

Facilitating peer tutoring and assessment in intelligent learning systems

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Abstract

Research has observed substantial value in learning interventions where peers tutor and assess each other, and has outlined activities (e.g., explaining, questioning, and feedback) that enable interactive and reflective knowledge-building. This chapter considers how the underlying learning processes of peer tutoring and peer assessment can be enacted and supported within intelligent learning systems. We present a framework of *allowances*, *affordances*, and *adaptances* for describing different levels of scaffolding via technology. Example applications and recommendations for future research are discussed.

Keywords: explaining, feedback, intelligent tutoring systems, learning by teaching, peer tutoring, peer assessment, teachable agents, questioning, self-monitoring, social interaction

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References

Aleven, V. A., & Koedinger, K. R. (2002). An effective metacognitive strategy: Learning by doing and explaining with a computer-based Cognitive Tutor. *Cognitive Science*, 26(2), 147-179.

Anson, R., & Goodman, J. A. (2014). A peer assessment system to improve student team experiences. *Journal of Education for Business*, 89(1), 27-34.

Baghaei, N., Mitrovic, A., & Irwin, W. (2007). Supporting collaborative learning and problem-solving in a constraint-based CSCL environment for UML class

diagrams. *International Journal of Computer-Supported Collaborative Learning*, 2(2-3), 159-190.

Biswas, G., Leelawong, K., Schwartz, D., Vye, N., & The Teachable Agents Group at Vanderbilt (2005). Learning by teaching: A new agent paradigm for educational software. *Applied Artificial Intelligence*, 19(3-4), 363-392.

Biswas, G., Segedy, J. R., & Bunchongchit, K. (2016). From design to implementation to practice a learning by teaching system: Betty's Brain. *International Journal of Artificial Intelligence in Education*, 26(1), 350-364.

Bowman-Perrott, L., Burke, M. D., Zhang, N., & Zaini, S. (2014). Direct and collateral effects of peer tutoring on social and behavioral outcomes: A meta-analysis of single-case research. *School Psychology Review*, 43(3), 260-285.

Bowman-Perrott, L., Davis, H., Vannest, K., & Williams, L. (2013). Academic benefits of peer tutoring: A meta-analytic review of single-case research. *School Psychology Review*, 42(1), 39-55.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245-281.

Çevik, Y. D. (2015). Assessor or assessee? Investigating the differential effects of online peer assessment roles in the development of students' problem-solving skills. *Computers in Human Behavior*, 52, 250-258.

Chaffey, T., Kim, H., Nobrega, E., Lubold, N., & Pon-Barry, H. (2018, March). Dyadic stance in natural language communication with a teachable robot. In *Companion of the 2018 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 85-86). ACM.

Charney, D. H., & Carlson, R. A. (1995). Learning to write in a genre: What student writers take from model texts. *Research in the Teaching of English*, 29(1), 88-125.

Chase, C. C., Chin, D. B., Opezzo, M. A., & Schwartz, D. L. (2009). Teachable agents and the protégé effect: Increasing effort towards learning. *Journal of Science Education and Technology*, 18(4), 334-352.

Chi, M. T. H. (2000). Self-explaining expository texts: The dual processes of generating inferences and repairing mental models. In R. Glaser (Ed.), *Advances in instructional*

psychology: Educational design and cognitive science (pp. 161-238). Mahwah, NJ: Erlbaum.

Chi, M. T. H. (2009). Active–constructive–interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science*, 1(1), 73-105.

Chi, M. T. H., De Leeuw, N., Chiu, M. H., & LaVancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science*, 18(3), 439-477.

Chi, M. T. H., Roy, M., & Hausmann, R. G. M. (2008). Chi, M. T., Roy, M., & Hausmann, R. G. (2008). Observing tutorial dialogues collaboratively: Insights about human tutoring effectiveness from vicarious learning. *Cognitive Science*, 32(2), 301-341.

Chi, M. T. H., Siler, S. A., Jeong, H., Yamauchi, T., & Hausmann, R. G. (2001). Learning from human tutoring. *Cognitive Science*, 25(4), 471-533.

Chi, M. T. H., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist*, 49(4), 219-243.

Chin, D. B., Dohmen, I. M., & Schwartz, D. L. (2013). Young children can learn scientific reasoning with teachable agents. *IEEE Transactions on Learning Technologies*, 6(3), 248-257.

Cho, K., & MacArthur, C. (2010). Student revision with peer and expert reviewing. *Learning and Instruction*, 20(4), 328–338.

Cho, K., & MacArthur, C. (2011). Learning by reviewing. *Journal of Educational Psychology*, 103(1), 73–84. <https://doi.org/10.1037/a0021950>

Cho, K., & Schunn, C. D. (2007). Scaffolded writing and rewriting in the discipline: A web-based reciprocal peer review system. *Computers & Education*, 48(3), 409–426. <https://doi.org/10.1016/j.compedu.2005.02.004>

Cho, K., Schunn, C. D., & Charney, D. (2006). Commenting on writing: Typology and perceived helpfulness of comments from novice peer reviewers and subject matter experts. *Written Communication*, 23(3), 260–294. <https://doi.org/10.1177/0741088306289261>

Choi, E., Munoz, R., Balak, M., Mukhlas, D., Farias, L., Jara, D., Turnip, P., & Burkov, O. (2016, March). Understanding user motivations for asking and answering a question on brainly, online social learning network. In *iConference 2016 Proceedings* (pp. 1-4). iSchools.

Cho, K., Schunn, C. D., & Wilson, R. W. (2006). Validity and reliability of scaffolded peer assessment of writing from instructor and student perspectives. *Journal of Educational Psychology, 98*(4), 891-901. doi:10.1037/0022-0663.98.4.891

Cohen, P., Kulik, J., & Kulik, C. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American Educational Research Journal, 19*(2), 237–248.

Crespo, R. M., Pardo, A., Pérez, J. P. S., & Kloos, C. D. (2005, June). An algorithm for peer review matching using student profiles based on fuzzy classification and genetic algorithms. In *International Conference on Industrial, Engineering and Other Applications of Applied Intelligent Systems* (pp. 685-694). Springer, Berlin, Heidelberg.

Dawson, P. (2017). Assessment rubrics: Towards clearer and more replicable design, research and practice. *Assessment & Evaluation in Higher Education, 42*(3), 347-360.

Desmarais, M. C., & Baker, R. S. (2012). A review of recent advances in learner and skill modeling in intelligent learning environments. *User Modeling and User-Adapted Interaction, 22*(1-2), 9-38.

Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed), *Three worlds of CSCL: Can we support CSCL* (pp. 61-91). Heerlen, The Netherlands: Open Universiteit Nederland.

DiPardo, A., & Freedman, S. W. (1988). Peer response groups in the writing classroom: Theoretic foundations and new directions. *Review of Educational Research, 58*(2), 119–149.

Duran, D. (2017). Learning-by-teaching: Evidence and implications as a pedagogical mechanism. *Innovations in Education and Teaching International, 54*(5), 476-484.

Durlach, P. J., & Lesgold, A. M. (Eds.). (2012). *Adaptive technologies for training and education*. New York, NY: Cambridge University Press.

Estévez-Ayres, I., García, R. M. C., Fisteus, J. A., & Kloos, C. D. (2013). An Algorithm for Peer Review Matching in Massive Courses for Minimising Students' Frustration. *J. UCS, 19*(15), 2173-2197.

Falchikov, N. (1995). Peer feedback marking: Developing peer assessment. *Innovations in Education and Training International, 32*(2), 175-187.

Falchikov, N., & Goldfinch, J. (2000). Student peer assessment in higher education: A meta-analysis comparing peer and teacher marks. *Review of Educational Research, 70*(3), 287-322.

Fiorella, L., Mayer, R. E. (2013). The relative benefits of learning by teaching and teaching expectancy. *Contemporary Educational Psychology, 38*(4), 281-288.

Fiorella, L., & Mayer, R. E. (2014). Role of expectations and explanations in learning by teaching. *Contemporary Educational Psychology, 39*(2), 75-85.

Fraser, C. A., Ngoon, T. J., Weingarten, A. S., Dontcheva, M., & Klemmer, S. (2017, October). CritiqueKit: A mixed-initiative, real-time interface for improving feedback. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology* (pp. 7-9). ACM.

Gielen, M., & De Wever, B. (2015). Scripting the role of assessor and assessee in peer assessment in a wiki environment: Impact on peer feedback quality and product improvement. *Computers & Education, 88*, 370-386.

doi: 10.1016/j.compedu.2015.07.012

Gielen, S., Tops, L., Dochy, F., Onghena, P., & Smeets, S. (2010). A comparative study of peer and teacher feedback and of various peer feedback forms in a secondary school writing curriculum. *British Educational Research Journal, 36*(1), 143–162.

Ginsburg-Block, M. D., Rohrbeck, C. A., & Fantuzzo, J. W. (2006). A meta-analytic review of social, self-concept, and behavioral outcomes of peer-assisted learning. *Journal of Educational Psychology, 98*(4), 732-749.

Goldin, I., Narciss, S., Foltz, P., & Bauer, M. (2017). New directions in formative feedback in interactive learning environments. *International Journal of Artificial Intelligence in Education, 27*(3), 385-392.

Graesser, A. C., Baggett, W., & Williams, K. (1996). Question-driven explanatory reasoning. *Applied Cognitive Psychology, 10*(7), 17-31.

Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal, 31*(1), 104-137.

Graesser, A. C., Person, N. K., & Magliano, J. P. (1995). Collaborative dialogue patterns in naturalistic one-to-one tutoring. *Applied Cognitive Psychology, 9*(6), 495-522.

Greene, J. A., & Azevedo, R. (2007). A theoretical review of Winne and Hadwin's model of self-regulated learning: New perspectives and directions. *Review of Educational Research, 77*(3), 334-372.

Gunersel, A. B., Simpson, N. J., Aufderheide, K. J., & Wang, L. (2008). Effectiveness of Calibrated Peer Review™ for improving writing and critical thinking skills in biology undergraduate students. *Journal of the Scholarship of Teaching and Learning, 8*(2), 25-37.

Hayes, J. R., Flower, L., Schriver, K. A., Stratman, J. F., & Carey, L. (1987). Cognitive processes in revision. In S. Rosenberg (Ed.), *Advances in applied psycholinguistics Volume 2 Reading, writing, and language learning* (pp. 176-240). New York: Cambridge University Press.

Hodgson, P., Chan, K., & Liu, J. (2014). Outcomes of synergetic peer assessment: First-year experience. *Assessment & Evaluation in Higher Education, 39*(2), 168-178.

Hood, D., Lemaignan, S., & Dillenbourg, P. (2015, March). When children teach a robot to write: An autonomous teachable humanoid which uses simulated handwriting. In *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction* (pp. 83-90). ACM.

Hsiao, I. H., & Naveed, F. (2015, October). Identifying learning-inductive content in programming discussion forums. In *Frontiers in Education Conference (FIE), 2015 IEEE* (pp. 1-8). IEEE.

Hudson, M. E., Browder, D. M., & Jimenez, B. A. (2014). Effects of a peer-delivered system of least prompts intervention and adapted science read-alouds on listening comprehension for participants with moderate intellectual disability. *Education & Training in Autism & Developmental Disabilities, 49*(1), 60-77.

Johnson, D. W., Johnson, R. T., Johnson, J., & Anders, D. (1976). Effects of cooperative versus individualized instruction on student prosocial behavior, attitudes toward learning, and achievement. *Journal of Educational Psychology, 68*(4), 446-452.

Jonsson, A., & Svingby, G. (2007). The use of scoring rubrics: Reliability, validity and educational consequences. *Educational Research Review, 2*(2), 130-144.

King, A. (1998). Transactive peer tutoring: Distributing cognition and metacognition. *Educational Psychology Review, 10*(1), 57-74.

King, A., Staffieri, A., & Adelgais, A. (1998). Mutual peer tutoring: Effects of structuring tutorial interaction to scaffold peer learning. *Journal of Educational Psychology, 90*(1), 134–152.

Kinnebrew, J. S., Segedy, J. R., & Biswas, G. (2017). Integrating model-driven and data-driven techniques for analyzing learning behaviors in open-ended learning environments. *IEEE Transactions on Learning Technologies, 10*(2), 140-153.

Koh, A. W. L., Lee, S. C., & Lim, S. W. H. (2018). The learning benefits of teaching: A retrieval practice hypothesis. *Applied Cognitive Psychology*. DOI: 10.1002/acp.3410

Lai, C.-L., & Hwang, G.-J. (2015). An interactive peer-assessment criteria development approach to improving students' art design performance using handheld devices. *Computers & Education, 85*, 149-159. doi:10.1016/j.compedu.2015.02.011

Landry, A., Jacobs, S., & Newton, G. (2015). Effective use of peer assessment in a graduate level writing assignment: A case study. *International Journal of Higher Education, 4*(1), 38-51.

Leelawong, K., & Biswas, G. (2008). Designing learning by teaching agents: The Betty's Brain system. *International Journal of Artificial Intelligence in Education, 18*(3), 181-208.

Leung, K. C. (2015). Preliminary empirical model of crucial determinants of best practice for peer tutoring on academic achievement. *Journal of Educational Psychology, 107*(2), 558-579.

Liu, E. Z.-F., & Lee, C.-Y. (2013). Using peer feedback to improve learning via online peer assessment. *Turkish Online Journal of Educational Technology – TOJET, 12*(1), 187-199.

Lu, J., & Law, N. (2012). Online peer assessment: Effects of cognitive and affective feedback. *Instructional Science, 40*(2), 257–275.

Lubold, N., Walker, E., & Pon-Barry, H. (2016, March). Effects of voice-adaptation and social dialogue on perceptions of a robotic learning companion. *In Human-Robot Interaction (HRI), 2016 11th ACM/IEEE International Conference on* (pp. 255-262). IEEE.

Lubold, N., Walker, E., Pon-Barry, H., & Ogan, A. (to appear). Automated Pitch Convergence Improves Learning in a Social Teachable Robot for Middle School Mathematics. To appear in *AIED 2018*.

Lundstrom, K., & Baker, W. (2009). To give is better than to receive: The benefits of peer review to the reviewer's own writing. *Journal of Second Language Writing, 18*(1), 30–43. <https://doi.org/10.1016/j.jslw.2008.06.002>

Madaio, M. A., Ogan, A., & Cassell, J. (2016, June). The effect of friendship and tutoring roles on reciprocal peer tutoring strategies. In *International Conference on Intelligent Tutoring Systems* (pp. 423-429). Springer.

Magnisalis, I., Demetriadis, S., & Karakostas, A. (2011). Adaptive and intelligent systems for collaborative learning support: A review of the field. *IEEE transactions on Learning Technologies, 4*(1), 5-20.

Margerum, L. D., Gulsrud, M., Manlapez, R., Rebong, R., & Love, A. (2007). Application of Calibrated Peer Review (CPR) writing assignments to enhance experiments with an environmental chemistry focus. *Journal of Chemical Education, 82*(2), 292-295.

Matsuda, N., Cohen, W. W., & Koedinger, K. R. (2015). Teaching the teacher: Tutoring SimStudent leads to more effective cognitive tutor authoring. *International Journal of Artificial Intelligence in Education, 25*(1), 1-34.

Matsuda, N., Cohen, W. W., Sewall, J., Lacerda, G., & Koedinger, K. R. (2007). Predicting students' performance with simstudent: Learning cognitive skills from observation. *Frontiers in Artificial Intelligence and Applications, 158*, 467-476.

Matsuda, N., Yarzebinski, E., Keiser, V., Raizada, R., Cohen, W. W., Stylianides, G. J., & Koedinger, K. R. (2013). Cognitive anatomy of tutor learning: Lessons learned with SimStudent. *Journal of Educational Psychology, 105*(4), 1152-1163.

McLaren, B. M., Scheuer, O., & Mikšátko, J. (2010). Supporting collaborative learning and e-Discussions using artificial intelligence techniques. *International Journal of Artificial Intelligence in Education, 20*(1), 1-46.

McNamara, D. S. (2017). Self-explanation and Reading Strategy Training (SERT) improves low-knowledge students' science course performance. *Discourse Processes, 54*(7), 479-492.

- McNamara, D. S., Levinstein, I. B., & Boonthum, C. (2004). iSTART: Interactive strategy training for active reading and thinking. *Behavior Research Methods, Instruments, & Computers, 36*(2), 222-233.
- McNamara, D. S., O'Reilly, T. P., Best, R. M., & Ozuru, Y. (2006). Improving adolescent students' reading comprehension with iSTART. *Journal of Educational Computing Research, 34*(2), 147-171.
- McMaster, K., Fuchs, D., & Fuchs, L. (2006). Research on peer-assisted learning strategies: The promise and limitation of peer-mediated instruction. *Reading and Research Quarterly, 22*, 5–25.
- Molloy, E. K., & Boud, D. (2014). Feedback models for learning, teaching and performance. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology, fourth edition* (pp. 413-424). New York, NY: Springer Science+Business Media
- Mory, E. H. (2004). Feedback research revisited. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology, second edition* (pp. 745-783). Mahwah, NJ: Lawrence Erlbaum Associates.
- Mulder, R., Baik, C., Naylor, R., & Pearce, J. (2014). How does student peer review influence perceptions, engagement and academic outcomes? A case study. *Assessment & Evaluation in Higher Education, 39*(6), 657-677.
- Muldner, K., Lozano, C., Giroto, V., Burleson, W., & Walker, E. (2013, July). Designing a tangible learning environment with a teachable agent. In *International Conference on Artificial Intelligence in Education* (pp. 299-308). Springer, Berlin, Heidelberg.
- Mumford, M. D. (1983). Social comparison theory and the evaluation of peer evaluations: A review and some applied implications. *Personnel Psychology, 36*(4), 867–881. <https://doi.org/10.1111/j.1744-6570.1983.tb00516.x>
- Nelson, M. M., & Schunn, C. D. (2009). The nature of feedback: How different types of peer feedback affect writing performance. *Instructional Science, 37*(4), 375–401. <https://doi.org/10.1007/s11251-008-9053-x>
- Ngoon, T. J., Fraser, C. A., Weingarten, A. S., Dontcheva, M., & Klemmer, S. (2018, April). Interactive guidance techniques for improving creative feedback. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (pp. 1-11). ACM.

- Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199-218.
- Nguyen, H. V., Xiong, W., & Litman, D. (2014, June). *Classroom evaluation of a scaffolding intervention for improving peer review localization*. Paper presented at the 12th International Conference on Intelligent Tutoring Systems (ITS), Honolulu, HI.
- Nguyen, H., Xiong, W., & Litman, D. (2017). Iterative design and classroom evaluation of automated formative feedback for improving peer feedback localization. *International Journal of Artificial Intelligence in Education, 27*(3), 582-622.
- Panadero, E., & Jonsson, A. (2013). The use of scoring rubrics for formative assessment purposes revisited: A review. *Educational Research Review, 9*, 129-144.
- Papamitsiou, Z., & Economides, A. A. (2014). Learning analytics and educational data mining in practice: A systematic literature review of empirical evidence. *Journal of Educational Technology & Society, 17*(4), 49-64.
- Parr, J. M., & Timperley, H. S. (2010). Feedback to writing, assessment for teaching and learning and student progress. *Assessing Writing, 15*(2), 68-85.
- Patchan, M. M., Charney, D., & Schunn, C. D. (2009). A validation study of students' end comments: Comparing comments by students, a writing instructor, and a content instructor. *Journal of Writing Research, 1*(2), 124–152. <https://doi.org/10.17239/jowr-2009.01.02.2>
- Patchan, M. M., & Schunn, C. D. (2015). Understanding the benefits of providing peer feedback: How students respond to peers' texts of varying quality. *Instructional Science, 43*(5), 591–614. <https://doi.org/10.1007/s11251-015-9353-x>
- Patchan, M. M., & Schunn, C. D. (2016). Understanding the effects of receiving peer feedback for text revision: Relations between author and reviewer ability. *Journal of Writing Research, 8*(2), 227–265. <https://doi.org/10.17239/jowr-2016-08.02.03>
- Patchan, M. M., Schunn, C. D., & Clark, R. J. (2011). Writing in natural sciences: Understanding the effects of different types of reviewers on the writing process. *Journal of Writing Research, 2*(3), 365–393. <https://doi.org/10.17239/jowr-2011.02.03.4>

Patchan, M. M., Schunn, C. D., & Clark, R. J. (2017). Accountability in peer assessment: Examining the effects of reviewing grades on peer ratings and peer feedback. *Studies in Higher Education*.

[https://doi: 10.1080/03075079.2017.1320374](https://doi.org/10.1080/03075079.2017.1320374)

Patchan, M. M., Schunn, C. D., & Correnti, R. J. (2016). The nature of feedback: How feedback features affect students' implementation rate and quality of revisions. *Journal of Educational Psychology*, 108(8), 1098-1120. doi:10.1037/edu0000103

Pareto, L., Arvemo, T., Dahl, Y., Haake, M., & Gulz, A. (2011, June). A teachable-agent arithmetic game's effects on mathematics understanding, attitude and self-efficacy. In *International Conference on Artificial Intelligence in Education* (pp. 247-255). Springer, Berlin, Heidelberg.

Ploetzner, R., Dillenbourg, P., Preier, M., & Traum, D. (1999). Learning by explaining to oneself and to others. *Collaborative learning: Cognitive and computational approaches*, 1, 103-121.

Reddy, Y. M., & Andrade, H. (2010). A review of rubric use in higher education. *Assessment & Evaluation in Higher Education*, 35(4), 435-448.

Reif, F., & Scott, L. A. (1999). Teaching scientific thinking skills: Students and computers coaching each other. *American Journal of Physics*, 67(9), 819-831.

Rezaei, A. R., & Lovorn, M. (2010). Reliability and validity of rubrics for assessment through writing. *Assessing Writing*, 15(1), 18-39.

Roscoe, R. D. (2014). Self-monitoring and knowledge-building in learning by teaching. *Instructional Science*, 42, 327-351.

Roscoe, R. D., & Chi, M. T. H. (2004). The influence of the tutee in learning by peer tutoring. In K. Forbus, D. Gentner, & T. Regier (Eds.), *Proceedings of the 26th Annual Meeting of the Cognitive Science Society* (pp. 1179-1184). Cognitive Science Society: Chicago, IL.

Roscoe, R. D., & Chi, M. T. H. (2007). Understanding tutor learning: Knowledge-building and knowledge-telling in peer tutors' explanations and questions. *Review of Educational Research*, 77(4), 534-574.

Roscoe, R. D., & Chi, M. T. H. (2008). Tutor learning: The role of explaining and responding to questions. *Instructional Science*, 36, 321-3530.

Roscoe, R. D., Segedy, J. R., Sulcer, B., Jeong, H., & Biswas, G. (2013). Shallow strategy development in a teachable agent environment designed to support self-regulated learning. *Computers & Education, 62*, 286-297.

Rummel, N., Walker, E., & Alevan, V. (2016). Different futures of adaptive collaborative learning support. *International Journal of Artificial Intelligence in Education, 26*(2), 784-795.

Russell, A. A. (2005). Calibrated Peer Review™: A writing and critical-thinking instructional tool. *Invention and impact: Building excellence in undergraduate science, technology, engineering and mathematics (STEM) education*. Washington DC: American Association for the Advancement of Science.

Sadauskas, J., Tinapple, D., Olson, L., & Atkinson, R. (2013, June). CritViz: A network of peer critique structure for large classrooms. In *Proceedings of EdMedia 2013: World Conference on Education Media and Technology* (pp. 1437-1445). AACE.

Schunn, C. D. (2016). Writing to learn and learning to write through SWoRD. In S. A. Crossley & D. S. McNamara (Eds.), *Adaptive educational technologies for literacy instruction* (pp. 243-259). New York: Taylor & Francis, Routledge.

Schwartz, D. L., Chase, C. C., Opezzo, M. A., & Chin, D. B. (2011). Practicing versus inventing with contrasting cases: The effects of telling first on learning and transfer. *Journal of Educational Psychology, 103*(4), 759-775.

Segedy, J. R., Kinnebrew, J. S., & Biswas, G. (2013). The effect of contextualized conversational feedback in a complex open-ended learning environment. *Educational Technology Research and Development, 61*(1), 71-89.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research, 78*(1), 153-189.

Slater, S., Joksimović, S., Kovanovic, V., Baker, R. S., & Gasevic, D. (2017). Tools for educational data mining: A review. *Journal of Educational and Behavioral Statistics, 42*(1), 85-106.

Soller, A., Martínez, A., Jermann, P., & Muehlenbrock, M. (2005). From mirroring to guiding: A review of state of the art technology for supporting collaborative learning. *International Journal of Artificial Intelligence in Education, 15*(4), 261-290.

Tinapple, D., Olson, L., & Sadauskas, J. (2013). CritViz: Web-based software supporting peer critique in large creative classrooms. *Bulletin of the IEEE Technical Committee on Learning Technology*, 15(1), 29-35.

Topping, K. J. (1996). The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education*, 32(3), 321-345.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research*, 68, 249-276.

Topping, K. J. (2005). Trends in peer learning. *Educational Psychology*, 25, 631-645.

Topping, K. (2009). Peer assessment. *Theory into Practice*, 48, 20-27.

Topping, K. J., Dehkinet, R., Blanch, S., Corcelles, M., & Duran, D. (2013). Paradoxical effects of feedback in international online reciprocal peer tutoring. *Computers & Education*, 61, 225-231. doi:10.1016/j.compedu.2012.10.002

Topping, K., & Ehly, S. (2001). Peer assisted learning: A framework for consultation. *Journal of Educational and Psychological Consultation*, 12(2), 113-132.

Tsuei, M. (2012). Using synchronous peer tutoring system to promote elementary students' learning in mathematics. *Computers & Education*, 58(4), 1171-1182.

van de Sande, C. (2011). A description and characterization of student activity in an open, online, mathematics help forum. *Educational Studies in Mathematics*, 77(1), 53-78.

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist*, 46(4), 197-221.

VanLehn, K., Siler, S., Murray, C., Yamauchi, T., & Baggett, W. B. (2003). Why do only some events cause learning during human tutoring?. *Cognition and Instruction*, 21(3), 209-249.

Vassileva, J., McCalla, G. I., & Greer, J. E. (2016). From small seeds grow fruitful trees: How the PHelpS peer help system stimulated a diverse and innovative research agenda over 15 Years. *International Journal of Artificial Intelligence in Education*, 26(1), 431-447.

Walker, E., Giroto, V., Kim, Y., & Muldner, K. (2016, July). The effects of physical form and embodied action in a teachable robot for geometry learning. In *2016 IEEE*

16th International Conference on Advanced Learning Technologies (ICALT) (pp. 381-385). IEEE.

Walker, E., & Ogan, A. (2016). We're in this together: Intentional design of social relationships with AIED systems. *International Journal of Artificial Intelligence in Education*, 26(2), 713-729.

Walker, E., Rummel, N., & Koedinger, K. R. (2009a). CTRL: A research framework for providing adaptive collaborative learning support. *User Modeling and User-Adapted Interaction*, 19(5), 387-431.

Walker, E., Rummel, N., & Koedinger, K. R. (2009b). Integrating collaboration and intelligent tutoring data in the evaluation of a reciprocal peer tutoring environment. *Research and Practice in Technology Enhanced Learning*, 4(03), 221-251.

Walker, E., Rummel, N., & Koedinger, K. R. (2011a). Designing automated adaptive support to improve student helping behaviors in a peer tutoring activity. *International Journal of Computer-Supported Collaborative Learning*, 6(2), 279-306.

Walker, E., Rummel, N., & Koedinger, K. R. (2011). Adaptive support for CSCL: Is it feedback relevance or increased student accountability that matters. In *Proceedings of the International Conference on CSCL*.

Walker, E., Rummel, N., & Koedinger, K. R. (2014). Adaptive intelligent support to improve peer tutoring in algebra. *International Journal of Artificial Intelligence in Education*, 24(1), 33-61.

Wecker, C., & Fischer, F. (2007, July). Fading scripts in computer-supported collaborative learning: The role of distributed monitoring. In *Proceedings of the 8th International conference on Computer supported collaborative learning* (pp. 764-772). International Society of the Learning Sciences.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277-300). New York, NY: Routledge.

Wooley, R. S., Was, C., Schunn, C. D., & Dalton, D. (2008). *The effects of feedback elaboration on the giver of feedback*. Paper presented at the Annual Meeting of the Cognitive Science Society. Washington DC.

Xiong, W., Litman, D., & Schunn, C. (2012). Natural language processing techniques for researching and improving peer feedback. *Journal of Writing Research, 4*(2), 155-176.

Yang, E. F. Y., Chang, B., Cheng, H. N. H., & Chan, T. W. (2016). Improving pupils' mathematical communication abilities through computer-supported reciprocal peer tutoring. *Educational Technology & Society, 19*(3), 157–169.

Zhao, R., Papangelis, A., & Cassell, J. (2014, August). Towards a dyadic computational model of rapport management for human-virtual agent interaction. In *International Conference on Intelligent Virtual Agents* (pp. 514-527). Springer, Cham.