

**Appendix C**  
**Articles Related to K–6 In-service Teacher Training for Computing, Coding, and CT**

<b>Authors, Year</b>	<b>Participants</b>	<b>Context</b>	<b>Duration, Format</b>	<b>Focus</b>	<b>Learning Activities</b>	<b>Assessment/Data</b>	<b>Learning Outcomes</b>	<b>Attitude Outcomes</b>
CS as Content								
Bers, Seddighin, & Sullivan, 2013	25 early childhood educators	Free institute held in Massachusetts; participants from 7 states	3-day workshop	Robotics & programming	Lecture; discussion; KIWI robotics sets and CHERP programming software; curriculum design	Pre/post questionnaires to assess attitudes, self-efficacy, and knowledge; interviews	Significant increases in technology, pedagogy, and content knowledge	Significant improvement in technology self-efficacy and attitudes toward technology
Leonard et al., 2018	45 K–9 teachers	Wyoming, online graduate course	8-week course	Robotics, game design, & culturally responsive pedagogy (CRP)	Readings & discussion; built & programmed LEGO MindStorms robots; designed games	Pre/post CT attitude survey (Yadav, Zhou, Mayfield, Hambrusch, & Korb, 2011); Dimensions of Success rating tool (Shah, Wylie, Gitomer, & Noam, 2018); games assessed with rating rubric; CRP survey	Small gains in CT understanding—higher improvements for teachers who did game design than for those who did robotics.	Small improvements in CT attitudes—greater effect for game design than robotics.
Marcelino, Pessoa, Vieira, Salvador, & Mendes, 2018	7 K–12 teachers, 1 other participant	University of Coimbra, Portugal; online course	54-hour course	Scratch programming, CT, pedagogy	Individual and collaborative programming activities and project	Activity & project evaluations; Dr. Scratch	Improved CT knowledge and programming skill, but learning depth varied among participants.	
Roberts, Prottzman, & Gray, 2018	3,092 K–5 teachers and staff	University-driven workshops in Alabama and Indiana	1-day workshop	Computing, coding, CT	Teaching & observing using Code.org’s Computer Science Fundamentals curriculum and additional CS content	Post-PD surveys provided by Code.org	Increased content and pedagogical knowledge	Improved self-efficacy, content knowledge, beliefs, and attitudes toward CS

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Toikkanen & Leinonen, 2017	501 K–9 teachers	Finland, online course	2-month MOOC	Teaching programming, CT	Instruction; programming in ScratchJr, Scratch, or Racket; online discussion	Pedagogical ideas shared in Padlet	Increased knowledge and skills to teach programming	Teachers overcame reservations and preconceptions.
Integrated CS								
P. J. Rich et al., 2017	27 K–6 teachers	Title I school, western U.S.	1 year, weekly, embedded PD	Integrating computing and engineering	Engineering challenges, Engineering is Elementary curriculum, computing lessons and activities, Scratch programming	Survey of self-efficacy & beliefs; semi-structured interviews		Significantly more positive technology self-efficacy and beliefs toward computing than comparison group
Carter et al., 2014	53 fourth- and fifth-grade teachers	Southeastern U.S., large, urban school district	5-day workshop; embedded PD	Integrating computing	Instruction, modeling, and lesson plan creation	Survey of computing attitudes and anxiety		Amount of training correlated with decreases in anxiety and improvements in attitude.
Coleman, Gibson, Cotten, Howell-Moroney, & Stringer, 2016	54 fourth- and fifth-grade teachers	Southeastern U.S., large, urban school district	5-day workshop; embedded PD	Integrating computing	Instruction, modeling, lesson plan creation, practice teaching, supported classroom integration	Survey; in-class observation; rating scale for preparedness & execution (ability to teach lesson without assistance)	Summer institute participants scored higher in preparedness and execution than other teachers.	Attitude positively influenced execution. Attitude and anxiety showed no impact on preparation.
Hestness, Ketelhut, McGinnis, & Plane, 2018	13 Grades 3–5 mentor teachers	Mentor teachers from 3 Maryland public school districts	2 half-day workshops, 6 weeks apart	Integrating CT into classroom practice	Learned CT concepts; collaboratively completed robotics challenges with LEGO MindStorms, KIBO, & Think & Learn Code-a-Pillar; discussed integration	Drawings, written reflections, and focus group interviews	New content and pedagogical content knowledge were integrated with previous professional knowledge.	