

References

- Aarhus University. (2017). *Computational thinking and design to become a mandatory part of curriculum in Danish primary school*. Center for Computational Thinking and Design, Aarhus University, Denmark. Retrieved from <http://cctd.au.dk/currently/news/show/artikel/computational-thinking-and-design-to-become-a-mandatory-part-of-curriculum-in-danish-primary-school/>.
- ACARA. (2012). *National Assessment Program – ICT literacy years 6 and 10 report 2011*. Sydney, Australia: Australian Curriculum, Assessment and Reporting Authority.
- ACARA. (2015). *National Assessment Program – ICT literacy years 6 & 10 2014 report*. Sydney, Australia: Australian Curriculum and Reporting Authority (ACARA). Retrieved from: http://www.nap.edu.au/_resources/D15_8761__NAP-ICT_2014_Public_Report_Final.pdf.
- Aesaert, K., van Braak, J., van Nijlen, D., & Vanderlinde, R. (2015). Primary school pupils ICT competences: Extensive model and scale development. *Computers & Education*, 81, 326–344. Retrieved from <https://doi.org/10.1016/j.compedu.2014.10.021>.
- Aesaert, K., van Nijlen, D., Vanderlinde, R., & van Braak, J. (2014). Direct measures of digital information processing and communication skills in primary education: Using item response theory for the development and validation of an ICT competence scale. *Computers & Education*, 76, 168–181: Retrieved from <https://doi.org/10.1016/j.compedu.2014.03.013>.
- Aho, A. (2012). Computation and computational thinking. *The Computer Journal*, 55(7), 832–835.
- Ainley, J., Enger, L., & Searle, D. (2009). Students in a digital age: Implications for teaching and learning. In J. Voogt & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 63–80). Heidelberg, Germany: Springer.
- Anderson, R., & Ainley, J. (2010). Technology and learning: Access in schools around the world. In B. McGaw, E. Baker, & P. Peterson (Eds.), *International encyclopedia of education* (3rd ed., pp. 21–33). Amsterdam, the Netherlands: Elsevier.
- Atmatzidou, S., & Demetriadis, S. (2016). Advancing students' computational thinking skills through educational robotics: A study on age and gender relevant differences, *Robotics and Autonomous Systems*, 75, 661–670.
- Audunson, R., & Nordlie, R. (2003). Information literacy: The case or non-case of Norway? *Library Review*, 52(7), 319–325.
- Bakia, M., Murphy, R., Anderson, K., & Trinidad, G. E. (2011). *International experiences with technology in education: Final report*. Washington, DC: US Department of Education.
- Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, 28(2), 117–148.
- Barr, D., Harrison, J., & Conery, L. (2011). Computational thinking: A digital age skill for everyone. *Learning and Leading with Technology*, 38(6), 20–23.
- Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12: What is involved and what is the role of the computer science education community? *ACM Inroads*, 2, 48e54. Retrieved from <https://dx.doi.org/10.1145/1929887.1929905>.
- Bawden, D. (2001). Information and digital literacies: A review of concepts. *Journal of Documentation*, 57(2), 218–259.
- Berland, M., & Wilensky, M. (2015). Comparing virtual and physical robotics environments for supporting complex systems and computational thinking. *Journal of Science Education and Technology*, 24, 628–647.
- Bienkowski, M., Rutstein, D., & Snow, E. (2015a). *Computer science concepts in the next generation science standards*. Paper presented at the 2015 annual meeting of the American Educational Research Association (AERA), Chicago, IL. Retrieved from <https://www.aera.net/Publications/Online-Paper-Repository/AERA-Online-Paper-Repository>.

- Bienkowski, M., Snow, E., Rutstein, D. W., & Grover, S. (2015b). *Assessment design patterns for computational thinking practices in secondary computer science: A first look* (SRI technical report). Menlo Park, CA: SRI International. Retrieved from <http://pact.sri.com/resources.html>.
- Binkley, M., Erstad, E., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining 21st century skills. In P. Griffin, B. McGaw, & E. Care (Eds.), *Assessment and teaching of 21st century skills* (pp. 17–66). Dordrecht, The Netherlands: Springer.
- Bocconi, S., Chiocciariello, A., Dettori, G., Ferrari, A., & Engelhardt, K. (2016). *Developing computational thinking in compulsory education. Implications for policy and practice*. Joint Research Centre Report EUR 28295 EN. Luxembourg: Publications Office of the European Union. Retrieved from <https://doi.org/10.2791/792158>.
- Boekhorst, A. K. (2003). Becoming information literate in the Netherlands. *Library Review*, 52(7), 298–309.
- Bower, M., Wood, L., Lai, J. W. M., Howe, C., & Lister, R. (2017). Improving the computational thinking pedagogical capabilities of school teachers. *Australian Journal of Teacher Education*, 42(3), 53–72. Retrieved from <http://dx.doi.org/10.14221/ajte.2017v42n3.4>
- Brennan, K., & Resnick, M. (2013). Imagining, creating, playing, sharing, reflecting: How online community supports young people as designers of interactive media. In C. Moza & N. Lavigne (Eds.), *Emerging technologies for the classroom: A learning sciences perspective* (pp. 253–268). New York, NY: Springer. Retrieved from <https://doi.org/10.1007/978-1-4614-4696-5>.
- Bundsgaard, J., & Gerick, J. (2017). Patterns of students' computer use and relations to their computer and information literacy: Results of a latent class analysis and implications for teaching and learning. *Large-scale Assessments in Education*, 5(17), 1–15. Retrieved from <https://largescaleassessmentsineducation.springeropen.com/articles/10.1186/s40536-017-0052-8>.
- Burbules, N. (2007). E-lessons learned. *National Society for the Study of Education 2007 Yearbook*, 106(2), 207–216.
- Caeli, E. N., & Bundsgaard, J. (2019). Datalogisk tænkning og teknologiforståelse i folkeskolen tur-retur. Manuscript submitted for publication.
- Carretero, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*. Joint Research Centre Report EUR 28558 EN. Luxembourg: Publication Office of the European Union. Retrieved from <https://doi.org/10.2760/38842>.
- Caspersen, J., & Raaen, F. D. (2014). Novice teachers and how they cope. *Teachers and Teaching: Theory and Practice*, 20, 189–211.
- Catts, R., & Lau, J. (2008). *Towards information literacy indicators*. Paris, France: UNESCO.
- Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. *International Journal of Instruction*, 11(3), 1–16.
- Charalambos, V., & Glass, G. (2007). Teacher professional development and ICT: Strategies and models. *National Society for the Study of Education 2007 Yearbook*, 106(2), 87–102.
- Chen, G., Shen, J., Barth-Cohen, L., Jiang, S., Huang, X., & Eltoukhy, M. (2017). Assessing elementary students' computational thinking in everyday reasoning and robotics programming. *Computers & Education*, 109, 162–175. Retrieved from <https://doi.org/10.1016/j.compedu.2017.03.001>.
- Christ, W. G., & Potter, W. J. (1998). Media literacy: Symposium. *Journal of Communication*, 48(1), 5–15.
- Claro, M., Preiss, D., San Martín, E., Jara, J., Hinojosa, E., Valenzuela, S., Cortes, F., & Nussbaum, M. (2012). Assessment of 21st century ICT skills in Chile: Test design and results from high school level students. *Computers & Education*, 59, 1042–1053. Retrieved from <https://doi.org/10.1016/j.compedu.2012.04.004>.
- Church, A. (1999). The human-computer interface and information literacy: Some basics and beyond. *Information Technology and Libraries*, 18(1), 3–21.

- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.
- Dede, C. (2007). Reinventing the role of information and communications technologies in education. *National Society for the Study of Education 2007 Yearbook*, 106(2), 11–38.
- Denning, P. J. (2017). Remaining trouble spots with computational thinking. *Communications of the ACM*, 60(6), 33–39. Retrieved from <https://cacm.acm.org/magazines/2017/6/217742-remaining-trouble-spots-with-computational-thinking/abstract>.
- Digital Technologies Hub. (2018). *Computational thinking*. Melbourne, Australia: Digital Technologies Hub, Education Services Australia Ltd. Retrieved from <http://www.digitaltechnologieshub.edu.au/teachers/topics/computational-thinking>.
- diSessa, A. A. (2000). *Changing minds: Computers, learning, and literacy*. Cambridge, MA: MIT Press.
- Drossel, K., & Eickelmann, B. (2017). Teachers' participation in professional development concerning the implementation of new technologies in class: a latent class analysis of teachers and the relationship with the use of computers, ICT self-efficacy and emphasis on teaching ICT skills. *Large-scale Assessments in Education*, 5(19), 1–13. Retrieved from <https://doi.org/10.1186/s40536-017-0053-7>.
- Drossel, K., Eickelmann, B., & Gerick, J. (2017a). Predictors of teachers' use of ICT in school: the relevance of school characteristics, teachers' attitudes and teacher collaboration. *Education and Information Technologies*, 22(2), 551–573. Retrieved from <https://doi.org/10.1007/s10639-016-9476-y>.
- Drossel, K., Eickelmann, B., & Schulz-Zander R. (2017b). Determinants of teachers' collaborative use of ICT for teaching and learning. *European Educational Research Journal*, 16(6), 781–799. Retrieved from <https://doi.org/10.1177/1474904116655811>.
- Dutta, S., & Mia, I. (Eds.). (2011). *The global information technology report 2010:2011 transformations 2.0*. Geneva, Switzerland: World Economic Forum.
- Eickelmann, B. (2018). Digitalisierung an Schulen. Eine Bestandsaufnahme. [Digitization in schools. An inventory]. *Schulverwaltung Spezial*, 20(4), 152-155.
- Eickelmann, B., & Vennemann, M. (2017). Teachers' attitudes and beliefs towards ICT in teaching and learning in European countries. *European Educational Research Journal*, 16(6), 1–29. Retrieved from <https://doi.org/10.1177/1474904117725899>.
- Estapa, A., Hutchison, A., & Nadolny, L. (2018). Recommendations to support computational thinking in the elementary classroom. *Technology and Engineering Teacher*, 77(4), 25–29.
- ETS (2002). *Digital transformation: A framework for ICT literacy*. Princeton, NJ: Educational Testing Service. Retrieved from http://www.ets.org/Media/Tests/Information_and_Communication_Technology_Literacy/ictreport.pdf.
- European Commission. (2013). *Survey of schools: ICT in education. Benchmarking access, use and attitudes to technology in Europe's schools* (final report). Brussels, Belgium: Author. Retrieved from <https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KK-31-13-401-EN-N.pdf>.
- Ferrari, A. (2012). *Digital competence in practice: An analysis of frameworks*. Seville, Spain: Institute for Prospective Technological Studies, European Commission. Retrieved from <http://www.ifap.ru/library/book522.pdf>.
- Ferrari, A. (2013). *DigComp: A framework for developing and understanding digital competence in Europe*. Joint Research Centre Report EUR 26035 EN. Luxembourg: Publication Office of the European Union. Retrieved from <https://doi.org/10.2788/52966>.
- Finnish National Agency for Education. (2016). *New national core curriculum for basic education*. Helsinki, Finland: Author.
- Fletcher, G., Schaffhauser, D., & Levin, D. (2012). *Out of print: Reimagining the K–12 textbook in a digital age*. Washington, DC: State Educational Technology Directors Association (SETDA).

- Fraillon, J. (2018) International large-scale computer-based studies on information technology literacy in education. In J. Voog, G. Knezek, R. Christensen, & K.W. Lai (Eds.), *Second handbook of information technology in primary and secondary education*. Cham, Switzerland: Springer. Retrieved from https://doi.org/10.1007/978-3-319-53803-7_80-1.
- Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). *Preparing for Life in a Digital Age: the IEA International Computer and Information Literacy Study International Report*. Cham, Switzerland: Springer. Retrieved from <https://www.springer.com/gp/book/9783319142210>.
- Fraillon, J., Schulz, W., & Ainley, J., (2013). *International Computer and Information Literacy Study: Assessment Framework*. Amsterdam, the Netherlands: International Association for the Evaluation of Educational Achievement. Retrieved from http://pub.iea.nl/fileadmin/user_upload/Publications/Electronic_versions/ICILS_2013_Framework.pdf.
- Ganzeboom, H. B. G., de Graaf, P. M., & Treiman, D. J. (1992). A standard international socioeconomic index of occupational status. *Social Science Research*, 21(1), 1–56.
- Gebhardt, E., & Schulz, W. (2015). Scaling procedures for ICILS test items. In J. Fraillon, W. Schulz, T. Friedman, J. Ainley, & E. Gebhardt (Eds.), *ICILS 2013 technical report* (pp. 155–176), Amsterdam, The Netherlands: International Association for the Evaluation of Educational Achievement (IEA). Retrieved from http://www.iea.nl/fileadmin/user_upload/Publications/Electronic_versions/ICILS_2013_Technical_Report.pdf.
- Gerick, J. (2018). School level characteristics and students' CIL in Europe: A latent class analysis approach. *Computers & Education*, 120, 160–171.
- Gerick, J., Eickelmann, B., & Bos, W. (2017). School-level predictors for the use of ICT in schools and students' CIL in international comparison. *Large-scale Assessments in Education*, 5(1), 1–13. Retrieved from <https://doi.org/10.1186/s40536-017-0037-7>.
- Goode, J., & Chapman, G. (2013). *Exploring computer science*. Stanford Research International (SRI).
- Greenhow, C., Robelia, B., & Hughes, J. (2009). Learning, teaching, and scholarship in a digital age: Web 2.0 and classroom research. What path should we take now? *Educational Researcher*, 38, 246–259.
- Grover, S. (2017). Assessing algorithmic and computational thinking in K-12: Lessons from a middle school classroom. In J. Rich and B. Hodges (Eds.) *Emerging research, practice, and policy on computational thinking* (pp. 269–288). Cham, Springer. Retrieved from <https://doi.org/10.1007/978-3-319-52691-1>.
- Grover, S., & Pea, R. (2013). Computational thinking in K-12: A review of the state of the field. *Educational Researcher*, 42(1), 38–43.
- Grover, S., Pea, R., & Cooper, S. (2015). Designing for deeper learning in a blended computer science course for middle school students. *Computer Science Education*. 25(2), 199–237. Retrieved from <https://doi.org/10.1080/08993408.2015.1033142>.
- Haigh, R. W. (1985) Planning for computer literacy. *The Journal of Higher Education*, 56(2), 161–17. Retrieved from <https://doi.org/10.1080/00221546.1985.11777083>.
- Hacker, M. (2018). Integrating computational thinking into technology and engineering education. *Technology and Engineering Teacher*, 77(4), 8–14.
- Hatlevik, O.E. (2016). Examining the relationship between teacher's self-efficacy, their digital competence, strategies to evaluate information, and use of ICT at school. *Scandinavian Journal of Educational Research*, 61(5), 555–567.
- Hatlevik, O., Ottestad, G., & Throndsen, I. (2015). Predictors of digital competence in 7th grade: a multilevel analysis. *Journal of Computer Assisted Learning Archive*, 31(3), 220–231. Retrieved from <https://doi.org/10.1111/jcal.12065>.
- Haßler, B., Major, L., & Hennessy, S. (2016). Tablet use in schools: A critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning*, 32(2), 139–156.
- Homann, B. (2003). German libraries at the starting line for the new task of teaching information literacy. *Library Review*, 52(7), 310–318.

- Hwang, G.-J., & Tsai, C.-C. (2011). Research trends in mobile and ubiquitous learning: A review of publications in selected journals from 2001 to 2010. *British Journal of Educational Technology*, 42(4), E65–E70.
- ILO. (2007). *International Standard Classification of Occupations: ISCO-2008*. Geneva, Switzerland: International Labour Organisation.
- ISTE. (2007). *National educational technology standards for students* (2nd ed.). Eugene, OR: International Society for Technology in Education.
- ISTE. (2018). *ISTE standards*. Retrieved from <https://www.iste.org/standards>.
- ITU. (2017). *2017 global ICT development index*. Retrieved from <https://www.itu.int/net4/ITU-D/idi/2017/>.
- Jago, C. (2009). *A history of NAEP assessment frameworks*. Washington, DC: National Assessment Governing Board (ERIC Document Reproduction Service No. ED509382). Retrieved from <http://www.nagb.org/content/nagb/assets/documents/who-we-are/20-anniversary/jagoframeworks-formatted.pdf>.
- Janssen, J., & Stoyanov, S. (2012). *Online consultation on experts' views on digital competence*. Joint Research Centre Institute for Prospective Technological Studies Report, Seville, Spain. Retrieved from <http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5339>.
- Karakainen, M., Kivinen, O., & Vainio, T. (2018). Performance-based testing for ICT skills assessing: a case study of students and teachers' ICT skills in Finnish schools. *Universal Access in the Information Society*, 17(2), 349–360.
- Kim, H. S., Kil, H. J., & Shin, A. (2014). An analysis of variables affecting the ICT literacy level of Korean elementary school students. *Computers & Education*, 77, 29–38. Retrieved from <https://doi.org/10.1016/j.compedu.2014.04.009>.
- Kim, J., & Lee, W. (2013). Meanings of criteria and norms: Analyses and comparisons of ICT literacy competencies of middle school students. *Computers & Education*, 64, 81–94. Retrieved from <https://doi.org/10.1016/j.compedu.2012.12.018>.
- KMK. (2016). *Bildung in der digitalen Welt. Strategie der Kultusministerkonferenz* [Education in a digital world. Strategy of the Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany]. Berlin, Germany: Kultusministerkonferenz.
- Koskinen, K. (2017). *Finland: Country report on ICT in education*. Brussels, Belgium: European Schoolnet. Retrieved from <http://www.eun.org/documents/411753/839549/Country+Report+Finland+2017.pdf>.
- Kozma, R. (Ed.). (2003). *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Technology in Education.
- Kwon, S., & Schroderus, K. (2017). *Coding in schools: Comparing integration of programming into basic education curricula of Finland and South Korea*. Helsinki, Finland: Finnish Society on Media Education.
- Lampe, C., Resnick, P., Forte, A., Yardi, S., Rotman, D., Marshall, T., & Lutters, W. (2010). Educational priorities for technology-mediated social participation. *IEEE Computer*, 43(11), 60–67.
- Law Library of Congress. (2015). *Public Law No. 114-95, S. 1177, Every Student Succeeds Act. 114th US Congress*. Retrieved from <https://www.congress.gov/bill/114th-congress/senate-bill/1177>.
- Law, N., Pelgrum, W., & Plomp, T. (2008). *Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study*. Dordrecht, The Netherlands: Springer. Retrieved from <https://www.springer.com/gb/book/9781402089275>.
- Lee, V.R., & Recker, M. (2018). Paper circuits: A tangible, low threshold, low cost entry to computational thinking. *TechTrends: Linking Research and Practice to Improve Learning*, 62(2), 197–203.
- Lemke, C. (2003). Standards for a modern world: Preparing students for their future. *Learning and Leading with Technology*, 31(1), 6–9.
- Lithuanian Education and Science Ministry (2011). *Strategy on ICT integration into general and vocational education (2008–2012)*. Retrieved from http://www.itc.smm.lt/wp-content/uploads/2009/11/IKT_strategija.zip.

- Livingstone, S., Van Couvering, E., & Thumim, N. (2008). Converging traditions of research on media and information literacies. In J. Corio, M. Knobel, C. Lankshear, & D. Leu (Eds.), *Handbook of research on new literacies* (pp. 103–132). New York, NY: Lawrence Erlbaum Associates.
- Lye, S. Y., & Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12? *Computers in Human Behavior*, *41*, 51–61. Retrieved from <https://doi.org/10.1016/j.chb.2014.09.012>.
- Maddux, C. D., & Johnson, D. L. (1997). *Logo: A retrospective*. Computers in the Schools Monographs/Separates, Vol. 14, Numbers 1–2. New York, NY: CRC Press.
- Marcum, J. (2002). Rethinking information literacy. *Library Quarterly*, *72*(1), 1–26.
- Martin, F., & Ertzberger, J. (2013). Here and now mobile learning: An experimental study on the use of mobile technology. *Computers & Education*, *68*, 76–85.
- Martin, M.O., Mullis, I.V.S., Foy, P., & Hooper, M. (2016). *TIMSS 2015 international results in science*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College. Retrieved from <http://timssandpirls.bc.edu/timss2015/international-results/>.
- McDougall, A., Murnane, J., & Wills, S. (2014). The education programming language Logo: Its nature and its use in Australia. In A. Tatnall & B. Davey (Eds.), *Reflections on the history of computers in education: Early use of computers and teaching about computing in schools*. IFIP Advances in Information and Communication Technology Vol. 424. Berlin, Heidelberg: Springer.
- MCEETYA. (2007). *National assessment program: ICT literacy Years 6 and 10 report 2005*. Ministerial Council on Education, Employment, Training and Youth Affairs. Carlton South, VIC, Australia: Curriculum Corporation. Retrieved from http://www.nap.edu.au/verve/_resources/2005_ICTL_Public_Report_file_main.pdf.
- MCEECDYA. (2010). *National assessment program: ICT literacy Years 6 and 10 report 2008*. Ministerial Council for Education, Early Childhood Development, and Youth Affairs (ERIC Document ED534805). Carlton South, VIC, Australia: Curriculum Corporation.
- Moos, D., & Azevedo, R. (2009). Learning with computer-based learning environments: A literature review of computer self-efficacy. *Review of Educational Research*, *79*(2), 576–600.
- Mullis, I.V.S., Martin, M.O., Robitaille, D. F., & Foy, P. (2009). *TIMSS Advanced 2008 international report: Findings from IEA's study of achievement in advanced mathematics and physics in the final year of secondary school*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Mullis, I.V.S., Martin, M.O., Foy, P., & Hooper, M. (2016). *TIMSS 2015 international results in mathematics*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College. Retrieved from <http://timssandpirls.bc.edu/timss2015/international-results/>.
- Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2017). *PIRLS 2016 international results in reading*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College. Retrieved from <http://timssandpirls.bc.edu/pirls2016/international-results/>.
- Nasah, A., DaCosta, B., Kinsell, C., & Seok, S. (2010). The digital literacy debate: An investigation of digital propensity and information and communication technology. *Educational Technology Research and Development*, *58*(5), 531–555.
- NAGB. (2013). *2014 Abridged Technology and Engineering Literacy Framework for the 2014 National Assessment of Educational Progress*. Washington, DC: National Assessment Governing Board.
- National Research Council. (2010). *Committee for the Workshops on Computational Thinking: Report of a workshop on the scope and nature of computational thinking*. Washington, DC: National Academies Press.
- OECD. (2013) *PISA 2012 Results: What students know and can do. Student performance in mathematics, reading and science (Volume I)*. Paris, France: OECD Publishing. Retrieved from <https://dx.doi.org/10.1787/9789264208780-en>.
- OECD. (2016a). *Working Party on measurement and analysis of the digital economy. Skills for a digital world. Background Paper for Ministerial Panel 4.2. DSTI/ICCP/IIS(2015)10/FINAL*. Paris, France: OECD. Retrieved from [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/IIS\(2015\)10/FINAL&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/IIS(2015)10/FINAL&docLanguage=En).

- OECD. (2016b). *PISA 2015 results (Volume 2): Policies and practices for successful schools*. Paris, France: OECD Publishing. Retrieved from <https://dx.doi.org/10.1787/9789264266490-en>.
- OECD. (2016c). *PISA 2015 results (Volume 1): Excellence and equity in education*. Paris, France: OECD Publishing. Retrieved from <https://doi.org/10.1787/9789264266490-en>.
- Ofcom. (2006). *Media literacy audit: Report on media literacy amongst children*. London, UK: Ofcom.
- Ortiz-Colon, A. M., & Marato Romo, J. L. (2016). Teaching with Scratch in compulsory secondary education. *International Journal of Emerging Technologies in Learning*, 11(2), 67–70. Retrieved from <https://doi.org/10.3991/ijet.v11i02.5094>.
- Papert, S. (1980) *Mindstorms: Children, computers, and powerful ideas*. New York, NY: Basic Books.
- Papert, S. (1991). Situating constructionism. In I. Harel & S. Papert (Eds.), *Constructionism* (pp. 1–11). Norwood, NJ: Ablex.
- Pangrazio, L. (2016). Reconceptualising critical digital literacy. *Discourse: Studies in the Cultural Politics of Education*, 37(2), 163–174. Retrieved from <https://doi.org/10.1080/01596306.2014.942836>.
- Pelgrum, W. J., & Doornekamp, B. D. (2009). *Indicators on ICT in primary and secondary education*. Report IIPSE: EACEA-2007-3278/001-001. Brussels, Belgium: European Commission, Directorate General Education and Culture.
- Peters, J. (2004). *Learning outcomes and information literacy*. London, UK: Society of College, National and University Libraries.
- Petko, D., Cantieni, A., & Prasse, D. (2016). Perceived quality of educational technology matters: A secondary analysis of students' ICT use, ICT-related attitudes, and PISA 2012 test scores. *Journal of Educational Computing Research*, 54(8), 1070–1091.
- Pew Research Center. (2015). *Internet seen as positive influence on education but negative influence on morality in emerging and developing nations*. Washington, DC: Pew Research Center. Retrieved from <http://assets.pewresearch.org/wp-content/uploads/sites/2/2015/03/Pew-Research-Center-Technology-Report-FINAL-March-19-20151.pdf>.
- Peyton Jones, S. (2011). *Computing at school: International comparisons*. London, UK: Microsoft Research.
- Plomp, T., Anderson, R. E., Law, N., & Quale, A. (Eds.). (2009). *Cross national policies and practices on information and communication technology in education* (2nd ed.). Greenwich, CT: Information Age Publishing.
- Punter, R., Meelissen, M., & Glas, C. (2017). Gender differences in computer and information literacy: An exploration of the performances of girls and boys in ICILS 2013. *European Educational Research Journal*, 16(6), 762–780. Retrieved from <https://doi.org/10.1177/1474904116672468>.
- Ranguelov, S. (2010). Summary report. Education on online safety in schools in Europe. *New Horizons in Education*, 58(3), 149–163.
- Richter, T., Naumann, J., & Groeben, N. (2000). The computer literacy inventory (INCOBI): An instrument for the assessment of computer literacy and attitudes toward the computer in university students of the humanities and the social sciences. *Psychologie in Erziehung und Unterricht*, 48(1), 1–13.
- Rohatgi, A., Scherer, R., & Hatlevik, O. (2016). The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. *Computers & Education*, 102, 103–116.
- Rowlands, I., Nicholas, D., Williams, P., Huntington, P., Fieldhouse, M., Gunter B., Withey, R., Jamali, R. J., Dobrowolski, T., & Tenopir, C. (2008) The Google generation: the information behaviour of the researcher of the future. *Aslib Proceedings*, 60(4), 290–310. Retrieved from <https://doi.org/10.1108/00012530810887953>.
- Royal Society. (2012). *Shutdown or restart: The way forward for computing in UK schools*. London, UK: The Royal Society.
- Royal Society. (2017). *After the reboot: computing education in UK schools*. London, UK: The Royal Society.

- Rutstein, D. W., Snow, E. B., & Bienkowski, M. (2014). *Computational thinking practices: Analyzing and modeling a critical domain in computer science education*. Paper presented at the annual meeting of the American Educational Research Association, Philadelphia, PA. Retrieved from <https://www.aera.net/Publications/Online-Paper-Repository/AERA-Online-Paper-Repository>.
- Saari, A., & Sääntti, J. (2018). The rhetoric of the 'digital leap' in Finnish educational policy documents. *European Educational Research Journal*, 17(3), 442–457. Retrieved from <https://doi.org/10.1177/1474904117721373>.
- Saha, L. J. (1997). Introduction: The centrality of the family in educational processes. In L. J. Saha (Ed.), *International encyclopedia of the sociology of education* (pp. 587–588). Oxford/New York/Tokyo: Elsevier.
- Scherer, R., & Siddiq, F. (2015). Revisiting teachers' computer self-efficacy: A differentiated view on gender differences. *Computers in Human Behavior*, 53, 48–57.
- Schöber, C., Schütte, K., Köller, O., McElvany, N., & Gebauer, M. M. (2018). Reciprocal effects between self-efficacy and achievement in mathematics and reading. *Learning and Individual Differences*, 63, 1–11.
- Schulz, W., Ainley, J., Fraillon, J., Losito, B., & Agrusti, G. (2016). *IEA International Civic and Citizenship Education Study 2016: Assessment framework*. Cham, Switzerland: Springer. Retrieved from <https://www.springer.com/gb/book/9783319393568>.
- Schulz, W., Ainley, J., Fraillon, J., Losito, B., Agrusti, G., & Friedman, T. (2017). *Becoming citizens in a changing world: IEA International Civic and Citizenship Education Study 2016 international report*. Cham, Switzerland: Springer. Retrieved from <https://www.springer.com/gb/book/9783319739625>.
- Schulz, W., & Friedman, T. (2015). Scaling procedures for ICILS questionnaire items. In J. Fraillon, W. Schulz, T. Friedman, J. Ainley, & E. Gebhardt (Eds.), *ICILS 2013 technical report* (pp. 177–220). Amsterdam, the Netherlands: The International Association for the Evaluation of Educational Achievement. Retrieved from https://www.iea.nl/fileadmin/user_upload/Publications/Electronic_versions/ICILS_2013_Technical_Report.pdf.
- Selby, C. C., & Woollard, J. (2013). *Computational thinking: the developing definition*. Southampton, UK: University of Southampton. Retrieved from <https://eprints.soton.ac.uk/id/eprint/356481>.
- Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review* 22, 142–158. Retrieved from <https://doi.org/10.1016/j.edurev.2017.09.003>.
- Siddiq, F., Hatlevik, O. E., Olsen, R. V., Throndsen, I., & Scherer, R. (2016). Taking a future perspective by learning from the past: A systematic review of assessment instruments that aim to measure primary and secondary school students' ICT literacy. *Educational Research Review*, 19, 58–84.
- Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research*, 75(3), 417–453.
- Slovak Republic Ministry of Education. (2013). *Koncepcia informatizácie rezortu školstva s výhľadom do roku 2020: DIGIPEDIA 2020* [The concept of digitalization of the system of education with a view till the year 2020: DIGIPEDIA 2020]. Bratislava: Slovak Republik Ministry of Education. Retrieved from <https://www.minedu.sk/data/att/4796.pdf>.
- Tamin, R., Bernard, R., Borokhovski, E., Abrami, P., & Schmid, R. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, 81(1), 4–28.
- Talsma, K., Schüz, B., Schwarzer, R., & Norris, K. (2018). I believe, therefore I achieve (and vice versa): A meta-analytic cross-lagged panel analysis of self-efficacy and academic performance. *Learning and Individual Differences*, 61, 136–150.
- Tatnall, A., & Davey, B. (2014). Reflections on the beginnings of an educational revolution. In A. Tatnall & B. Davey (Eds.), *Reflections on the history of computers in education: Early use of computers and teaching about computing in schools*. IFIP Advances in Information and Communication Technology (pp. 417–422). New York, NY: Springer.

- Tuhkala, A., Wagner, M.-L., Nielsen, N., Iversen, O. S., & Kärkkäinen, T. (2018). Technology comprehension: Scaling making into a national discipline. In M. Giannakos, M. Divitini, L. Jaccheri, & O. S. Iversen (Eds.), *Proceedings of the Conference on Creativity and Making in Education* (FabLearn Europe'18) (pp. 72–80). New York, NY: ACM. Retrieved from <https://doi.org/10.1145/3213818.3213828>.
- UNDP. (2016). *Human Development Report: Human development for everyone*. New York, NY: United Nations Development Programme. Retrieved from http://hdr.undp.org/sites/default/files/2016_human_development_report.pdf.
- UNESCO. (2003). *The Prague Declaration: Towards an information literate society*. Paris, France: United Nations Education Scientific and Cultural Organisation.
- UNESCO. (2011). *International Standard Classification of Education: ISCED 2011*. Paris, France: United Nations Education Scientific and Cultural Organisation. Retrieved from <http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf>.
- UNESCO. (2014). *Fostering digital citizenship through safe and responsible use of ICT: A review of current status in Asia and the Pacific as of December 2014*. Paris, France: United Nations Education Scientific and Cultural Organisation. Retrieved from http://www.unescobkk.org/fileadmin/user_upload/ict/SRU-ICT/SRU-ICT_mapping_report_2014.pdf.
- US Department of Education, National Center for Education Statistics. (2016). *The Nation's Report Card: 2014 Technology & Engineering Literacy (TEL) Report Card at Grade 8, NCES2016119*. Washington DC: National Center for Education Statistics. Retrieved from https://www.nationsreportcard.gov/tel_2014/.
- US Department of Education, Office of Educational Technology (2017). *Reimagining the role of technology in education: 2017 National Education Technology Plan update*. Washington, DC: US Department of Education, Office of Educational Technology. Retrieved from <https://tech.ed.gov/files/2017/01/NETP17.pdf>.
- Van Laar, E., van Deursen, A.J.A.M., van Dijk, J.A.G.M., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, 577–588. Retrieved from <https://doi.org/10.1016/j.chb.2017.03.010>.
- Vanderlinde, R., Aesaert, K., & van Braak, J. (2014). Institutionalised ICT use in primary education: A multilevel analysis. *Computers & Education*, 72, 1–10. Retrieved from <https://doi.org/10.1016/j.compedu.2013.10.007>.
- Virkus, S. (2003). Information literacy in Europe: A literature review. *Information Research: An International Electronic Journal*, 8(4), 329–345. Retrieved from <http://www.informationr.net/ir/8-4/paper159.html>.
- Vuorikari, R., Punie, Y., Carretero Gomez S., & Van den Brande, G. (2016). *DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The conceptual reference model*. Joint Research Centre Report EUR 27948 EN. Luxembourg Publication Office of the European Union. Retrieved from <https://doi.org/10.2791/11517>.
- Voogt, J., Fisser, P., Good, J., Mishra, P., & Yadav, A. (2015). Computational thinking in compulsory education: Towards an agenda for research and practice. *Education and Information Technologies*, 20(4), 715–728.
- Voogt, J., & Roblin, N. P. (2012) A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies, *Journal of Curriculum Studies*, 44(3), 299–321. Retrieved from <https://doi.org/10.1080/00220272.2012.668938>.
- Voogt, J., & ten Brummelhuis, A. (2014). Information literacy in the Netherlands: rise, fall and revival. In A. Tatnall & B. Davey (Eds.), *Reflections on the history of computers in education: early use of computers and teaching about computing in schools*, IFIP Advances in Information and Communications Technology, No. 424 (pp. 83–93). Berlin, Heidelberg: Springer. Retrieved from https://doi.org/10.1007/978-3-642-55119-2_5.
- Warschauer, M., & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education*, 34, 179–225.

- Wilson, M., Scalise, K., & Gochyyev, P. (2015). Rethinking ICT literacy: From computer skills to social network settings. *Thinking Skills and Creativity*, 18, 65–80.
- Wilkinson, K. (2006). Students' computer literacy: Perception versus reality. *Delta Pi Epsilon Journal*, 48(2), 108–120.
- Wing, J.M. (2006) Computational thinking. *Communications of the ACM*, 49, 33–35. Retrieved from <https://doi.org/10.1145/1118178.1118215>.
- Woessmann, L. (2004). *How equal are educational opportunities? Family background and student achievement in Europe and the United States*. IZA Discussion Papers 1284. Bonn, Germany: Institute for the Study of Labor (IZA).
- World Bank (2016). *World development report 2016: Digital dividends*. Washington, DC: The World Bank. Retrieved from <http://www.worldbank.org/en/publication/wdr2016>.
- Yadav A., Sands P., Good J., & Lishinki A. (2018) Computer science and computational thinking in the curriculum: Research and practice. In J. Voogt, G. Knezek, R. Christensen, & K.W. Lai (Eds.), *Second handbook of information technology in primary and secondary education*. Cham, Switzerland: Springer. Retrieved from https://link.springer.com/referenceworkentry/10.1007/978-3-319-71054-9_6.
- Zhong, B., Wang, Q., Chen, J., & Li, Y. (2016). An exploration of three-dimensional integrated assessment for computational thinking. *Journal of Educational Computing Research*, 53(4), 562–590. Retrieved from <https://journals.sagepub.com/doi/pdf/10.1177/0735633115608444>.

APPENDIX

Organizations and individuals involved in ICILS 2018

International study center

The international study center is located at the Australian Council for Educational Research (ACER) and serves as the international study center for ICILS. Center staff at ACER were responsible for designing and implementing the study in close cooperation with the IEA in Hamburg, Germany, and Amsterdam, the Netherlands.

Staff at ACER

Julian Fraillon, *research director*
John Ainley, *project coordinator*
Wolfram Schulz, *assessment coordinator*
Tim Friedman, *project researcher*
Daniel Duckworth, *test developer*
Melissa Hughes, *test developer*
Laila Helou, *quality assurer*
Alex Daraganov, *data analyst*
Renee Kwong, *data analyst*
Leigh Patterson, *data analyst*

International Association for the Evaluation of Educational Achievement (IEA)

IEA provides overall support in coordinating and implementing ICILS. The IEA Amsterdam, the Netherlands, is responsible for membership, translation verification, quality control monitoring, and publication. The IEA Hamburg, Germany is mainly responsible for field operations, sampling procedures, and data-processing.

Staff at the IEA Amsterdam

Dirk Hastedt, *executive director*
Andrea Netten, *director IEA Amsterdam*
Roel Burgers, *financial director*
Isabelle Gémin, *senior financial officer*
David Ebbs, *senior research officer (project team)*
Michelle Djekić, *research and liaison officer (project team)*
Sandra Dohr, *junior research officer (project team)*
Sive Finlay, *communications officer*
Mirjam Govaerts, *public relations and events officer*
Jennifer Ross, *media and outreach officer*
Jan-Philipp Wagner, *junior research officer (project team)*
Gillian Wilson, *senior publications officer*

Staff at the IEA Hamburg

Heiko Sibberns, *director*
 Ralph Carstens, *co-head of international studies unit*
 Sebastian Meyer, *ICILS international data manager*
 Ekaterina Mikheeva, *ICILS deputy international data manager*
 Sabine Meinck, *head of research, analysis and sampling unit*
 Sabine Tieck, *research analyst (sampling)*
 Sabine Weber, *research analyst (sampling)*
 Oriana Mora, *research analyst*
 Adeoye Oyekan, *research analyst*
 Christine Busch, *research analyst*
 Alena Becker, *research analyst*
 Hannah Köhler, *research analyst*
 Wolfram Jarchow, *research analyst*
 Lorelia Nithianandan, *research analyst*
 Rea Car, *research analyst*
 Clara Beyer, *research analyst*
 Dirk Oehler, *research analyst*
 Tim Daniel, *research analyst*
 Yasin Afana, *research analyst*
 Guido Martin, *head of coding unit*
 Katharina Sedelmayr, *research analyst (coding)*
 Meng Xue, *head of software unit*
 Kevin Mo, *programmer*
 Deepti Kalamadi, *programmer*
 Maïke Junod, *programmer*
 Limiao Duan, *programmer*
 Juan Jose Carmona Vilas, *programmer*
 Svetoslav Velkov, *software tester*
 Bettina Wietzorek, *meeting and seminar coordinator*

SoNET Systems

SoNET Systems was responsible for developing the software systems underpinning the computer-based student assessment instruments for the Main Survey. This work included development of the test and questionnaire items, the assessment delivery system, and the web-based translation, scoring, and data-management modules.

Staff at SoNET Systems

Mike Janic, *managing director*
 Stephen Birchall, *deputy CEO*
 Erhan Halil, *product development manager*
 Rakshit Shingala, *team leader*
 James Liu, *analyst programmer*
 Nilupuli Lunuwila, *analyst programmer*
 Richard Feng, *analyst programmer*
 Stephen Ainley, *quality assurance*
 Ranil Weerasinghe, *quality assurance*

ICILS sampling referee

Marc Joncas was the sampling referee for the study. He has provided invaluable advice on all sampling-related aspects of the study.

National research coordinators

The national research coordinators (NRCs) played a crucial role in the development of the project. They provided policy- and content-oriented advice on the development of the instruments and were responsible for the implementation of ICILS in the participating countries.

Chile

Carolina Leyton
National Agency for Educational Quality

City of Moscow (Russian Federation)

Elena Zozulia
Moscow Center for Quality of Education

Denmark

Jeppe Bundsgaard
Danish School of Education, Aarhus University

Finland

Kaisa Leino
Finnish Institute for Educational Research, University of Jyväskylä

France

Marion Le Cam
Ministry of National Education

Germany and North-Rhine Westphalia (Germany)

Birgit Eickelmann
Institute for Educational Science, University of Paderborn

Italy

Elisa Caponera
Riccardo Pietracci
INVALSI, National Institute for the Educational Evaluation of Instruction and Training

Gemma De Sanctis (through May 2018)
MIUR, Ministry of Education, University and Research

Kazakhstan

Aigerim Zuyeva
Arailym Soltanbekova
Ruslan Abrayev
Information-analytic Center

Luxembourg

Catalina Lomos
SCRIPT, Ministry of Education, Children and Youth (MENJE)
Luxembourg Institute of Socio-Economic Research (LISER)

Portugal

Vanda Lourenco
João Marôco
IAVE, IP (Institute of Educational Evaluation)

Republic of Korea

Sangwook Park
Kyongah Sang
Korean Institute for Curriculum and Evaluation

United States of America

Lydia Malley

Linda Hamilton

National Center for Education Statistics, US Department of Education

Uruguay

Cristobal Cobo

Center for Research, Ceibal Foundation

Cecilia Hughes

Evaluation and Monitoring Department at Plan Ceibal