

# IT'S A TWO-WAY STREET: FROM THE COMPUTING CLASSROOM TO COMPUTING EDUCATION RESEARCH



**BRETT A. BECKER**

UNIVERSITY COLLEGE DUBLIN

DUBLIN, IRELAND

[BRETT.BECKER@UCD.IE](mailto:BRETT.BECKER@UCD.IE)

[WWW.BRETTBECKER.COM](http://WWW.BRETTBECKER.COM)



# A BIT ABOUT ME

- [www.brettbecker.com](http://www.brettbecker.com)
- Vice-Chair: ACM SIGCSE [www.sigcse.org](http://www.sigcse.org)
- Steering Committee: ACM/IEEE/AAAI CS2023 Model Curriculum (CS2023) [csed.acm.org](http://csed.acm.org)
- Steering Committee Chair: ACM Global Computing Education Conference (CompEd) [comped.acm.org](http://comped.acm.org)
- But today I'm speaking just as me, not with any of these hats on!

# COMPUTING EDUCATION (RESEARCH)

- There is much discussion in computing education about turning **research into practice** because **research-informed teaching** could (or should) be more effective
- Learning can be difficult, and teaching can be difficult
  - *Teaching and Learning* are never perfect
- Every *learner, every teacher, and every context* is unique
  - *Teaching and Learning* can always be improved

# COMPUTING EDUCATION (RESEARCH)



Systematic &  
organized.  
Have testable  
explanations  
and predictions

Pedagogy: *The* **A** **B** **T** *and Science of teaching and learning*

# GOALS

- Provide a brief look at publishing research with a focus on that which originates in classroom practice
- Some of this is also applicable to other types of research. However, our classrooms are often fertile grounds for research.
- After all, the goal of much computing education research is to improve teaching and learning, so why not start in the classroom?
- Note: Many listeners will already know some of what follows. Nonetheless I hope that there is something for everyone.
  - I find that often good ideas and approaches come from talking to others about things that I “already know”



# PASSION!

- Being passionate about teaching and learning gives you a great start to conducting effective research
  - Focus on what you are passionate about! If nothing comes to mind, be curious! Look at what others are doing. Talk to others, and *read* research. There is so much interesting work out there and so much of it can be put to practice in a new context, be extended, be adapted, etc.
  - Truly original research never comes from a vacuum! It comes from being informed.
  - Follow the road(s) that interest you
  - Also! Reviewing for conferences is great for getting your own research in gear!
- 

- It is often noted that there is a disconnect between practice and research
- “There seems to be little overlap between the questions that people who conduct computing education research think are important and the questions considered important by people who teach but do not conduct research”

Paul Denny, Brett A. Becker, Michelle Craig, Greg Wilson, and Piotr Banaszekiewicz. 2019. Research This! Questions that Computing Educators Most Want Computing Education Researchers to Answer. In Proceedings of the 2019 ACM Conference on International Computing Education Research (ICER '19). ACM, New York, NY, USA, 259–267.

<https://doi.org/10.1145/3291279.3339402>

The image features a white background with decorative green circuit-like lines in the corners. These lines consist of straight segments and small circles, resembling a stylized PCB or network diagram. The lines are positioned in the top-left, top-right, bottom-left, and bottom-right corners, framing the central text.

Here's one view of *practice* and *research*



# PRACTICE AND RESEARCH

- **A lot of research rarely informs classroom practice**
  - A lot of research may not (directly) apply to your context - but some will
  - Relevant research can be difficult to find
    - Scan the tables of contents of proceedings and journal issues! Spend some time on the ACM Digital Library. It can be a fascinating place.
- **Often classroom practice is not informed by research**
  - Can be difficult to implement/modify/adapt/apply research in a context that is different to where the research was conducted - but it can be fruitful!
  - Introducing changes into classroom practice can be difficult - but it can be impactful!

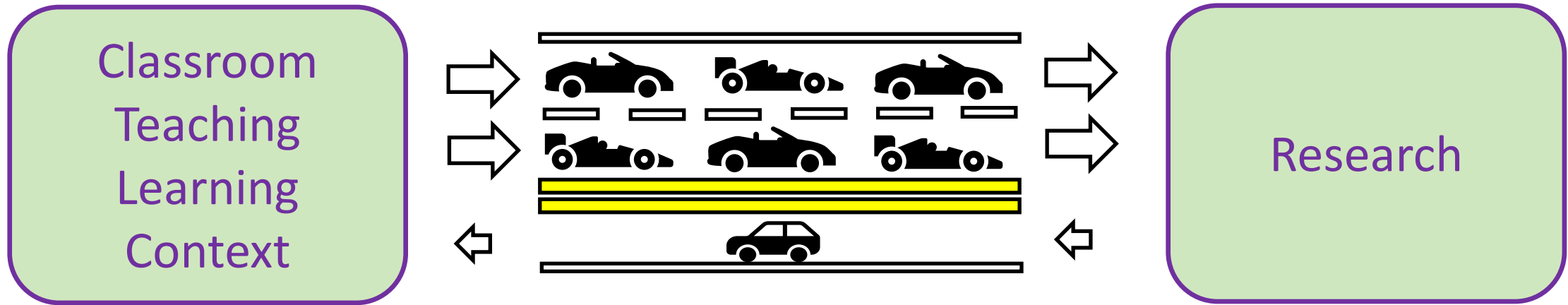


**BUT!\***

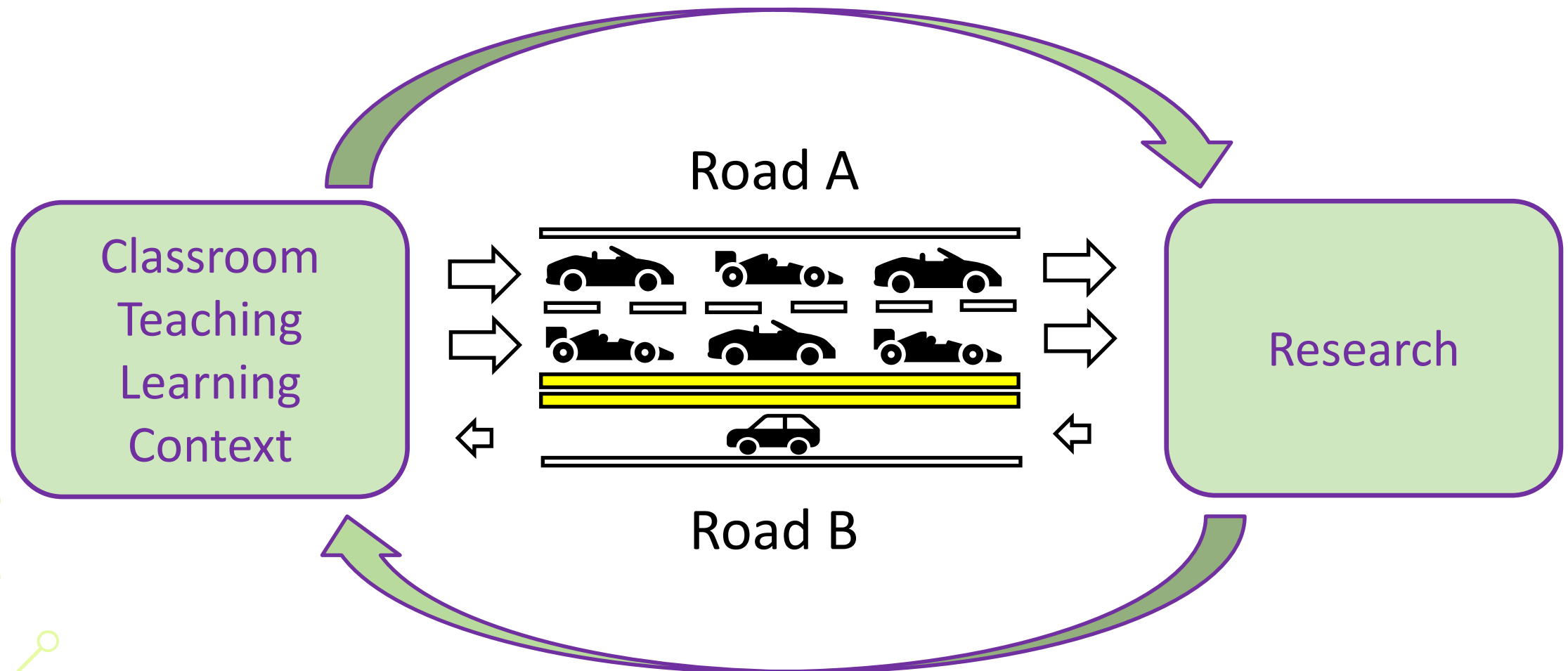
- Where does this research come from? How does it become research?
  - A lot of research comes from the classroom!
  - The classroom is a natural laboratory
  - You have control in your context
  - You are the expert in your context

\* This is not the last but!

# ONE PERSPECTIVE

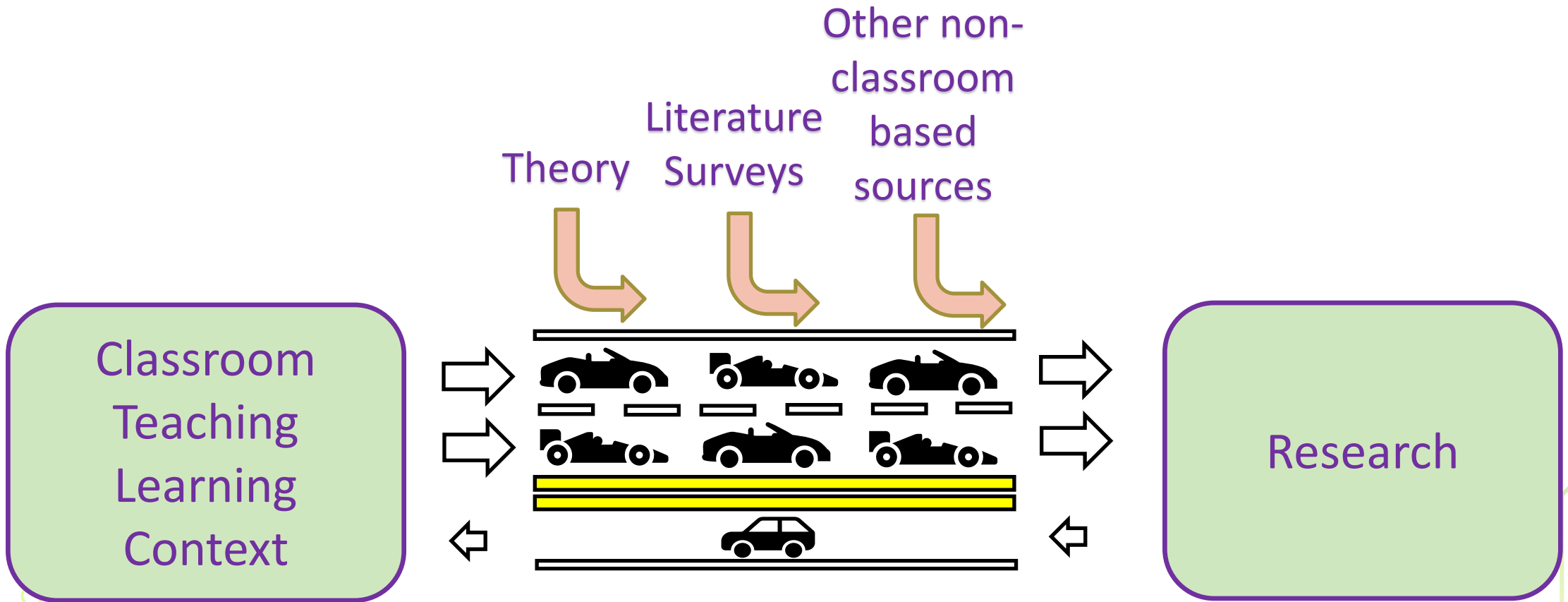


# TWO ROADS, ONE CYCLE

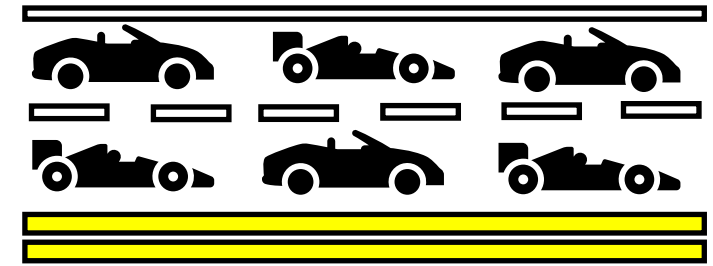


# THERE ARE OTHER SEEDS FOR RESEARCH

But these are for another day...

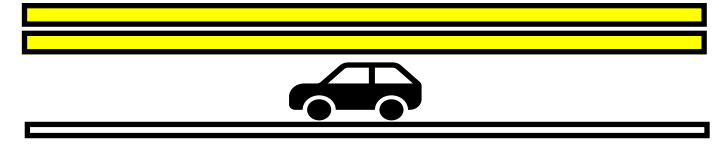


# ROAD A – IT'S BUSY OUT THERE!

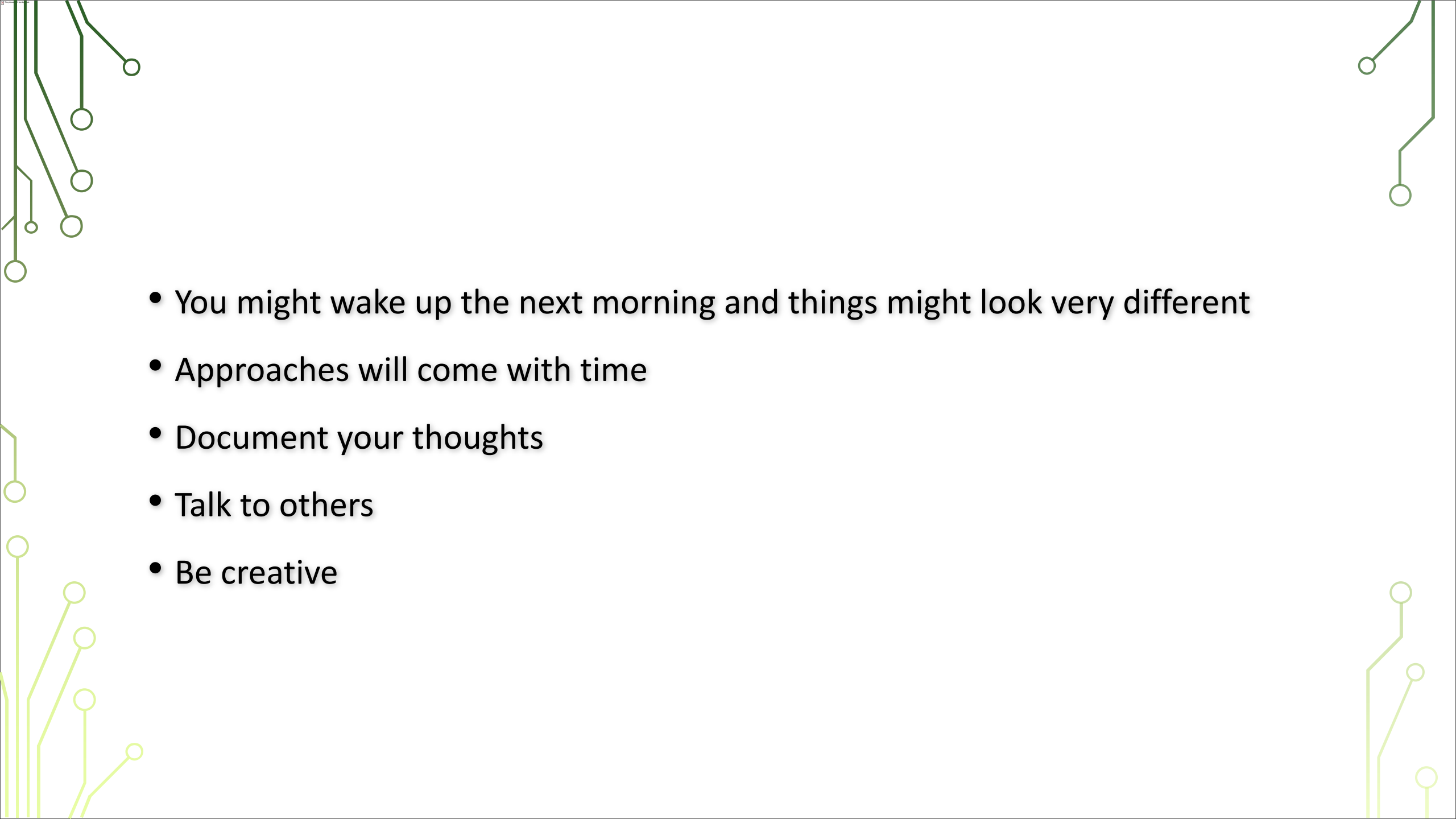


- Look at issues/solutions/problems/approaches in *your practice* that are relevant to **other** contexts.
- Looking for gaps in the research literature is difficult – it's a busy road!
- Try looking from the **practice** perspective
  - What facets of classroom practice are common in your context but not well-represented in the **literature**?
  - What facets of classroom practice are unique to your context but might inform **others**?

# ROAD B – IT CAN BE LONELY OUT THERE!



- Look at issues/problems/solutions/approaches in *the research* that might be relevant to **your** context.
- You are the expert in your context!
- Try looking from the **research** perspective
  - What in the research is applicable to **your** context, possibly with a little modification?
  - What facets of the research can inform **you**?
    - *Quite likely, many!*

- 
- You might wake up the next morning and things might look very different
  - Approaches will come with time
  - Document your thoughts
  - Talk to others
  - Be creative



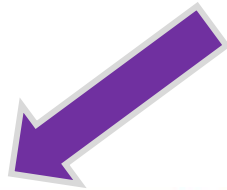
# WHERE DO YOU START?



Neil Brown: Academic Computing ([academiccomputing.wordpress.com/](http://academiccomputing.wordpress.com/))

# WHERE DO YOU START?

How about here?



Neil Brown: Academic Computing ([academiccomputing.wordpress.com/](http://academiccomputing.wordpress.com/))

# WHERE DO YOU START?

How about here?



# SCOPING CLASSROOM-BASED RESEARCH

- What angle? We do A LOT in the classroom
- Grand goal: Better teaching and better learning
- In reality:
  - Delivery: physical/online; large vs. small; lab vs. no lab; lecture vs. flipped; ...;
  - Materials: books; slides; lectures; examples; videos; curriculum; *research*; ...;
  - Activities: exercises; practice; show-and-do; projects; ...
  - Assessment: exams; artifacts; portfolios; ...
  - Feedback: formative; summative; written; verbal; ...
  - Much more here ...



# BUT!

- Almost all classroom activities involve humans
- To conduct research in this context, ethical\* review/permission is required
  - This is typically done on a local (institutional) level
    - Different countries/institutions have different procedures
    - Some have *laws*
  - Conferences/journals are increasingly requiring demonstration of ethical approval

\*in North America and some other locales this is often called IRB (Institutional Review Board)

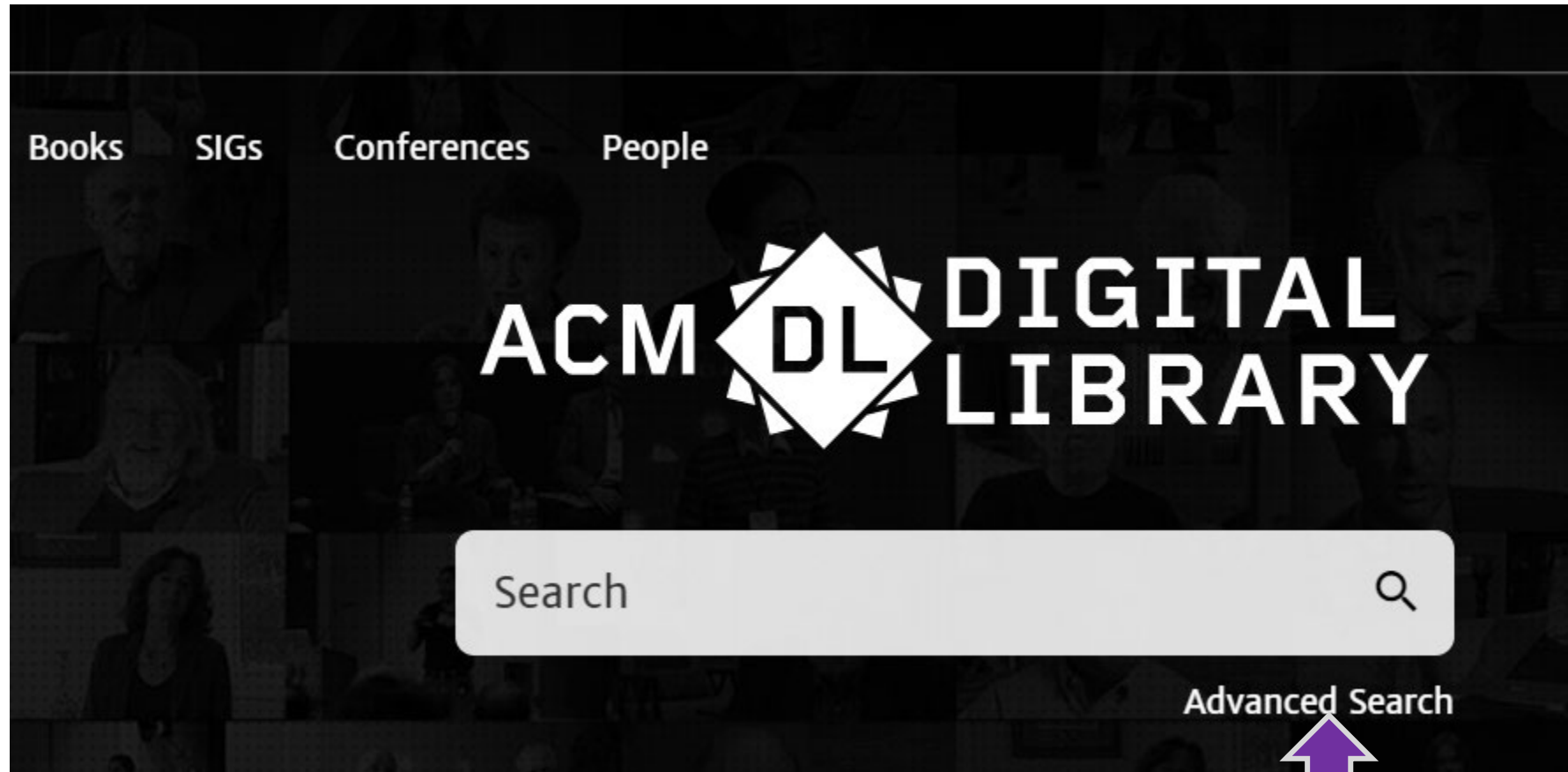
# APPROACHES (BOTTOM UP, 1 OF N\*)

- Identify problems in your classroom
- Identify successes in your classroom
- Look at your students
- Look at your practices
- Look at your curriculum
- Then:
  - Look at the literature (ACM Digital Library, Google Scholar, etc.)
  - Is there work on this? Are there gaps and can you fill one? Can you build on this?
- Then: Do it and publish it!

# APPROACHES (TOP DOWN, 1 OF N)

- Look at the literature (ACM Digital Library, Google Scholar, etc.)
- Is there work on this? Are there gaps? Can you fill one?
- Then:
  - Identify things you can do in your classroom
  - Identify things you can take further
  - Identify things that worked in one context that hasn't been tested in yours
  - etc.
- Then: Do it and publish it!

- ACM Digital Library ([dl.acm.org](https://dl.acm.org))



Advanced Search





- ACM Digital Library ([dl.acm.org](https://dl.acm.org)): Advanced Search


## Advanced Search



### Search

Search anything within the ACM Digital Library or go to your [Saved Searches](#)


**Search items from:**

The ACM Full-Text collection  

**Search Within** 

Anywhere  "threshold concept" 

Add search field

**Filters** 

### SEARCH

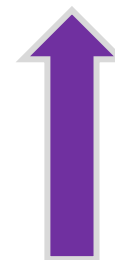
#### Boolean

Use the narrow

By default Search ' operatc

By default words v

Enclose (" ") tc



- ACM Digital Library ([dl.acm.org](https://dl.acm.org)): “Conference Sponsor” -> SIGCSE

## ■ *Advanced Search*

### Search

Search anything within the ACM Digital Library or go to your [Saved Searches](#)

Search items from:

The ACM Full-Text collection



Search Within ⓘ

Anywhere

"threshold concept"



Conference Sponsor



SIGCSE





# METHODS

- What is the best way to measure what you want to measure?
- Observational; Experimental; Quasi-experimental; Simulated; Derived; etc.
- Qualitative; Quantitative; Mixed-Methods; etc.
- Learn the basics of these, and go from there!
  - If you already know these, read more about them!
- See “Resources” later

# DATA COLLECTION AND ANALYSIS

- Consider making data/code/surveys/etc. available as supplementary material
  - This is a good idea for many reasons including but not limited to: reproducibility, allowing others to build on your work, transparency
  - Ensure data is de-identified (or anonymised) and that you have ethical (IRB) permission to do this
  - Choose the means of doing this carefully. Sometimes the publisher has a mechanism for this, but not always. The means should be “permanent” (e.g. not personal or institutional websites). Consider Zenodo.org or similar.
- However, some venues require links to supplementary material to be anonymised. Others don't require reviewers to consider this when reviewing. Others explicitly instruct reviewers to not consider this at all.
- Regardless, you can state that material will be available, should the paper be accepted: e.g., “We have made our [data/code/etc.] available at <redacted for anonymous review>.”
- See “Resources” later

# RESOURCES

- **The Cambridge Handbook of Computing Education Research (Edited by Sally Fincher and Anthony Robbins)** [www.cambridge.org/core/books/cambridge-handbook-of-computing-education-research/F8CFAF7B81A8F6BF5C663412BA0A943D](http://www.cambridge.org/core/books/cambridge-handbook-of-computing-education-research/F8CFAF7B81A8F6BF5C663412BA0A943D)
- I cannot recommend this book highly enough. These 918 pages, and hundreds of references, is the core of just about everything you need to know to conduct computing education research.
- *The best book I ever bought. So good I bought two. I got tired of carrying it to the office every day.*

**Contributors:** Sally A. Fincher, Anthony V. Robins, Mark Guzdial, Benedict du Boulay, Josh Tenenber, Brian Dorn, Christopher Hundhausen, Robert McCartney, Laurie Murphy, Paulo Blikstein, Sepi Hejazi Moghadam, Amy J. Ko, Patricia Haden, Lauren E. Margulieux, Kristin A. Searle, Briana B. Morrison, Kerry Shephard, Michael C. Loui, Maura Borrego, Shriram Krishnamurthi, Kathi Fisler, Thomas Lancaster, Katrina Falkner, Judy Sheard, Colleen M. Lewis, Niral Shah, Paul Curzon, Tim Bell, Jane Waite, Mark Dorling, Jan Vahrenhold, Quintin Cutts, R. Benjamin Shapiro, Mike Tissenbaum, Lauri Malmi, Ian Utting, Michael Horn, Marina Bers, Adam Carter, Daniel Olivares, Joanna Goode, Jean J. Ryoo, Yifat Ben-David Kolikant, Andrew Begel, Michael J. Clancy, Alex Lishinski, Aman Yadav, Beth Simon, Charlie McDowell, Linda Werner, Helen Hu, Clif Kussmaul, Leo Porter

# RESOURCES

- The Big Book of Computing Pedagogy (Free)
  - [helloworld.raspberrypi.org/books/big\\_book\\_of\\_pedagogy](http://helloworld.raspberrypi.org/books/big_book_of_pedagogy)
  - Particularly useful for not only perfecting your classroom practice, but an excellent place to start **to join the busy road from turning classroom practice into research**

# RESOURCES

- Statistics for Dummies (~\$15)
  - [www.wiley.com/en-ie/Statistics+For+Dummies%2C+2nd+Edition-p-9781119293521](http://www.wiley.com/en-ie/Statistics+For+Dummies%2C+2nd+Edition-p-9781119293521)
- Statistics II for Dummies (~\$15)
  - [www.wiley.com/en-ie/Statistics+II+for+Dummies-p-9780470543887](http://www.wiley.com/en-ie/Statistics+II+for+Dummies-p-9780470543887)

# RESOURCES

- Past, Present and Future of Computing Education Research - A Global Perspective (Edited by Mikko Apiola, Sonsoles López-Pernas and Mohammed Saqr)
  - Section Editors: Lauri Malmi, Simon, Arnold Pears, Mats Daniels
- [cerbook.org](http://cerbook.org) (*to be published by Springer in 2023*)
- History, context, communities of practice, case studies, and global landscape of computing education research

**Contributors:** Mikko Apiola, Sonsoles López-Pernas, Mohammed Saqr, Lauri Malmi, Mats Daniels, Arnold Pears, Judithe Sheard, Simon, Päivi Kinnunen, Anders Berglund, Jane Sinclair, Matti Tedre, Robert McCartney, Kate Sanders, Maria Ntinda, Erkki Sutinen, Valentina Dagienė, Mart Laanpere, Juris Borzovs, Friday Joseph Agbo, Arto Hellas, Petri Ihantola, Ville Isomöttönen, Ilkka Jormanainen, Terhi Kilamo, Antti Knutas, Ari Korhonen, Timo Poranen, Tapio Salakoski, Jarkko Suhonen, Judithe Sheard, Andrew Luxton-Reilly, Claudia Szabo, Michel Armoni, Judith Gal-Ezer, Joseph Maguire, Brett A. Becker, Steven Bradley, Keith Quille, Michaela Black, Sue Sentence, Tom Crick, Yasemin Gulbahar, Natasa Grugurina, Yasmin B. Kafai, Luis Morales-Navarro



# RESOURCES

- [csedresearch.org](https://csedresearch.org) (free)
- Many actionable, usable, tools and resources to help research your practice

The logo for csedresearch.org, featuring the text "csedresearch.org" in a multi-colored font (c: red, s: blue, e: green, d: purple, r: blue, e: green, s: purple, e: blue, a: red, r: blue, c: green, h: purple, .: blue, o: red, r: blue) enclosed in a blue rounded rectangular border.

Community Resources

Current Projects

Our Resources

Survey Instruments

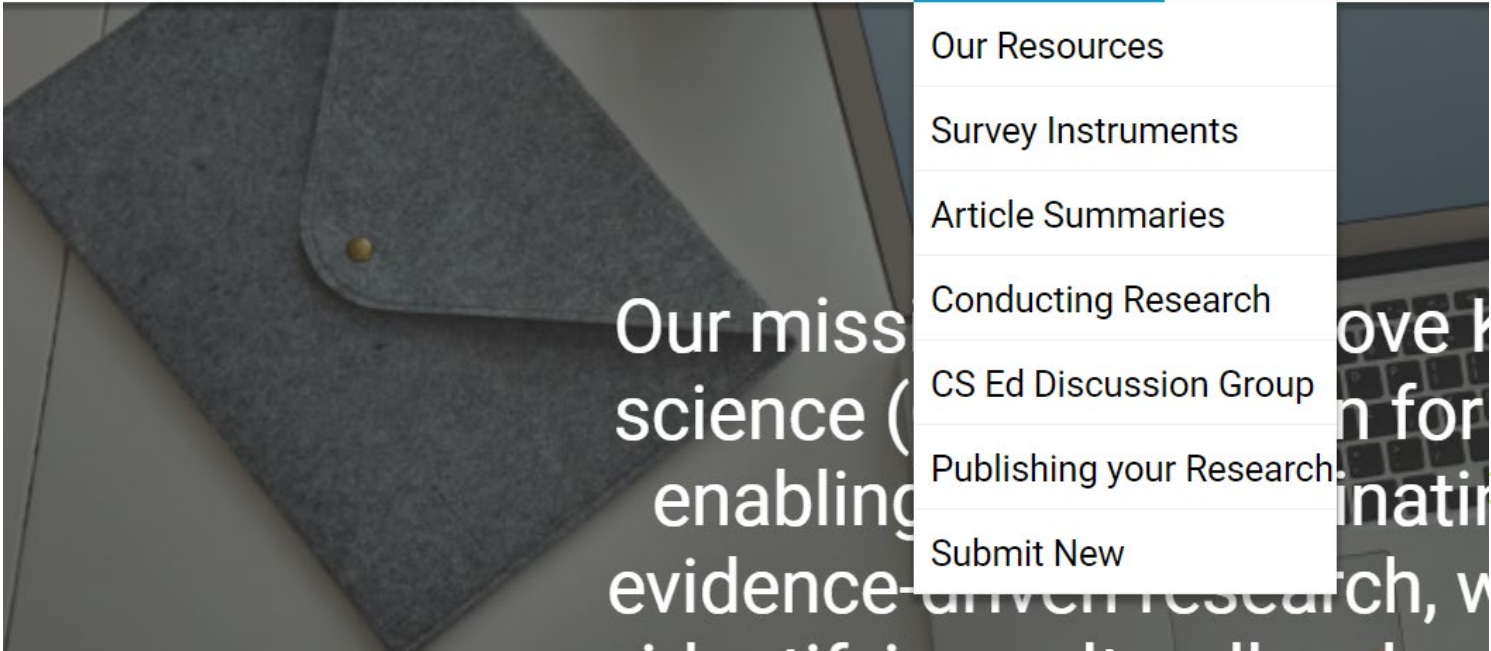
Article Summaries

Conducting Research

CS Ed Discussion Group

Publishing your Research

Submit New

A banner image featuring a dark grey envelope on a light grey surface. Overlaid on the right side is a white text box containing a list of menu items. Below the envelope, there is white text on a dark background.

Our mission is to advance the science of learning by enabling evidence-driven research, with the goal of identifying effective practices that improve learning for all students.

# RESOURCES

- Consult other researchers like Lauren Margulieux ([laurenmarg.com/leetblog/](https://laurenmarg.com/leetblog/))

## Research Design: What Statistical Significance Means

Posted on October 25, 2022

In the scientific method, we collect data to support or refute hypotheses, not to prove or disprove them. We frame scientific research in this way because there might be factors that we are unaware of that affect the results.

## Research Design: Preparing Data for Quantitative Analysis

Posted on October 18, 2022

When handling quantitative data, there are a number of steps that need to be completed before you can run your first test. This post describes a basic protocol for data cleaning and tools that you can use for analysis.

# RESOURCES

- Consult other researchers like Neil Brown ([academiccomputing.wordpress.com](https://academiccomputing.wordpress.com))

## Recent Posts

**Permanent Registered Reports Track At Computer Science Education**

**Reflections on Dagstuhl organisation**

**Errordle: a serious game**

**CSE Special Issue: Registered Report Replications**

**New Blackbox Mini dataset**

# CURRICULUM

- SIGCSE Technical Symposium: Position and Curricula Initiatives track
- ACM/IEEE/AAAI CS2023 ([csed.acm.org](https://www.csed.acm.org)) – draft available now. Final version in 2023.
- Does your curriculum have a unique aspect? Have you made changes lately – or are you planning any?
  - Study them! Research them!

# EXPERIENCE REPORTS AND TOOLS

- SIGCSE Technical Symposium: Experience Reports and Tools track
  - Also applicable to many other conferences
- Have you started using a new tool? Have you developed a tool?
- Have you adopted a tool that hasn't been studied, or studied in your context?
- Have you tried a new method/approach/etc.? What was your experience?

# VENUE CHOICE - CONFERENCES

- Research and plan your venue
- There are many choices in computing education these days, including:
- SIGCSE
  - Technical Symposium ([sigcse2023.sigcse.org](https://sigcse2023.sigcse.org))
    - (USA or Canada) February or March
    - 3 Tracks, Research, Experience Reports and Tools, Position Papers and Curricular Initiatives. Deadline: August.
    - Also, posters, panels, birds-of-a-feather, etc. Some deadlines in October
    - 2019 >1,800 people; 2023 (Toronto) hybrid;

# VENUE CHOICE - CONFERENCES

- SIGCSE (continued)
  - ITiCSE ([iticse.acm.org](http://iticse.acm.org))
    - Europe, July or August, deadline normally January
    - ~250 attendees
    - 3 “tracks”
  - ICER ([icer.acm.org](http://icer.acm.org))
    - North America -> Europe -> Australasia -> North America -> repeat
    - August or September, deadline normally March/April
    - ~150 attendees
    - Research only, single-track

# VENUE CHOICE - CONFERENCES

- SIGCSE (continued)
  - CompEd ([comped.acm.org](https://comped.acm.org))
    - Modeled on ITiCSE
    - New in 2019 (China)
    - Every 2 years; NOT held in Europe or USA/Canada. Time of year varies
    - ~125 attendees
    - 3 “tracks”
    - On “pause” for 2021, 2022.
  - **2023 is planned (but not yet confirmed) for Hyderabad. Announcement of go/no-go Dec 2022.**



# VENUE CHOICE - CONFERENCES

- SIGCSE In-cooperation
  - Australasian Computing Education Research conference (ACE) ([aceconference.github.io](https://aceconference.github.io))
    - Australia/New Zealand; late January, deadline October, single track
  - Koli Calling (Koli) ([www.kolicalling.fi](http://www.kolicalling.fi))
    - Koli, Finland; end of November, deadline August/September; single-track
  - CSERC ([www.ou.nl/web/cserc](http://www.ou.nl/web/cserc))
  - COMPUTE ([event.india.acm.org/Compute/](http://event.india.acm.org/Compute/))
  - CCSC (Consortium for Computing Sciences in Colleges) series and more ([sigcse.org/events/incoop.html](http://sigcse.org/events/incoop.html))
  - WiPSCE ([www.wipsce.org](http://www.wipsce.org))
    - Primary and Secondary School
- There are more: UKICER ([ukicer.com](http://ukicer.com)), CEP (Computing Education Practice) ([cepconference.webspace.durham.ac.uk](http://cepconference.webspace.durham.ac.uk)), etc.

# VENUE CHOICE - JOURNALS

- ACM Transactions on Computing Education (TOCE) ([toce.acm.org](http://toce.acm.org))
- Taylor & Francis *Computer Science Education* ([www.tandfonline.com/journals/ncse20](http://www.tandfonline.com/journals/ncse20))
- Longer (page length); no deadlines; fairly rapid decision; more complete/conclusive/detailed studies

# SUBMISSION

- Before you write, read (at least twice):
  - Scope
  - Author instructions
    - Consider using LaTeX. The MS Word templates are often more difficult to work with and in general the LaTeX templates produce easier to read and more professional looking papers
  - *Reviewer* guidelines
  - Submission instructions
- It is always a good idea to read several papers from recent years at the venue you are aiming for

# POST SUBMISSION

- Regardless of decision, read and save the reviews
- Accept
  - Congratulations!
  - Pay careful attention to post-acceptance “camera-ready” instructions from the chairs or editors.
  - Carefully make changes that address reviewer comments, or consciously decide not to address other comments
  - Prepare presentation according to chair instructions (conference)

The slide features decorative circuit-like lines in the corners. The top-left and bottom-left corners have dark green lines, while the top-right and bottom-right corners have light green lines. These lines consist of straight segments connected by right-angle turns, ending in small circles.

# POST SUBMISSION

- Start plans to continue your research, or start something new!

The image features a white background with decorative circuit-like lines in the corners. The top-left and bottom-left corners have dark green lines, while the top-right and bottom-right corners have light green lines. These lines consist of straight segments and small circles, resembling a stylized circuit board or network diagram.

**THANKS! QUESTIONS?**

# ABSTRACT FOR THIS TALK

There is much discussion in computing education about turning research into practice because research-informed teaching could (or should) be more effective. However, it is often noted that there is a disconnect between practice and research. A lot of research rarely informs classroom practice, and often classroom practice is not informed by research. Nonetheless, for research to inform practice we need research. Where does this research come from? How does it become research? In addition to being informed by research, classroom practice can be one source of research, and the classroom itself can be the laboratory. The result is a two-way street between practice and research. While some research - for instance the presentation of some theories, literature reviews, and research not directly involving students - may not originate in the classroom, much research does originate in, or takes place in, the classroom. This talk describes several routes from the classroom to research. It will cover topics such as scoping classroom-based research studies, ethical review, approaches and methods, data collection and analysis, the role of curriculum, research presentation and paper types, venue choice, the submission and review process, publication, and post-publication considerations. The goals are to help those that are less familiar with computing education research to conduct research in their classrooms and additionally to help those in the classroom use research in their practice.