

Supplemental Material

CBE—Life Sciences Education

Vickrey *et al.*

Supplementary Materials

Table 1. Academic settings of each Peer Instruction study cited in the literature review

Article	Type of Institution			Subject Matter	Course Level			Class size	
	2-year	4-year	Research/Doctoral		Lower-level	Upper-level	Graduate	Small (<50)	Large (>50)
Beatty, I. D., Gerace, W. J., Leonard, W. J., & Dufresne, R. J. (2006). Designing Effective Questions for Classroom Response System Teaching. <i>American Journal of Physics</i> , 74(1), 31. doi:10.1119/1.2121753									
Boyle, J. T., & Nicol, D. J. (2003). Using Classroom Communication Systems to Support Interaction and Discussion in Large Class Settings. <i>Association for Learning Technology Journal</i> , 11(3), 43–57. doi:10.1080/0968776030110305			x	Engineering mechanics	x				x
Brady, M., Seli, H., & Rosenthal, J. (2013). “Clickers” and Metacognition: A Quasi-Experimental Comparative Study about Metacognitive Self-Regulation and Use of Electronic Feedback Devices. <i>Computers & Education</i> , 65, 56–63. doi:10.1016/j.compedu.2013.02.001			x	Educational Psychology		x			x
Brooks, B. B. J., & Koretsky, M. D. M. (2011). The Influence of Group Discussion on Students Responses and Confidence During Peer Instruction. <i>Journal of Chemical Education</i> , 88(11), 1477–1484.			x	Chemical thermodynamics		x			x
Bruck, A.D., & Towns, M.H. (2009). Analysis of classroom response system questions via four lenses in a General Chemistry course. <i>Chemistry Education Research and Practice</i> , 10(4), 291-295.			x	Chemistry	x				x
Butchart, S., Handfield, T., & Restall, G. (2009). Using Peer Instruction to Teach Philosophy, Logic, and Critical Thinking. <i>Teaching Philosophy</i> , 32, 1–40. doi:10.5840/teachphil20093212			x	Philosophy	x				x
Cortright, R. N., Collins, H. L., & DiCarlo, S. E. (2005). Peer Instruction Enhanced Meaningful Learning: Ability to Solve Novel Problems. <i>Advances in Physiology Education</i> , 29(2), 107–11. doi:10.1152/advan.00060.2004			x	Exercise Physiology		x		x	
Crossgrove, K., & Curran, K. L. (2008). Using Clickers in Nonmajors- and Majors-Level Biology Courses: Student Opinion, Learning, and Long-Term Retention of Course Material. <i>CBE Life Sciences Education</i> , 7(1), 146–54. doi:10.1187/cbe.07-08-0060			x	Non-major biology and genetics	x				x
Crouch, C. H. (1998). An Interactive Approach for Large Lecture Classes. <i>Optics and Photonics News</i> , (September), 37–41.			x	Calculus-based physics		x			x

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	2-year	4-year	Research/Doctoral		Lower-level	Upper-level	Graduate	Small (<50)	Large (>50)
Crouch, C. H., & Mazur, E. (2001). Peer Instruction: Ten Years of Experience and Results. <i>American Journal of Physics</i> , 69(9), 970. doi:10.1119/1.1374249			x	Physics- introductory algebra and calculus based	x				x
Crouch, C., & Watkins, J. (2007). Peer Instruction: Engaging Students One-on-One, All at Once. In E. F. Redish & P. Cooney (Eds.), <i>Reviews of Research-Based Reform Curricula in Introductory Physics</i> (pp. 1–55). College Park, MD: American Association of Physics Teachers.				Physics					
Fagen, A. P., Crouch, C., & Mazur, E. (2002). Peer Instruction: Results from a Range of Classrooms. <i>The Physics Teacher</i> , 40(4), 206. doi:10.1119/1.1474140			x	Physics, chemistry, life sciences, engineering, and astronomy					x
Fagen, A. P. (2003). Assessing and Enhancing the Introductory Science Course in Physics and Biology: Peer Instruction, Classroom Demonstrations, and Genetics Vocabulary. Harvard University. Retrieved from http://mazur.harvard.edu/sentFiles/Mazurpubs_537.pdf				Physics					
Ghosh, S., & Renna, F. (2006). <i>Technology in Support of Good Pedagogy: Electronic Response Systems and Peer Instruction in an Economics Classroom</i> (p. 22). Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=888544			x	Economics	x			x	x
Giuliodori, M. J., Lujan, H. L., & DiCarlo, S. E. (2006). Peer Instruction Enhanced Student Performance on Qualitative Problem-Solving Questions. <i>Advances in Physiology Education</i> , 30(4), 168–73. doi:10.1152/advan.00013.2006			x	Physiology/veterinary medical		x	x		x
Gok, T. (2012). The Effects of Peer Instruction on Student's Conceptual Learning and Motivation. <i>Asia-Pacific Forum on Science Learning and Teaching</i> , 13.	x			Introductory physics	x				x
Gray, K., Owens, K., Liang, X., & Steer, D. (2011). Assessing Multimedia Influences on Student Responses Using a Personal Response System. <i>Journal of Science Education and Technology</i> , 21(3), 392–402. doi:10.1007/s10956-011-9332-1			x	Geosciences	x				x
James, M., Barbieri, F., & Garcia, P. (2008). What are They Talking About? Lessons Learned from a Study of Peer Instruction. <i>Astronomy Education Review</i> , 7(1).			x	Astronomy	x				x
James, M. C. (2006). The Effect of Grading Incentive on Student Discourse in Peer Instruction. <i>American Journal of Physics</i> , 74(8), 689. doi:10.1119/1.2198887			x	Astronomy	x				x
James, M. C., & Willoughby, S. (2011). Listening to Student Conversations During Clicker Questions: What You Have not Heard Might Surprise You! <i>American Journal of Physics</i> , 79(1), 123.			x	Introductory physics	x				x

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	2-year	4-year	Research/Doctoral		Lower-level	Upper-level	Graduate	Small (<50)	Large (>50)
doi:10.1119/1.3488097									
Jones, M. E., Antonenko, P. D., & Greenwood, C. M. (2012). The Impact of Collaborative and Individualized Student Response System Strategies on Learner Motivation, Metacognition, and Knowledge Transfer. <i>Journal of Computer Assisted Learning</i> , 28, 477–487. doi:10.1111/j.1365-2729.2011.00470.x			x	Entomology	x				x
Knight, J. J. K., & Wood, W. B. W. (2005). Teaching More by Lecturing Less. <i>Cell Biology Education</i> , 4, 298–310. doi:10.1187/05			x	Developmental biology		x			x
Knight, J. K., Wise, S. B., & Southard, K. M. (2013). Understanding Clicker Discussions: Student Reasoning and the Impact of Instructional Cues. <i>CBE Life Sciences Education</i> , 12(4), 645–54. doi:10.1187/cbe.13-05-0090			x	Upper-division biology		x			x
Lasry, N., Mazur, E., & Watkins, J. (2008). Peer Instruction: From Harvard to the Two-Year College. <i>American Journal of Physics</i> , 76(11), 1066. doi:10.1119/1.2978182	x		x	Introductory physics	x			x	
Lasry, N. (2008). Clickers or Flashcards: Is There Really a Difference? <i>The Physics Teacher</i> , 46(4), 242. doi:10.1119/1.2895678				Physics	x			x	
Lasry, N., Charles, E., Whittaker, C., & Lautman, M. (2009). When Talking is Better than Staying Quiet. In M. Sabella, C. Henderson, & C. Singh (Eds.), <i>Physics Education Research Conference</i> (pp. 181–184). American Institute of Physics.			x	Introductory physics	x			x	
Lorenzo, M., Crouch, C. H., & Mazur, E. (2006). Reducing the Gender Gap in the Physics Classroom. <i>American Journal of Physics</i> , 74(2), 118. doi:10.1119/1.2162549			x	Calculus-based physics	x				x
Lucas, A. (2009). Using Peer Instruction and I-Clickers to Enhance Student Participation in Calculus. <i>Problems, Resources, and Issues in Mathematics Undergraduate Studies</i> , 19(3), 219–231. doi:10.1080/10511970701643970		x		Calculus (II)	x			x	
McConnell, D. A., Steer, D. N., Owens, K. D., Knott, J. R., Dick, J., & Heaney, P. J. (2006). Using Conceptests to Assess and Improve Student Conceptual Understanding in Introductory Geoscience Courses. <i>Journal of Geoscience Education</i> , 54, 61–68.		x	x	Geosciences	x				x
Miller, R. L. R., Santana-Vega, E., & Terrell, M. S. (2006). Can Good Questions and Peer Discussion Improve Calculus Instruction? <i>Problems, Resources, and Issues in Mathematics Undergraduate Studies</i> , 16(3), 193–203. doi:10.1080/10511970608984146			x	Calculus(I)	x			x	

Article	Type of Institution			Subject Matter	Course Level			Class size	
	2-year	4-year	Research/Doctoral		Lower-level	Upper-level	Graduate	Small (<50)	Large (>50)
Miller, K., Lasry, N., Lukoff, B., Schell, J., & Mazur, E. (2014). Conceptual Question Response Times in Peer Instruction Classrooms. <i>Physical Review Special Topics - Physics Education Research</i> , 10(2), 020113. doi:10.1103/PhysRevSTPER.10.020113			x	Introductory physics	x			x	x
Mora, G. (2010). Peer Instruction and Lecture Tutorials Equally Improve Student Learning in Introductory Geology Classes. <i>Journal of Geoscience Education</i> , 58(5), 286.	x			Geosciences	x			x	
Morgan, B. J. T., & Wakefield, C. (2012). Who Benefits from Peer Conversation? Examining Correlations of Clicker Question Correctness and Course Performance. <i>Journal of Science Teacher Education</i> , 41, 51–56.			x	Physics for non-majors	x				x
Nicol, D. J., & Boyle, J. T. (2003). Peer Instruction versus Class-wide Discussion in Large Classes: A Comparison of Two Interaction Methods in the Wired Classroom. <i>Studies in Higher Education</i> , 28, 458–473.			x	Engineering mechanics	x				x
Nielsen, K. L., Hansen-Nygård, G., & Stav, J. B. (2012). Investigating Peer Instruction: How the Initial Voting Session Affects Students' Experiences of Group Discussion. <i>ISRN Education</i> , 1–8. doi:10.5402/2012/290157			x	Introductory physics	x				x
Nielsen, K. L., Hansen, G., & Stav, J. B. (2013). Teaching with Student Response Systems (SRS): Teacher-Centric Aspects that can Negatively Affect Students' Experience of Using SRS. <i>Research in Learning Technology</i> , 21, 18989. doi:10.3402/rlt.v21i0.18989				Physics	x			x	
Nielsen, K. L., Hansen, G., & Stav, J. B. (2014). How the Initial Thinking Period Affects Student Argumentation during Peer Instruction: Students' Experiences versus Observations. <i>Studies in Higher Education</i> , 1–15. doi:10.1080/03075079.2014.915300	x			Introductory physics	x			x	
Perez, K. E., Strauss, E. A., Downey, N., Galbraith, A., Jeanne, R., Cooper, S., & Madison, W. (2010). Does Displaying the Class Results Affect Student Discussion during Peer Instruction? <i>CBE Life Sciences Education</i> , 9, 133–140. doi:10.1187/cbe.09			x	Biology	x				x
Pilzer, S. (2001). Peer Instruction in Physics and Mathematics. <i>Problems, Resources, and Issues in Mathematics Undergraduate Studies</i> , 11(2), 185–192.	x			Calculus	x			x	
Porter, L., Bailey-Lee, C., Simon, B., Cutts, Q., & Zingaro, D. (2011). Experience Report: A Multi-Classroom Report on the Value of Peer Instruction. In <i>Proceedings of the 16th annual joint conference on Innovation and technology in computer science education</i> (pp. 138–142). Retrieved from http://dl.acm.org/citation.cfm?id=1999788			x	Computer science	x	x		x	x

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	2-year	4-year	Research/Doctoral		Lower-level	Upper-level	Graduate	Small (<50)	Large (>50)
Porter, L., Bailey-Lee, C., Simon, B., & Zingaro, D. (2011). Peer Instruction: Do Students Really Learn from Peer Discussion in Computing? In <i>ICER'11 Proceedings of the seventh international workshop on Computing education research</i> . Retrieved from http://dl.acm.org/citation.cfm?id=2016923			x	Computer science		x		x	
Porter, L., Bailey-lee, C., & Simon, B. (2013). Halving Fail Rates using Peer Instruction: A Study of Four Computer Science Courses. In <i>SIGCSE '13: Proceeding of the 44th ACM technical symposium on Computer science education</i> (pp. 177–182).			x	Computer science	x				x
Rao, S. P., & DiCarlo, S. E. (2000). Peer Instruction Improves Performance on Quizzes. <i>Advances in Physiology Education</i> , 24(1), 51–5.			x	Medical physiology			x		x
Schmidt, B. (2011). Teaching Engineering Dynamics by Use of Peer Instruction Supported by an Audience Response System. <i>European Journal of Engineering Education</i> , 36(5), 413–423. doi:10.1080/03043797.2011.602185			x	Mechanical engineering	x				x
Simon, B., Kohanfars, M., & Lee, J. (2010). Experience Report: Peer Instruction in Introductory Computing. In <i>SIGCSE'10 Proceeding of the 41st ACM technical symposium on computer science education</i> (pp. 341–345). Retrieved from http://dl.acm.org/citation.cfm?id=1734381			x	Computer science	x				x
Simon, B., Parris, J., & Spacco, J. (2013). How we Teach Impacts Student Learning: Peer Instruction vs. Lecture in CS0. In <i>Proceeding of the 44th ACM technical symposium on Computer science education - SIGCSE '13</i> (p. 41). ACM Press. doi:10.1145/2445196.2445215			x	Computer science for non-majors	x				x
Simon, B., Esper, S., Porter, L., & Cutts, Q. (2013). Student Experience in a Student-Centered Peer Instruction Classroom. In <i>Proceedings of the ninth annual international ACM conference on International computing education research - ICER '13</i> (p. 129). doi:10.1145/2493394.2493407			x	Computer science	x				x
Smith, M. K., Trujilo, C., & Su, T. T. (2010). The Benefits of Using Clickers in Small-Enrollment Seminar-Style Biology Courses. <i>CBE Life Sciences Education</i> , 10(1), 14-17. doi:10.1187/cbe.10-09-0114			x	Embryology/biology		x		x	
Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why Peer Discussion Improves Student Performance on In-Class Concept Questions. <i>Science</i> , 323(5910), 122–4. doi:10.1126/science.1165919			x	Genetics/biology	x				x
Smith, M. K., Wood, W. B., Krauter, K., & Knight, J. K. (2011). Combining Peer Discussion with Instructor Explanation Increases			x	Genetics/biology	x				x

Article	Type of Institution			Subject Matter	Course Level			Class size	
	2-year	4-year	Research/Doctoral		Lower-level	Upper-level	Graduate	Small (<50)	Large (>50)
Student Learning from In-Class Concept Questions. <i>CBE Life Sciences Education</i> , 10(1), 55–63. doi:10.1187/cbe.10-08-0101									
Steer, D., McConnell, D., Gray, K., Kortz, K., & Liang, X. (2009). Analysis of Student Responses to Peer-Instruction Conceptual Questions Answered Using an Electronic Response System: Trends by Gender and Ethnicity. <i>Science Educator</i> , 18(2), 30–38.	x			Geosciences		x			x
Turpen, C., & Finkelstein, N. (2009). Not All Interactive Engagement is the Same: Variations in Physics Professors' Implementation of Peer Instruction. <i>Physical Review Special Topics - Physics Education Research</i> , 5(2), 20101. doi:10.1103/PhysRevSTPER.5.020101				Introductory physics		x			x
Turpen, C., & Finkelstein, N. D. (2010). The Construction of Different Classroom Norms during Peer Instruction: Students Perceive Differences. <i>Physical Review Special Topics - Physics Education Research</i> , 6(2), 020123. doi:10.1103/PhysRevSTPER.6.020123				Introductory physics		x			x
Zingaro, D., & Porter, L. (2014). Peer Instruction: A link to the Exam. In <i>Proceedings of the 19th Annual Conference on Innovation and Technology in Computer Science Education</i> (pp. 255–260). Retrieved from http://www.danielzingaro.com/iticse14.pdf				Computer science		x			x
Zingaro, D. (2014). Peer Instruction Contributes to Self-Efficacy in CS1. In <i>Proceedings of the 45th ACM technical symposium on Computer science education - SIGCSE '14</i> (pp. 373–378). New York, New York, USA: ACM Press. doi:10.1145/2538862.2538878				Computer science		x			x
Zingaro, D., & Porter, L. (2014). Peer Instruction in Computing: The Value of Instructor Intervention. <i>Computers and Education</i> , 71, 87–96. doi:10.1016/j.compedu.2013.09.015				Computer science		x			x