

# 50 Years of CS1 at SIGCSE

A Review of the Evolution of  
Introductory Programming Education Research

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#SIGCSE50CS1



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## A Review of the Evolution of Introductory Programming Education Research

#SIGCSE50CS1

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# Motivation

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- Happy Birthday SIGCSE!
- 50 Symposia (49 up to 2018)
  - >6,200 items in ACM DL
  - CS1 a constant theme
- Some prior work analysing CS1 work @ SIGCSE Technical Symposium
  - Vasiga, 2002 [1]; Valentine, 2004 [2]
- Some recent work on CS1 @ anywhere
  - Luxton-Reilly, Simon, et al., 2018 [3]
  - 2018 ITiCSE Working Group: Literature review starting with >5,000 papers whittled down to approx. 1,800, cited >750

[1] [dl.acm.org/citation.cfm?id=563350](https://dl.acm.org/citation.cfm?id=563350); [2] [dl.acm.org/citation.cfm?id=971391](https://dl.acm.org/citation.cfm?id=971391) [3] [dl.acm.org/citation.cfm?id=3295779](https://dl.acm.org/citation.cfm?id=3295779)

# Research Goals

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- RG1: Identify the important topics in introductory programming education research, including their trends, over the first 50 years of the SIGCSE Technical Symposium
- RG2: Situate the introductory programming research presented at the SIGCSE Technical Symposium in the context of the wider literature

# Method

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- Search SIGCSE (Symposium) papers for the following, in title, abstract, body:
  - CS1, “CS 1”, “introductory programming”, “introduction to programming”, “novice programming”, “novice programmers”
- 777 papers
- 481 after removing papers < 3 pages, papers deemed to not focus on CS1

# Situating the Technical Symposium

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- How does the volume of CS1 papers at the Symposium compare to the wider literature?

Search Space	hits	% total
ACM Digital Library Guide to Computing Literature	3,153	100%
Published by ACM	1,823	~58%
Conferences sponsored by SIGCSE	1,442	~46%
SIGCSE Technical Symposium	777	~25%

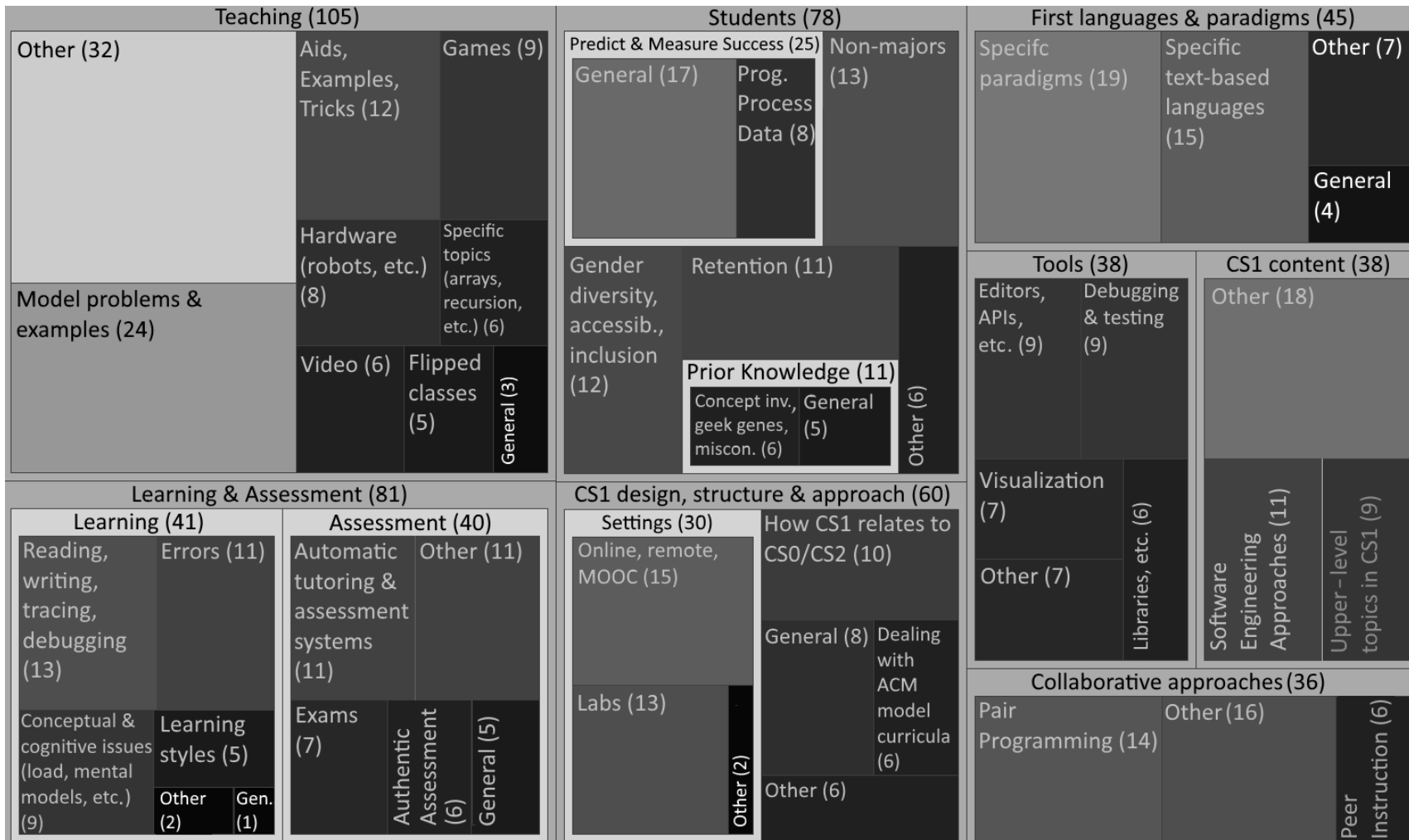
Number of hits and percentage of total (ACM DL Guide to Computing Literature) for our search query.

# Method

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- Allowed broad categories to emerge
- One category per paper
  - Sometimes difficult
- Refined categories and categorization of papers between authors and with one colleague (not otherwise involved)
- Categories:
  1. First languages & paradigms
  2. CS1 design, structure & approach
  3. CS1 content
  4. Tools
  5. Collaborative approaches
  6. Teaching
  7. Learning & Assessment
  8. Students

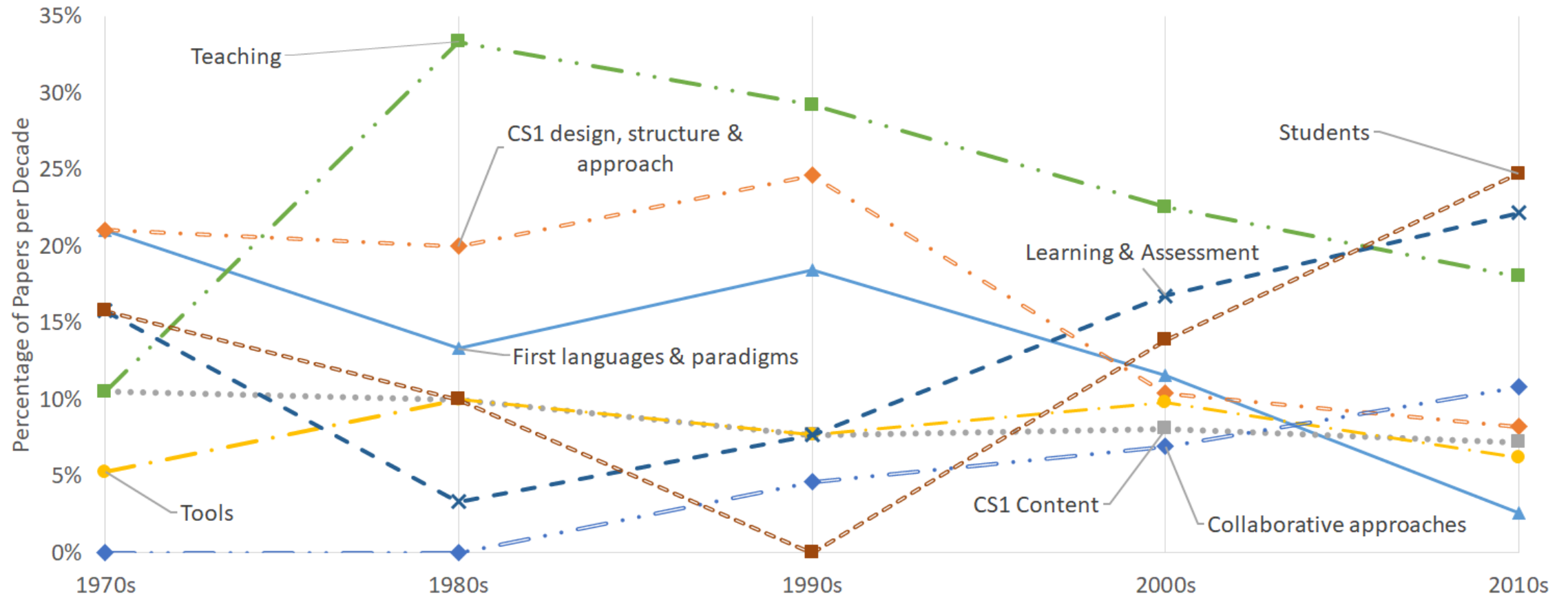
# Results – Categories



TreeMap of 481 papers in 8 categories and 54 subcategories. The area of each rectangle is proportional to the number of papers in each topic area.



# Results – Trends (normalized to account for increasing numbers of papers)



# Students

General Trend



	'70s	'80s	'90s	'00s	'10s
Non-majors	2			3	8
Retention		1		5	5
Gender, diversity, inclusion & accessibility				5	7
Prior knowledge				2	3
> Concept inventories, geek genes, misconceptions				1	5
Predicting & measuring success		2		5	10
> Programming process data				2	6
Other	1			1	4

# Learning & Assessment

General Trend



	'70s	'80s	'90s	'00s	'10s
<b>General learning</b>					1
Conceptual or cognitive issues			2	4	3
Learning styles				1	4
Reading, writing, tracing & debugging	1	1		5	6
Errors				3	8
Other learning					2
<b>General assessment</b>				4	1
Automatic tutoring & assessment systems	1		1	3	6
Authentic assessment			2	3	1
Exams				2	5
Other assessment	1			4	6

# Collaborative Approaches

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General Trend

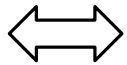


	'70s	'80s	'90s	'00s	'10s
Pair programming				5	9
Peer instruction				1	5
Other			3	6	7

# CS1 Content

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## General Trend

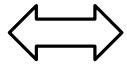


	'70s	'80s	'90s	'00s	'10s
Upper-level topics in CS1				5	4
Software engineering approaches	1	1	4	3	2
Other	1	2	1	6	8

# Tools

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## General Trend

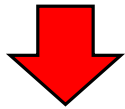


	'70s	'80s	'90s	'00s	'10s
Editors, APIs, etc.	1		2	2	4
Libraries, etc.			1	5	
Visualization			2	1	4
Debugging & testing		2		6	1
Other		1		3	3

# First Languages & Paradigms

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General Trend



	'70s	'80s	'90s	'00s	'10s
General languages & paradigms				2	2
Specific paradigms		1	7	10	1
Specific text-based languages		3	5	6	1
Other	4			2	1

# CS1 Design, Structure & Approach

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General Trend



	'70s	'80s	'90s	'00s	'10s
General design; structure; approach	3	1	2		2
How CS1 relates to CS0 or CS2				4	6
Dealing with ACM model curricula		1	3	2	
Physical Settings					
> Online, remote or MOOC delivery			2	8	5
> Labs		1	9	3	
> Other physical settings		1			1
Other	1	2		1	2



# Teaching

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General Trend



	'70s	'80s	'90s	'00s	'10s
General teaching		1		1	1
Model problems & exercises		4	9	10	1
Specific topics (arrays, recursion, etc.)			1	2	3
Games				6	3
Hardware (robots, etc.)				8	
Aids, examples & tricks		2	3	4	3
Flipped approaches					5
Video				2	4
Other	2	3	6	6	15

# Data available

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- CSV: Author(s), Title, Proceedings, Year, Category, ACM URL, Citations, Citations / Year
- [www.brettbecker.com/sigcse2019/](http://www.brettbecker.com/sigcse2019/)

# What will this look like in 2069?

