R. E., & Anderson, R. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Psychology*, 83, 484–490.
- Mayer, R. E., & Anderson, R. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology*, 84, 444–452.
- Mayer, R. E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual-processing systems in working memory. *Journal of Educational Psychology*, *90*, 312–320.
- Mayer, R. E., Hegarty, M., Mayer, S., & Campbell, J. (2005). When static media promote active learning: Annotated illustrations versus narrated animations in multimedia instruct. *Journal of Experimental Psychology: Applied, 11*, 256-265.
- McCrudden, M. T., Schraw, G., & Lehman, S. (2009). The use of adjunct displays to facilitate comprehension of causal relationships in expository text. *Instructional Science*, 37(1), 65-86.
- McDaniel, M. A., & Donnelly, C. M. (1996). Learning with analogy and elaborative interrogation. *Journal of Educational Psychology*, 88(3), 508.
- McDaniel, M. A., & Fisher, R. P. (1991). Tests and test feedback as learning sources. *Contemporary Educational Psychology*, 16, 192-201.
- McDaniel, M. A., Agarwal, P. K., Huelser, B. J., McDermott, K. B., & Roediger, H. L., III (2011). Test-Enhanced Learning in a Middle School Science Classroom: The Effects of Quiz Frequency and Placement. *Journal of Educational Psychology*, 103, 399-414.
- McDaniel, M. A., Anderson, J. L., Derbish, M. H., & Morrisette, N. (2007). Testing the testing effect in the classroom. European Journal of Cognitive Psychology, 19, 494-513.
- McDaniel, M. A., Roediger, H. L., & McDermott, K. B. (2007). Generalizing test enhanced learning from the laboratory to the classroom. *Psychonomic Bulletin & Review, 14,* 200-206
- McDaniel, M. A., Thomas, R. C., Agarwal, P. K., McDermott, K. B., & Roediger, H. L. (2013). Quizzing in middle-school science: Successful transfer performance on classroom exams. *Applied Cognitive Psychology*, 27, 360-372.

- McDermott, K. B., Agarwal, P. K., D'Antonio, L., Roediger, H. L., & McDaniel, M. A. (2014). Both multiple-choice and short-answer quizzes enhance later exam performance in middle and high school classes. *Journal of Experimental Psychology: Applied, 20*, 3-21.
- McLaren, B. M., Lim, S., Gagnon, F., Yaron, D., & Koedinger, K. R. (2006). Studying the effects of personalized language and worked examples in the context of a web-based intelligent tutor. In M. Ikeda, K. Ashley, & T. Chan (Eds.), *The Proceedings of the 8th International Conference on Intelligent Tutoring Systems* (pp. 318-328). New York: Springer.
- McNamara, D. S. (2004). SERT: Self-explanation reading training. Discourse Processes, 38, 1-30.
- McNamara, D. S., O'Reilly, T., Best, R., & Ozuru, Y. (2006). Improving adolescent students' reading comprehension with iSTART. *Journal of Educational Computing Research*, 34, 147-171.
- Meeter, M., & Nelson, T. O. (2003). Multiple study trials and judgments of learning. Acta Psychologica, 113, 123-132
- Metcalfe, J., & Dunlosky, J. (2008). Metamemory. In J.H. Byrne (Ed.), Learning and memory: A comprehensive reference. Oxford: Elsevier.
- Metcalfe, J., & Finn, B. (2008). Evidence that judments of learning are causally related to study choice. *Psychonomic Bulletin & Review, 15(1), 174-179*.
- Metcalfe, J., & Kornell, N. (2005). A region of proximal learning model of study time allocation. *Journal of Memory and Language*, 52, 463-477.
- Moreno, R., & Mayer, R. C. (1999a). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology*, *91*, 358-368.
- Moreno, R., & Mayer, R. C. (1999b). Multimedia-supported metaphors for meaning making in mathematics. *Cognition and Instruction*, 17, 215-248.
- Moreno, R., Ozogul, G., & Reisslein, M. (2011). Teaching with concrete and abstract visual representations: Effects on students' problem solving, problem representations, & learning perceptions. *Journal of Educational Psychology*, 103(1), 32-47.
- Moss, J. (2005). Pipes, tubs, & beakers: New approaches to teaching the rational-number system. In M. S. Donovan and J. D. Bransford (Eds.), *How students learn: History, math, and science in the classroom* (pp. 309-349). Washington, DC: National Academies Press.
- Moulton, C., Dubrowski, A., MacRae, H., Graham, B., Grober, E., & Reznick, R. (2006). Teaching surgical skills: What kind of practice makes perfect? *Annals of Surgery*, 244, 400-409.
- Mousavi, S. Y., Low, R., & Sweller, J. (1995). Reducing cognitive load by mixing auditory and visual presentation modes. *Journal of Educational Psychology, 87*, 319-334.
- Nye, B. D., Graesser, A. C., & Hu, X. (2014). AutoTutor and family: A review of 17 years of natural language tutoring. *International Journal of Artificial Intelligence in Education*, 24, 427–469.
- Otero, J., & Graesser, A. C. (2001). PREG: Elements of a model of question asking. Cognition and Instruction, 19, 143-175.
- Paas, F., & van Merriënboer, J. (1994). Variability of worked examples and transfer of geometrical problem-solving skills: A cognitive-load approach. *Journal of Educational Psychology, 86,* 122–133.

- Paik, E. S., & Schraw, G. (2013). Learning with animation and illusions of understanding. *Journal of Educational Psychology*, 105(2), 278-289.
- Paivio, A. (1974). Spacing of repetitions in the incidental and intentional free recall of pictures and words. Journal of Verbal *Learning and Verbal Behavior*, 13, 497-511.
- Palincsar, A. S., & Brown, A. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, 1, 117-175.
- Pane, J. F., Corbett, A. T., & John, B. E. (1996). Assessing dynamics in computer-based instruction. In M. Tauber (Ed.), Proceedings of ACM CHI'96 Conference on Human Factors in Computing Systems (pp. 197-204). Addison-Wesley Publishers.
- Pashler, H., Cepeda, N., Rohrer, D., & Wixted, J. T. (2004). The spacing effect: Useful or just interesting? Paper presented at the 45th Annual Meeting of the Psychonomic Society, Minneapolis, MN.
- Pashler, H., Rohrer, D., Cepeda, N. J., & Carpenter, S. K. (2007). Enhancing learning and retarding forgetting: Choices and consequences. *Psychonomic Bulletin & Review, 19*, 187-193.
- Pashler, H., Zarow, G., & Triplett, B. (2003). Is temporal spacing of tests helpful even when it inflates error rates? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 29*, 1051-1057.
- Peterson, L. R., Wampler, R., Kirkpatrick, M., & Saltzman, D. (1963). Effect of spacing presentations on retention of a paired associate over short intervals. *Journal of Experimental Psychology, 66,* 206-209.
- Pressley, M., & Afflerbach, P. (1995). Verbal protocols of reading: The nature of constructively responsive reading. Hillsdale, NJ: Erlbaum.
- Pressley, M., Symons, S., McDaniel, M. A., Snyder, B. L., & Turnure, J. E. (1988). Elaborative interrogation facilitates acquisition of confusing facts. *Journal of Educational Psychology*, *80*(3), 268.
- Pressley, M., Tannebaum, R., McDaniel, M.A., & Wood, E. (1990). What happens when university students try to answer prequestions that accompany textbook materials? *Contemporary Educational Psychology*, 15, 27-35.
- Pressley, M., Wood, E., Woloshyn, V. E., Martin, V., King, A., & Menk, D. (1992). Encouraging mindful use of prior knowledge: Attempting to construct explanatory answers facilitates learning. *Educational Psychologist*, *27*, 91-110.
- Rawson, K. A., Dunlosky, J., & Sciartelli, S. M. (2013). The power of successive relearning: Improving performance on course exams and long-term retention. *Educational Psychology Review*, 25, 523-548.
- Rea, C. P., & Modigliani, V. (1985). The effect of expanded versus massed practice on the retention of multiplication facts and spelling lists. *Human Learning*, *4*, 11-18.
- Renkl, A. (1997). Learning from worked-out examples: A study on individual differences. Cognitive Science, 21, 1–29.
- Renkl, A. (2002). Worked-out examples: Instructional explanations support learning by self-explanations. *Learning and Instruction*, 12, 529-556.
- Renkl, A., Atkinson, R. K., & Große, C. S. (2004). How fading worked solution steps works A cognitive load perspective. *Instructional Science*, *32*, 59-82.
- Renkl, A., Atkinson, R., Maier, U., & Staley, R. (2002). From example study to problem solving: Smooth transitions help learning. *Journal of Experimental Education*, 70, 293-315.

- Renkl, A., Stark, R., Gruber, H., & Mandl, H. (1998). Learning from worked-out examples: The effects of example variability and elicited self-explanations. *Contemporary Educational Psychology*, 23, 90-108.
- Resnick, L. B., & Omanson, S. F. (1987). Learning to understand arithmetic. In R. Glaser (Ed.), Advances in instructional psychology (Vol. 3, pp. 41-95). Hillsdale, NJ: Erlbaum.
- Retnowati, E., Ayres, P., & Sweller, J. (2010). Worked Example Effects in Individual and Group Work Settings. *Educational Psychology, 30*, 349-367.
- Richland, L. E., Zur, O., & Holyoak, K. J. (2007). Cognitive supports for analogy in the mathematics classroom. *Science*, 316, 1128-1129.
- Rickards, J. P. (1975). Processing effects of advance organizers interspersed in text. *Reading Research Quarterly,* 11, 599-622.
- Rickards, J. P. (1976). Interaction of position and conceptual level of adjunct questions on immediate and delayed retention of text. *Journal of Educational Psychology, 68*, 210-217.
- Roediger, H. L., & Karpicke, J. D. (2006a). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181-210.
- Roediger, H. L., & Karpicke, J. D. (2006b). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science*, *17*, 249-255.
- Rohrer, D. (2009). The effects of spacing and mixing practice problems. *Journal for Research in Mathematics Education*, 40, 4-17.
- Rohrer, D., & Taylor, K. (2006). The effects of overlearning and distributed practice on the retention of mathematics knowledge. *Applied Cognitive Psychology, 20*, 1209-1224.
- Rohrer, D., & Taylor, K. (2007). The shuffling of mathematics problems improves learning. *Instructional Science*, 35, 481-498.
- Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research*, 66, 181-221.
- Rowland, C. A. (2014). The effect of testing versus restudy on retention: A meta-analytic review of the testing effect. *Psychological Bulletin*, 140, 1432-1463.
- Schmidt, R. A., & Bjork, R. A. (1992). New conceptualization of practice: Common principles in three paradigms suggest new concepts for training. *Psychological Science*, *3*, 207-217.
- Schneider, W., Vise, M., Lockl, K., & Nelson, T. O. (2000). Developmental trends in children's memory monitoring: Evidence from a judgment-of-learning (JOL) task. *Cognitive Development*, 15, 115-134.
- Schwonke, R., Wittwer, J., Aleven, V., Salden, R. J. C. M., Krieg, C., & Renkl, A. (2007). Can tutored problem solving benefit from faded worked-out examples? *Paper presented at The European Cognitive Science Conference*, Delphi, Greece.
- Schworm, S., & Renkl, A. (2002). Learning by solved example problems: Instructional explanations reduce self-explanation activity. In W. D. Gray and C. D. Schunn (Eds.), *Proceedings of the 24th Annual Conference of the Cognitive Science Society* (pp. 816-821). Mahwah, NJ: Erlbaum.
- Serra, M. J, & Dunlosky, J. (2010). Metacomprehension judgments reflect the belief that diagrams improve learning from text. *Memory*, 18(7), 698-711.

- Slof, B., Erkens, G., Kirschner, P. A., & Helms-Lorenz, M. (2013). The effects of inspecting and constructing part-task-specific visualizations on team and individual learning. *Computers & Education*, 60, 221-233.
- Sloutsky, V. M., Kaminski, J. A., & Heckler, A. F. (2005). The advantage of simple symbols for learning and transfer. *Psychonomic Bulletin & Review*, *12*, 508-513.
- Sobel, H. S., Cepeda, N. J., & Kapler, I. V. (2011). Spacing effects in real-world classroom vocabulary learning. Applied Cognitive Psychology, 25, 763-767.
- Starch, D. (1927). Educational psychology. New York: MacMillan.
- Sweller, J. (1999). Instructional design in technical areas. Victoria, Australia: Australian Council for Education Press.
- Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review*, 22(2), 123-138.
- Sweller, J., & Cooper, G. A. (1985). The use of worked examples as a substitute for problem solving in learning algebra. *Cognition and Instruction*, *2*, 59–89.
- Thiede, K. W., Anderson, M. C. M., & Therriault, D. (2003). Accuracy of metacognitive monitoring affects learning of texts. *Journal of Educational Psychology*, 95, 66-73.
- Thiede, K. W., Dunlosky, J., Griffin, T. D., & Wiley, J. (2005). Understanding the delayed-keyword effect on metacomprehension accuracy. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*, 1267-1280.
- Thompson, C. P., Wegner, S. K., & Bartling, C. A. (1978). How recall facilitates subsequent recall: A reappraisal. *Journal of Experimental Psychology: Human Learning and Memory, 4*, 210-221.
- Trabasso, T., & Magliano, J. P. (1996). Conscious understanding during comprehension. Discourse Processes, 21, 255-287.
- Trafton, J. G., & Reiser, B. J. (1993). The contributions of studying examples and solving problems to skill acquisition. In M. Polson (Ed.), *Proceedings of the 15th Annual Conference of the Cognitive Science Society* (pp. 1017-1022). Hillsdale, NJ: Erlbaum.
- van Amelsvoort, M., Andriessen, J., & Kanselaar, G. (2008). How students structure and relate argumentative knowledge when learning together with diagrams. *Computers in Human Behavior, 24*, 1293-1313.
- van Gog, T., Kester, L., & Paas, F. (2011). Effects of worked examples, example-problem, & problem-example pairs on novices' learning. *Contemporary Educational Psychology*, 36, 212-218
- VanLehn, K., Graesser, A. C., Jackson, G. T., Jordan, P., Olney, A., & Rose, C. P. (2007). When are tutorial dialogues more effective than reading? *Cognitive Science*, *31*, 3-62.
- Vlach, H. A., & Sandhofer, C. M. (2012). Distributing learning over time: The spacing effect in children's acquisition and generalization of science concepts. *Child Development*, 83, 1137-1144.
- Vlach, H. A., Sandhofer, C. M., & Kornell, N. (2008). The spacing effect in children's memory and category induction. *Cognition*, 109, 163-167.
- Ward, M., & Sweller, J. (1990). Structuring effective worked examples. Cognition and Instruction, 7, 1-39.
- Ward, W., Cole, R., Bolaños, D., Buchenroth-Martin, C., Svirsky, E., & Weston, T. (2013). My science tutor: A conversational multimedia virtual tutor. *Journal of Educational Psychology*, 105, 1115-1125.

- Wisher, R. A., & Graesser, A. C. (2007). Question asking in advanced distributed learning environments. In S.M. Fiore and E. Salas (Eds.), *Toward a science of distributed learning and training* (pp. 209-234) Washington, DC: American Psychological Association.
- Zhu, X., & Simon, H. A. (1987). Learning mathematics from examples and by doing. *Cognition and Instruction*, 4, 137-166.

## Part 2: Studies investigating the impact of instruction of teacher candidates on the six fundamental instructional strategies

No inference regarding the quality of the design of these studies should be made on the basis of their inclusion in this research inventory.

- Ding, M. & Carlson, M. A. (2013). Elementary teachers' learning to construct high-quality mathematics lesson plans: A use of the IES recommendations. *The Elementary School Journal*, 113(3), 35-385.
- Gillies, R. M. & Haynes, M. (2011). Increasing explanatory behavior, problem-solving, and reasoning within classes using cooperative group work. *Instructional Science*, *39*, 349-366.
- Gillies, R. M. & Khan, A. (2009). Promoting reasoned argumentation, problem-solving and learning during small-group work. *Cambridge Journal of Education*, 39(1), 7-27.
- Haydar, H. (2003). Daring to ask the hard questions: The effect of clinical interview training upon teachers classroom questioning. *International Group for the Psychology of Mathematics Education Conference*, *3*, 33-38.
- Korkmaz, O. & Yesil, R. (2010). A comparison of different teaching applications based on questioning in terms of their effects upon pre-service teachers' good questioning skills. *College Student Journal*, 44(4), 1006-20.
- Oliveira, A. W. (2010). Improving teacher questioning in science inquiry discussions through professional development. *Journal of Research in Science Teaching*, 47(4), 422-453.
- Weiland, I. S., Hudson, R. A., & Amador, J. M. (2014). Preservice formative assessment interviews: The development of competent questioning. *International Journal of Science and Mathematics Education*, 12, 329-352.
- Windschitl, M. & Thompson, J. (2006). Transcending simple forms of school science investigation: The impact of preservice instruction on teachers' understandings of model-based inquiry. *American Educational Research Journal*, 43(4), 783-835.