

The State of Computer Science Education Research

Landscape Report 2012-2020

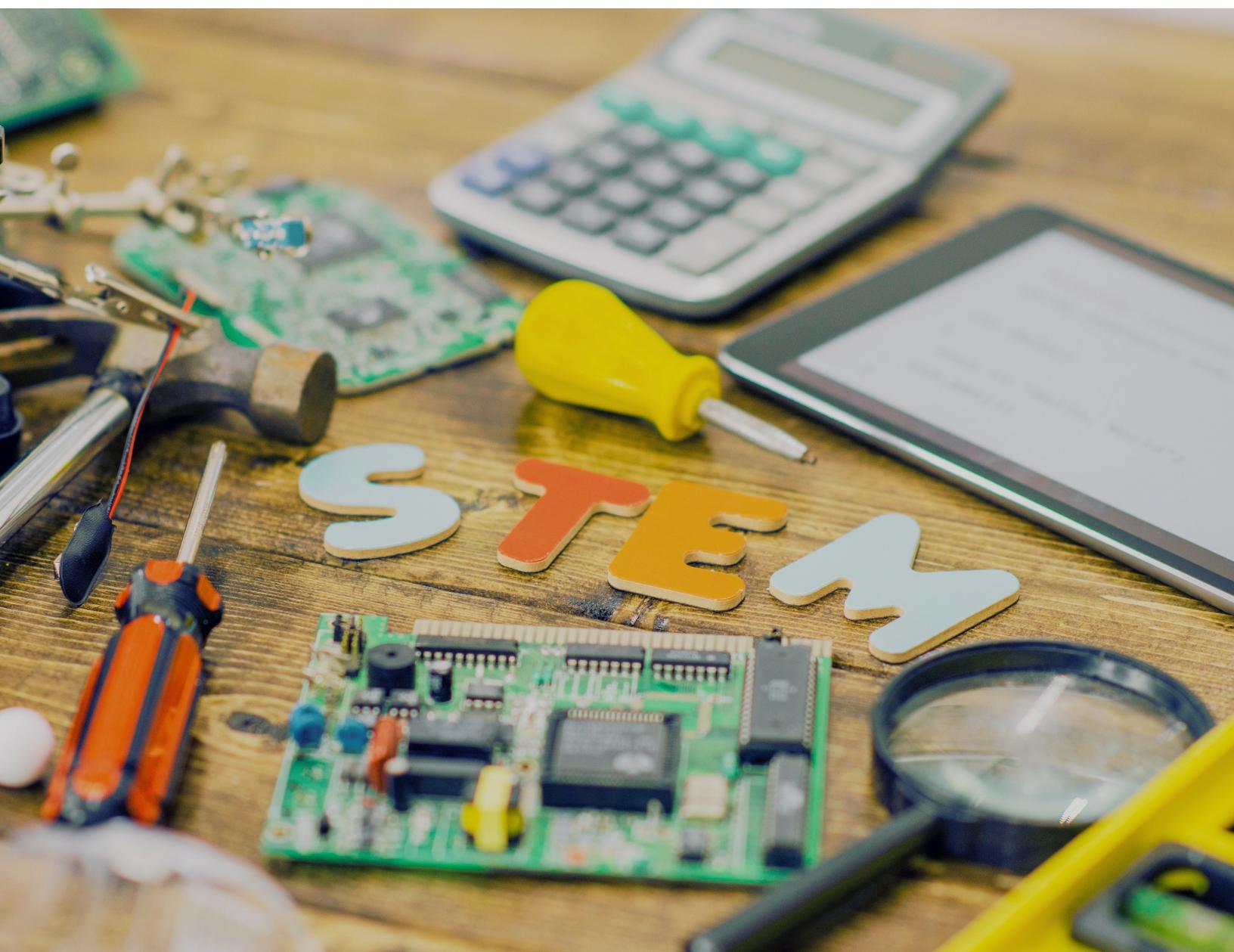


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CSEdResearch.org is a U.S.-based non-profit organization that envisions transforming Computer Science (CS) education research to promote high-impact, culturally relevant practices that are implemented in K-12 settings.

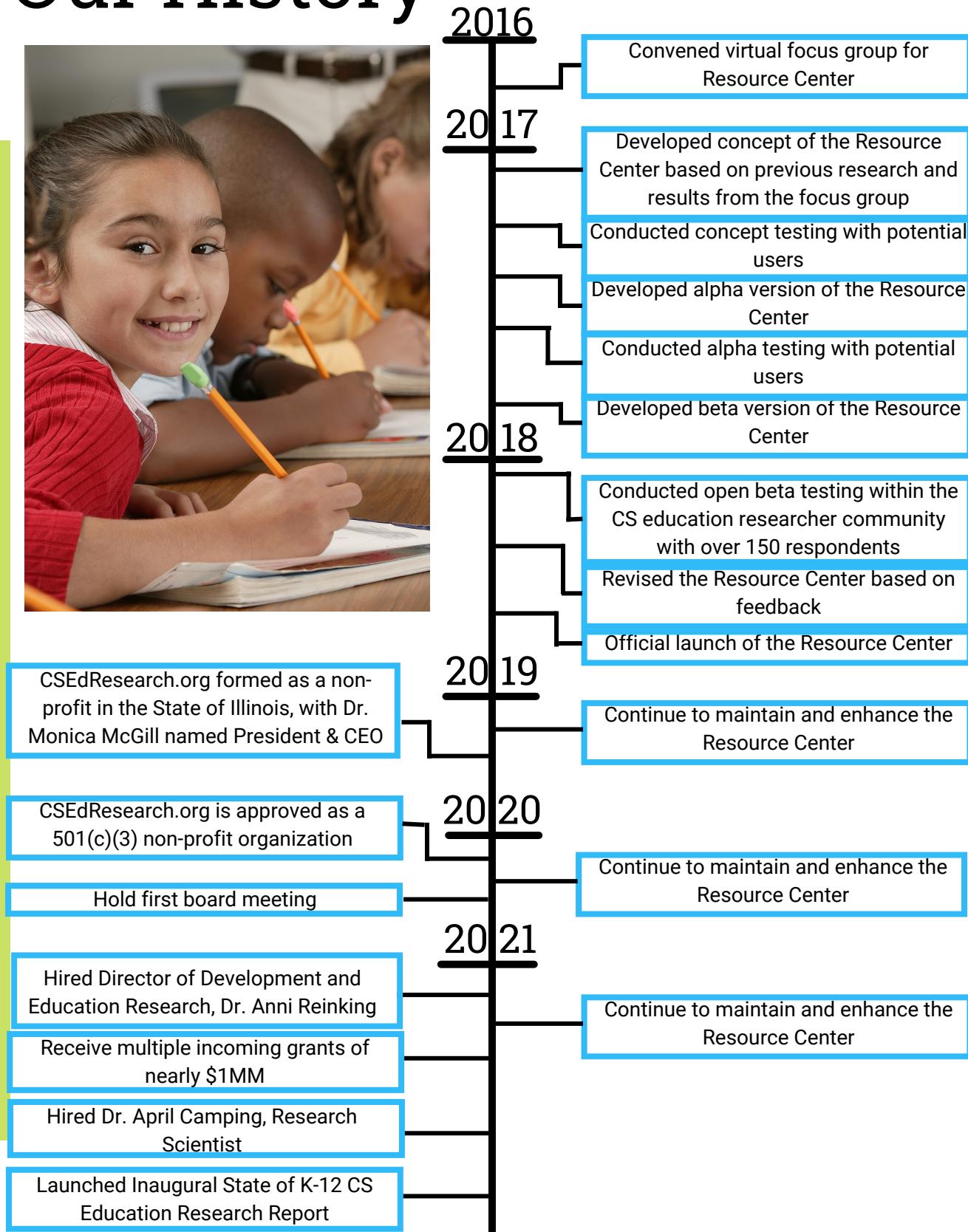
Our story began as a five-year National Science Foundation grant awarded to Drs. Adrienne Decker (University at Buffalo) and Monica McGill (CSEdResearch.org/Knox College) to investigate and propagate longitudinal research on underserved and underrepresented populations in computing. K-12 schools are becoming much more engrained with computer science (CS) education, and the introduction of CS classes in high schools has expanded so that now children in middle and elementary schools are being introduced to world of computing. As part of our effort, we created a Resource Center for K-12 education researchers.

Despite our primary funding sources being located in the U.S., we are committed to support research being conducted in other countries who may use this information to advance their efforts.

Our goal is to be a trustworthy, reliable source of information for researchers to find tools and sharpen their understanding of how to conduct and consume effective research, with a critical eye towards ensuring that this research is equity-focused.

Introduction

Our History



Message from the CEO



High quality CS education research enables the identification of high impact practices for all students.

***Monica McGill, Ed.D.
Founder & CEO***

PreK-12 Education is in the middle of something profound—a new core subject is being introduced to learners at an astonishing rate. This movement is like no other subject that has been introduced in our lifetimes.

In the U.S. alone, that means bringing impactful learning in computer science to over 50,000,000 curious learners. The opportunities to conduct high-quality research for investigating impactful practices is emerging all around us. The need for this type of research is greater than the current cadre of CS education researchers can conduct.

As we look ahead to the next five years of CS education research and its challenges, we see opportunity. Our mission is to not only conduct equity-focused research, but also enable others to meet the quickly growing need to identify promising practices for *all* learners.

We encourage you to join us in our efforts as collaborators, partners, and sponsors.

Board of Directors

Our organization is overseen by a Board of Directors from a variety of fields centered on raising interest in CS and STEM across all K-12 learners. Each director has selflessly volunteered their time and expertise to guide and support the organization, which has enabled the organization to secure \$1M in funding in its first full-year of operation and expand to three full-time staff.



Dr. Monica McGill, Founder & CEO

As CEO & President, Dr. McGill oversees daily operations and research initiatives, drawing from her experience as an educator and researcher and her work in industry and on nonprofit boards. She has taught computer science and game design as an Associate Professor in post-secondary institutions, worked as a computer scientist in industry and for the government, and has been active in the computer science education community for over 15 years. She received her Ed.D. in Curriculum and Instruction at Illinois State University, which complements her M.S. in Computer Science and her B.S. in Computer Science and Mathematics.



Dr. Dave Frye, Chair

As Chair, Dr. Frye brings experiences and knowledge as Director of Program Development and Operations at Code.org to the board. Prior to his current position, he developed and supported strategic initiatives at the intersection of education policy, research, and practice at the Friday Institute for Educational Innovation for 17 years. He helped to create the CS education initiative in North Carolina, has led over \$5MM in research projects, and collaborates with leaders throughout the country to grow CS opportunities for all students.



Dr. Leigh Ann DeLyser, Treasurer

Dr. DeLyser spent her career building the K-12 computer science (CS) field. As an Executive Director of CSforALL, she oversees programs and strategic planning and supervises research to build support for high-quality CS education at all levels. A former high school and university CS educator, Leigh Ann understands challenges faced by teachers, administrators, and students developing their competency in the field and accessing high-quality learning opportunities and resources. Previously, Leigh Ann was Director of Research and Education at CSNYC, which built a foundation for CS in New York City public schools. She received a PhD in Computer Science and Cognitive Psychology, with a focus on CS education, from Carnegie Mellon University.



Olivia Lu, Secretary

Olivia Lu, JD, is the Executive Director and one of the founders of the National Disabled Law Student Association. She has worked in law firms as well as for Civitas. She currently works as a Teaching Assistant and University of Texas Austin's School of Business.



Abi Olukeye, Member

Abi Olukeye, CEO & Founder of SmartGirlsHQ, is a STEM-inist with experience in EdTech Innovation and Business Development. Olukeye is an innovative and strategic thinker who is passionate about customer-focused solutions and building a platform to increase the number of positive experiences young girls have with STEM early in their learning journey.



Karen A. Peterson, Member

Karen Peterson, CEO of the National Girls Collaborative, has over 25 years of experience in education as a classroom teacher, university instructor, teacher educator, program administrator, and researcher. Currently, Peterson is the Principal Investigator for the National Girls Collaborative Project (NGCP). Designed by Peterson, the NGCP seeks to maximize access to shared resources for public and private sector organizations interested in expanding girls' participation in science, technology, engineering, and mathematics (STEM). The overarching goal of the NGCP is to use the leverage of a network or collaboration of individual girl-serving STEM programs to create the tipping point for gender equity in STEM. Currently, 33 Collaboratives, serving 41 states, facilitate collaboration between 36,400 organizations who serve 20.15 million girls and 9.5 million boys.



Dr. Bobby Schnabel, Member

Dr. Schnabel is a Professor of Computer Science, external chair of the department (including strategic planning, tech community and alumni relations, and faculty mentoring), College of Engineering and Applied Science Faculty Director for Entrepreneurship, and Campus Thought-Leader on Computing. Previously he was CEO of ACM (Association for Computing Machinery) from 2015-17, Dean of the School of Informatics and Computing at Indiana University from 2007-2015, and on the Computer Science faculty at University of Colorado Boulder from 1977-2007. At CU Boulder he also was CS department chair from 1990-95, CEAS associate dean for academic affairs from 1995-97, founding director of the ATLAS Institute from 1997-2007, and vice provost for academic and campus computing and campus Chief Information Officer from 1998-2007. He is a co-founder of the National Center for Women & Information Technology and continues to serve on the NCWIT executive team.

We Want to Say Thank You

To our Sponsors...

Our sponsors drive our work forward and are a lifeline to the valued work that we produce and the services we provide. We would like to thank all of our sponsors for their generous support of CSEdResearch.org.



Association for
Computing Machinery



To our Partners and Collaborators...

Together with our partners and collaborators, we work towards improving computer science education research sharing the knowledge and resources in pursuit of our joint mission.



We value all the support which has been provided to us throughout the years. It helped us continue our work in providing the necessary resources and standards for researchers, educators, and policymakers.

If you or your organization would like to become a sponsor or partner with us in other ways, please visit our website to donate at csedresearch.org/donate, or contact us directly at csedresearch.org/contact.

DRAFT

This report was made possible thanks to the support and contributions from the following organizations:



Microsoft

Organization's role and interest in K-12 CS
Education research.

Google

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Information School
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We Are a Part of Something Bigger...

As technology and computing have become major drivers for the job market in the US and around the world, non-profit and for-profit organizations have been collectively emphasizing and promoting access to computer science education for the youngest K-12 students. These grassroots movements have spawned organizations and partnerships such as CSforALL and Code.org. Together with others, such as the Computer Science Teachers Association (CSTA) and Expanding Computing Education Pathways (ECEP) Alliance, are crucial contributors to and advocates for expanding equity-focused CS education. This includes providing the highest-quality resources for implementing standardized curricula in the primary and secondary education level.

The community understands and highlights the importance of preparing the next generation of students to face the new, technology-based economy. We, at CSEdresearch.org, are a part of this global momentum and strive to provide the researchers, educators, and policy-makers with resources, training, and support to enable high-quality research that answers meaningful questions about K-12 CS education.



HOUR
OF
CODE

csedresearch.org

Computer Science
Education Week

CSforALL



CSTA



C
O
D
E

ECEP



csedresearch.org

Landscape Report 2012 - 2020

Methodology

To build our resource center, we first conducted a research study with a virtual focus group consisting of educational researchers involved in computing education. The study allowed us to identify an initial list of variables that should be collected in studies, as well as potential qualifying questions for our dataset candidate articles (McGill & Decker, 2018).

Our focus group provided valuable insight on what is usable and useful for educational researchers, evaluators, and practitioners when measuring the impact of K-12 computing activities.



That information formed the basis for the creation of our manually curated dataset consisting of both articles and evaluation instruments. Since then, we have collected 50 pieces of data from over 800 K-12 articles and more than 25 pieces for over 140 computing instruments included in our repository (McGill & Zahid, 2019). The articles and instruments provide the ability for users to quickly search for relevant articles and instruments.

Our established curation process includes organizing, evaluating, and parsing articles and instruments using a predefined methodology, with each article undergoing two reviews. Each article is analyzed to identify its primary research questions, data collected as part of the study, what was studied, how it was studied, and more. Instruments are analyzed to identify their purpose, methods (quantitative, qualitative), targeted demographic, and more. For instruments specifically designed for computing, we also identified the factors that the instrument measures (e.g., computational thinking, self-efficacy, intent to pursue CS).

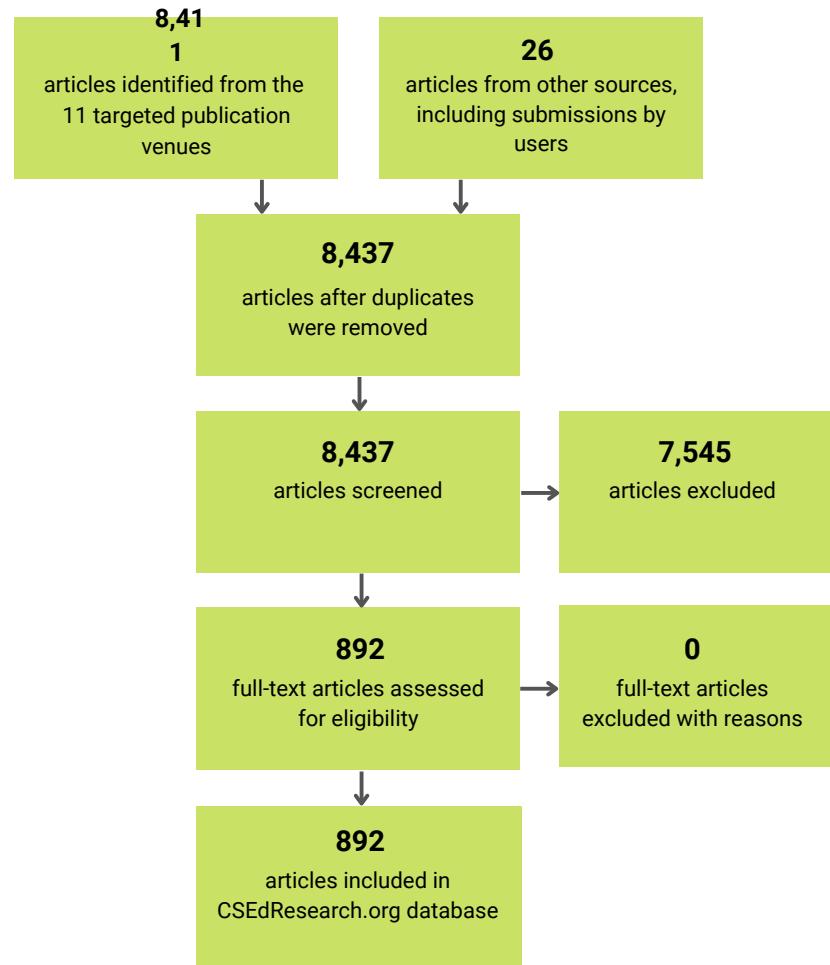
During the curation process, our team determines if an article meets the pre-defined criteria:

- Describe or evaluate a computing activity or process,
- Target K-12 participants (students or teachers), and
- Designed to teach computing or computational thinking?

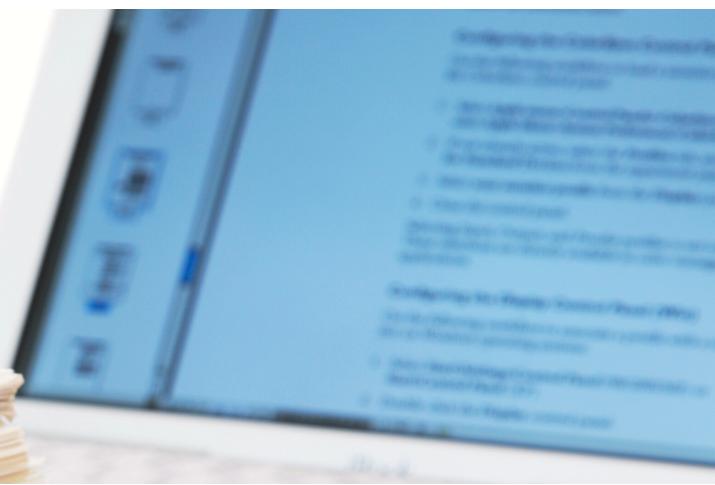
Similarly, for the evaluations instruments, our team ensures that the instruments included in our dataset meet the following:

- Measures factors related to computing education,
- Assesses programs related to computing education, and
- Has been used in computing education research.

We adapted a PRISMA chart to show the number of papers in our targeted publication venues throughout the years 2012-2020.



Although we target 11 publication venues for curating data, we welcome individual submissions from fellow researchers. To submit an article or evaluation instrument, please visit our submission page: csedresearch.org/submit-to-repository.



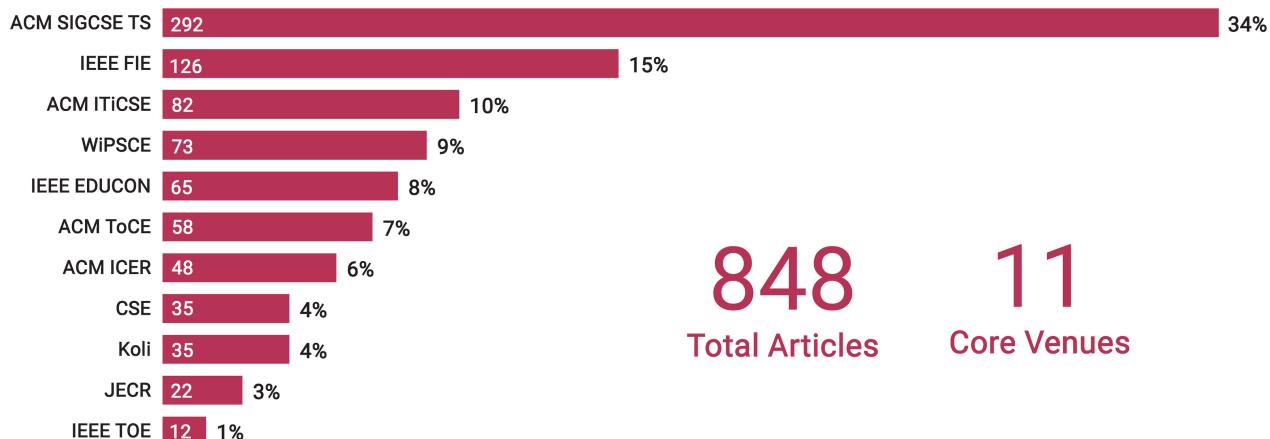
Where is K-12 CS Education Research Published?



The majority of the articles we collected comes from 11 core venues. These international and US-based journals, conferences and symposia provide a platform for researchers around the world to share their ideas and discoveries. Between 2012 and 2020, we collected and curated a total of 848 articles from these core venues, and summaries and sometimes the articles themselves are freely accessed through our website.

The most prolific of these core venues is ACM Special Interest Group in Computer Science Education (SIGCSE) Technical Symposium (TS), with 1 of 3 articles on our site coming from this flagship conference. The ACM SIGCSE TS has been held regularly since 1970, with attendance regularly exceeding 1,200 members. Since the beginning of the ACM SIGCSE TS conference, 7,669 articles have been published through the symposium (ACM Digital Library, 2021).

Percentage of Articles by Core Venue



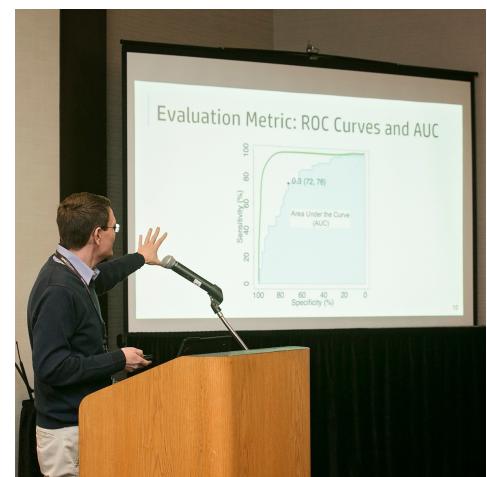
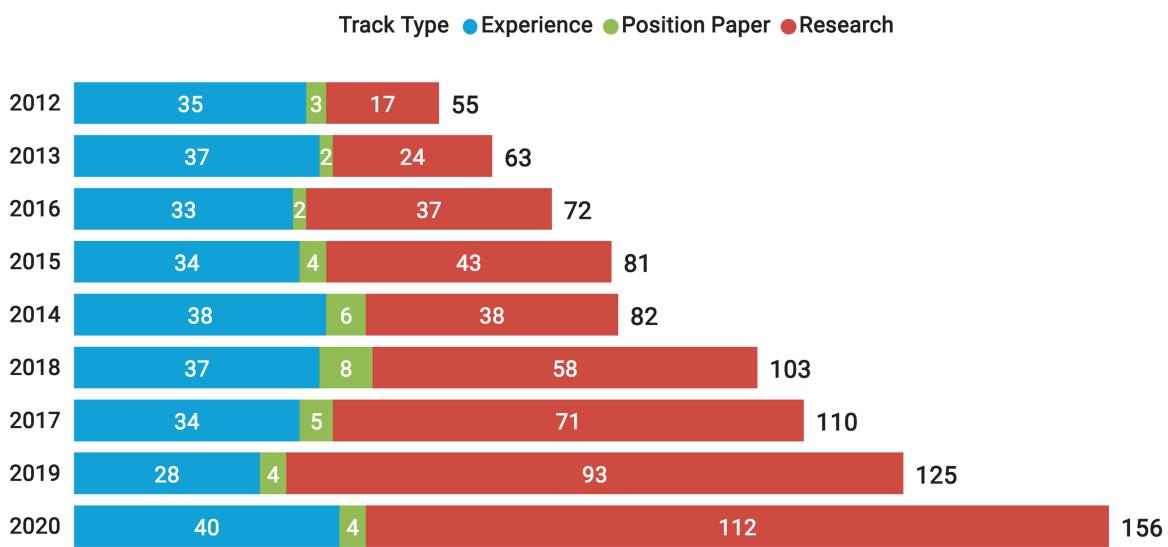
848
Total Articles 11
Core Venues

ACM ICER	ACM International Computing Education Research Workshop
ACM ITiCSE	ACM Innovation and Technology in Computer Science Education
ACM SIGCSE TS	ACM Technical Symposium on Computer Science Education
ACM ToCE	ACM Transactions on Computing Education
CSE	Taylor & Francis Computer Science Education
IEEE EDUCON	IEEE Global Engineering Education Conference
IEEE FIE	IEEE Frontiers in Education
IEEE TOE	IEEE Transactions on Education
JECR	Journal of Educational Computing Research
Koli	Koli Calling
WiPSCE	Workshop in Primary and Secondary Computing Education

Curated articles in our resource center are tagged as either research, experience, and position focused papers, with the majority being research papers. While we see a significant increase in the number of research papers over the past few years, the other papers have remained static and has declined in overall percentages.

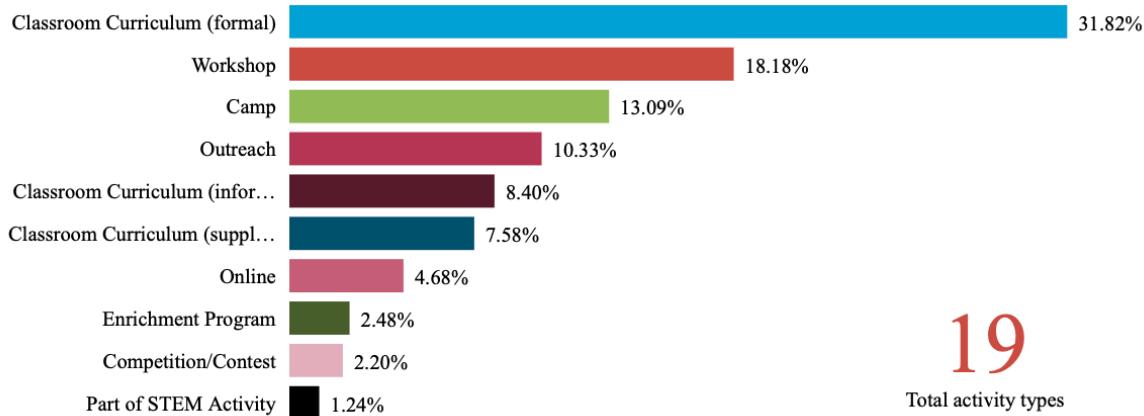
The number of articles in computer science education from the core venues has grown almost three times from 2012. In 2020, nearly 160 articles were published in the topic compared to 55 in 2012. This upward trend not only shows the momentum and significance that computer science education research has gained recently, but also gives a positive outlook for the future of the research field.

Number of Articles and Track by Year

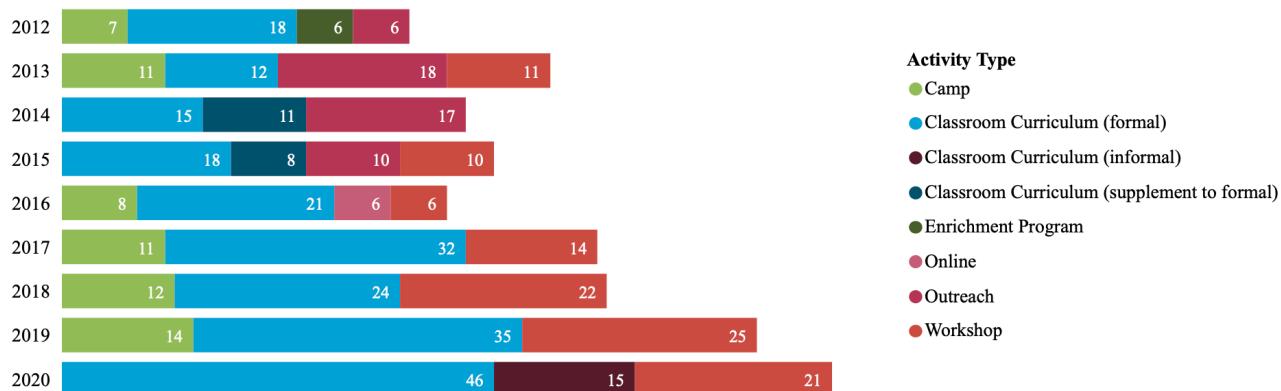


Activities Studied

Top 10 activities studied



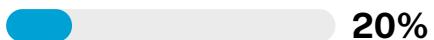
Top 3 activities studied by year



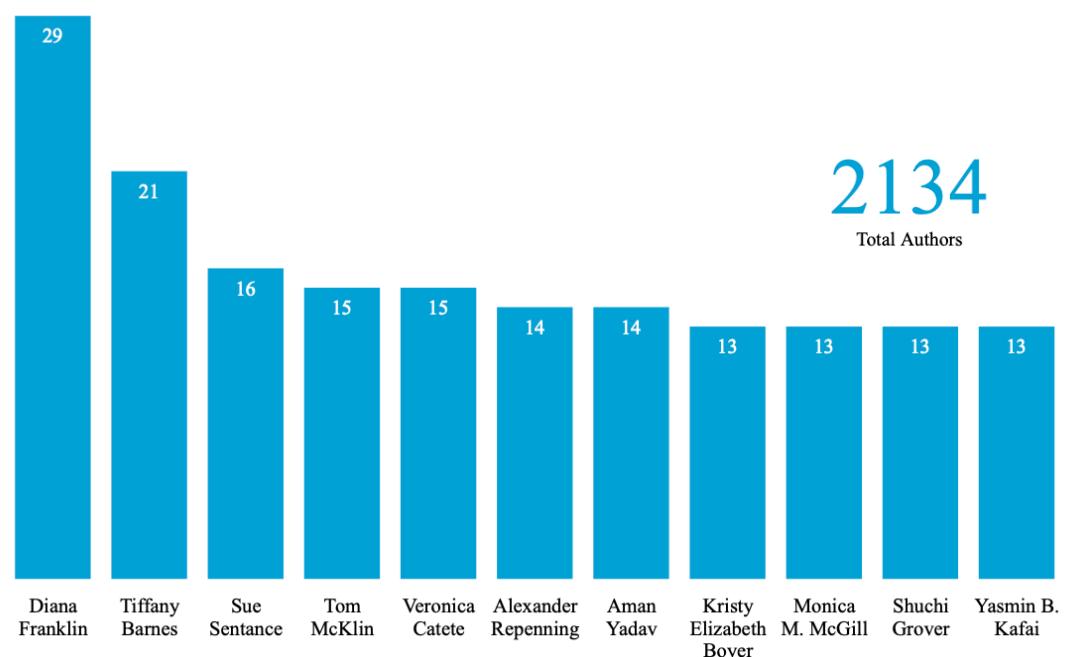
Of the studies, 3 out of 5 are conducted in classrooms, workshops and camps. This provides evidence that, as CS becomes more prevalent in the classroom, researchers are also shifting to study learners there. This may also indicate a shift in researchers studying teachers who teach CS, whereas researchers typically did not in the past study who was engaged in delivering workshops or camps and whether they were qualified (e.g., CS knowledge, CS pedagogical knowledge, beliefs and attitudes to support all learners).

Who's publishing research?

Our dataset of nearly 900 articles reflect the work of 2,134 accomplished authors. The top 11 authors in the last decade contributed an astounding 20% of all of the articles in our dataset.



Top 11 authors



Our authors are associated with over 700 organizations. The majority of these are post-secondary institutions. However, quite a few are organizations outside of academia, such as non-profits and industry. The top 10 organizations published total of 25% of all the articles.



731 associated organizations