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ROBERT GILLESPIE ACADEMIC SKILLS CENTRE

Scholarship of Teaching and Learning (SoTL) Series 4:

Quantitative Research Methods in SoTL.

Amanda Brijmohan, PhD
Educational Developer
Assessment and SoTL
Robert Gillespie Academic Skills Centre
University of Toronto, Mississauga

Prof. Rutwa Engineer
Assistant Professor (Teaching Stream)
Mathematical and Computational Sciences
University of Toronto, Mississauga

Land Acknowledgement

Art by Christi Belcourt
https://www.instagram.com/p/Cia4T9euYUu/

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island, and we are grateful to have the opportunity to work on this land.

Access Check

Encourage you to check, identify, and question your learning environment for any of the following and welcome comments if there are elements that we can support to reduce barriers.

- Technology
- Resources
- Pace
- Sound

Timeline of the SoTL Series

SoTL Research Questions

SoTL Research Paradigms

SoTL Research Ethics

Quantitative Research Methods

Today

Qualitative Research Methods

May 14th
11:00 – 1:00 pm
MS Teams

Learning Outcomes

After this session, participants will be able to:

- Identify sources of quantitative data that are available and/or can be collected for a SoTL study in their teaching context.
- Describe how survey design principles and sampling considerations will inform the data collection strategies of their SoTL project.
- Identify and describe commonly used quantitative research designs in SoTL as well as the strengths, challenges, and limitations of each approach in their teaching and learning context.

Quantitative Research in SoTL

- Seeks to reduce complexity in larger data sets in order to find patterns among variables
  - Descriptive = Describing these patterns that are limited to the dataset
  - Inferential = Inferring whether patterns can generalize to larger populations
- Using quantitative data = value objectivity, reduced bias, researcher distance
  - Caveat: Learning can only be "imperfectly" known, because our measures of learning are not direct, they are indirect

(pg. 99, Yeo, Miller-Young, & Manarin, 2024)

Gathering Quantitative Evidence of Student Learning

How will you collect evidence of relevant student thinking and learning (i.e., data) that will answer your specific question(s)?

Start by thinking about how will you determine what your students are learning.

- Does strong performance on a test necessarily mean they have truly learned the material?
- How do you assess and interpret what they are learning?
- How can you collect evidence of their thinking at earlier points in the learning process, rather than relying only on final summative assessments such as essays and exams?

Making Thinking and Learning Visible

- Midterm and/or Final grades
- Samples of student work (assessments, papers, journals, presentations, recorded or online group discussions, etc.)
- Institutional research data (admissions, financial aid, etc.)
- Classroom Assessment Techniques (clicker data, etc.)
- Students' reports on their learning (surveys, interviews, focus groups)
- Frequencies (office hour visits, demographics, time spent studying)

Cognitive Aspects of Survey Methodology (CASM)

- Involves the intersection of cognitive psychology and survey methods to better understand:
  - The cognitive processes involved with answering survey questions
  - How survey design can be used to support the collection of better-quality answers and/or more representative answers

(Robinson and Leonard, 2019)

The Psychology of Survey Response

Respondents should read and understand what the question is asking. They should also interpret it in the way the researcher intends.

Comprehension

(Tourangeau, Rips, & Rasinski, 2000)

The Psychology of Survey Response

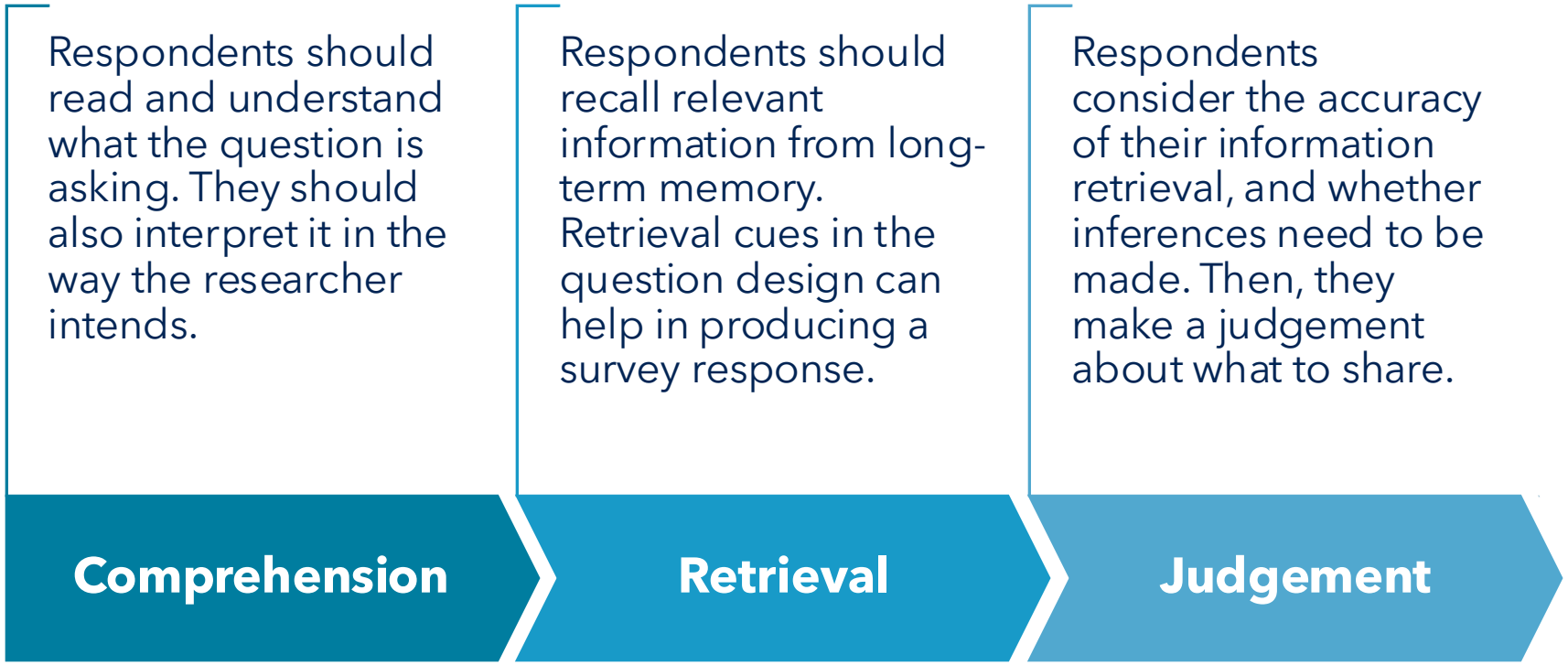
Respondents should read and understand what the question is asking. They should also interpret it in the way the researcher intends.

Respondents should recall relevant information from long-term memory. Retrieval cues in the question design can help in producing a survey response.

Comprehension → **Retrieval**

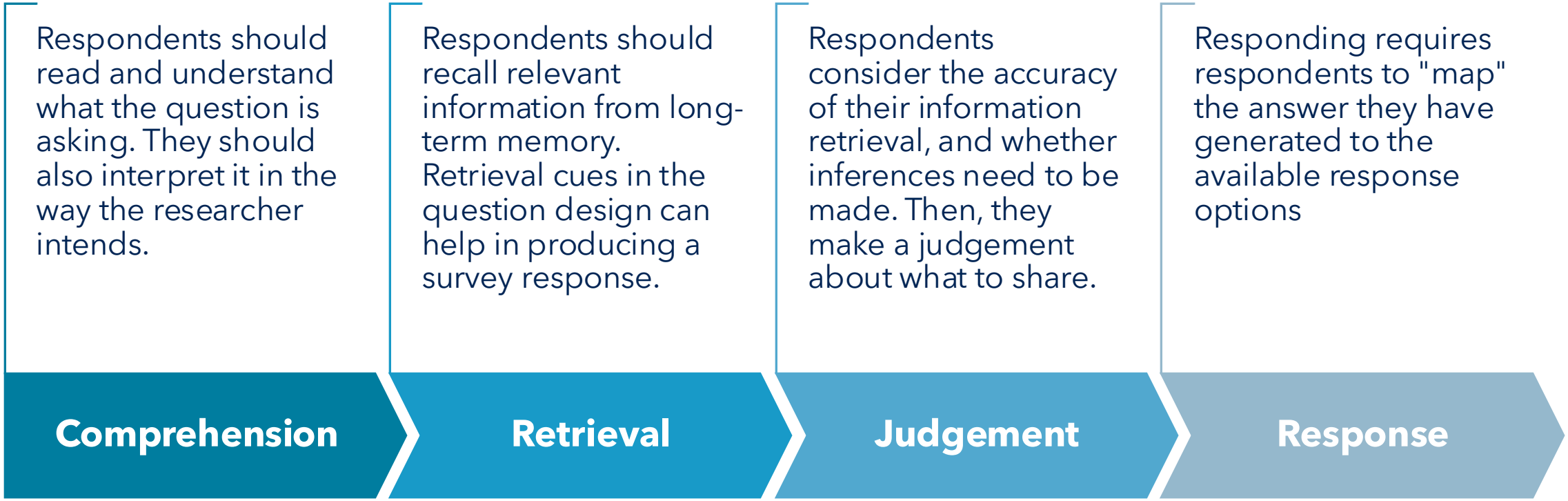
(Tourangeau, Rips, & Rasinski, 2000)

The Psychology of Survey Response



(Tourangeau, Rips, & Rasinski, 2000)

The Psychology of Survey Response



(Tourangeau, Rips, & Rasinski, 2000)

Thinking about how students respond

Are my questions using language that is understandable to students?

Comprehension

(adapted from Tourangeau, Rips, & Rasinski, 2000, for SoTL survey development)

Thinking about how students respond

Are my questions using language that is understandable to students?

Survey Question (unclear):
"In this biology course the flipped classroom pedagogical paradigm, which emphasizes student-centered active learning, significantly improved my cognitive engagement and metacognitive self-regulation."

Comprehension

(adapted from Tourangeau, Rips, & Rasinski, 2000, for SoTL survey development)

Thinking about how students respond

Are my questions using language that is understandable to students?

Comprehension

Survey Question (unclear):
"In this biology course the flipped classroom pedagogical paradigm, which emphasizes student-centered active learning, significantly improved my cognitive engagement and metacognitive self-regulation."

Survey Question (clear):
"The flipped classroom approach (where I watched videos before class and did activities during class time) helped me better understand and remember biology concepts."

(adapted from Tourangeau, Rips, & Rasinski, 2000, for SoTL survey development)

Thinking about how students respond

Are my questions using language that is understandable to students?

What kinds of information am I asking students to retrieve? What am I asking students to reflect on?

Consider the period of time that students are asked to recall upon in their survey:

- *Start* of the term?

Comprehension **Retrieval**

(adapted from Tourangeau, Rips, & Rasinski, 2000, for SoTL survey development)

Thinking about how students respond

Are my questions using language that is understandable to students?

Comprehension

What kinds of information am I asking students to retrieve? What am I asking students to reflect on?

Retrieval

Consider the period of time that students are being asked to recall and report on in their survey:

- *Start of the term?*
- *The mid-term?*
- *Their first year experience when they are in 2nd year?*

How accurate would their survey results be?

(adapted from Tourangeau, Rips, & Rasinski, 2000, for SoTL survey development)

Thinking about how students respond

Comprehension

Are my questions using language that is understandable to students?

Retrieval

What kinds of information am I asking students to retrieve? What am I asking students to reflect on?

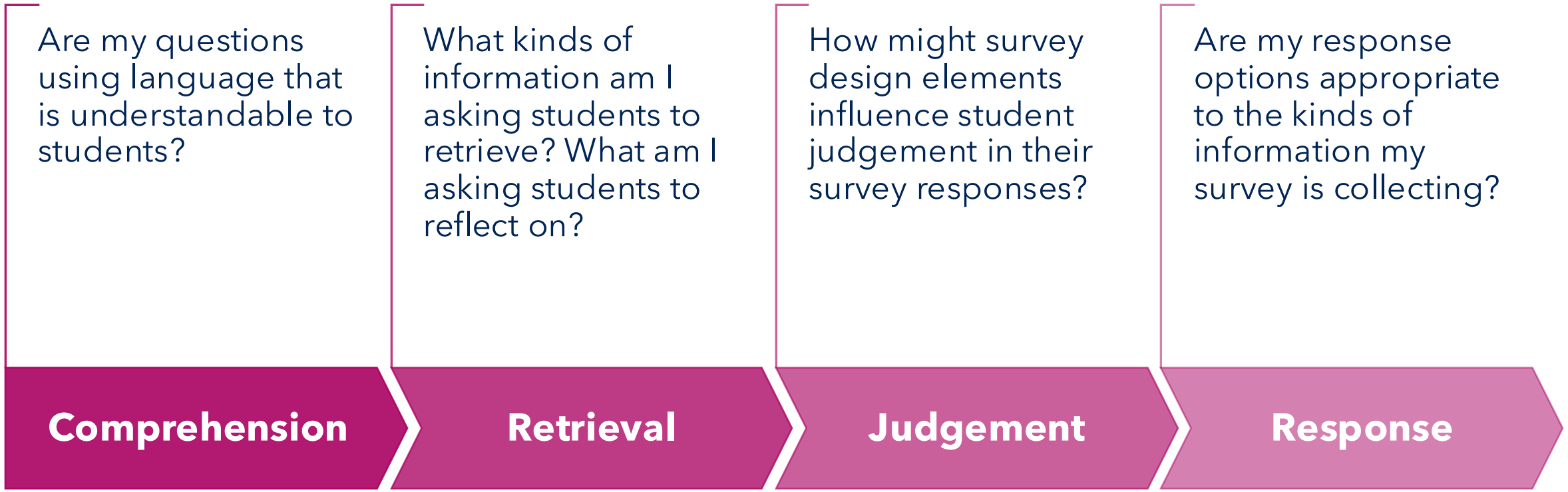
Judgement

How might survey design elements influence student judgement in their survey responses?

- *Consider survey length, and survey fatigue*
- *Consider the order of survey questions and how this might affect responses.*

(adapted from Tourangeau, Rips, & Rasinski, 2000, for SoTL survey development)

Thinking about how students respond



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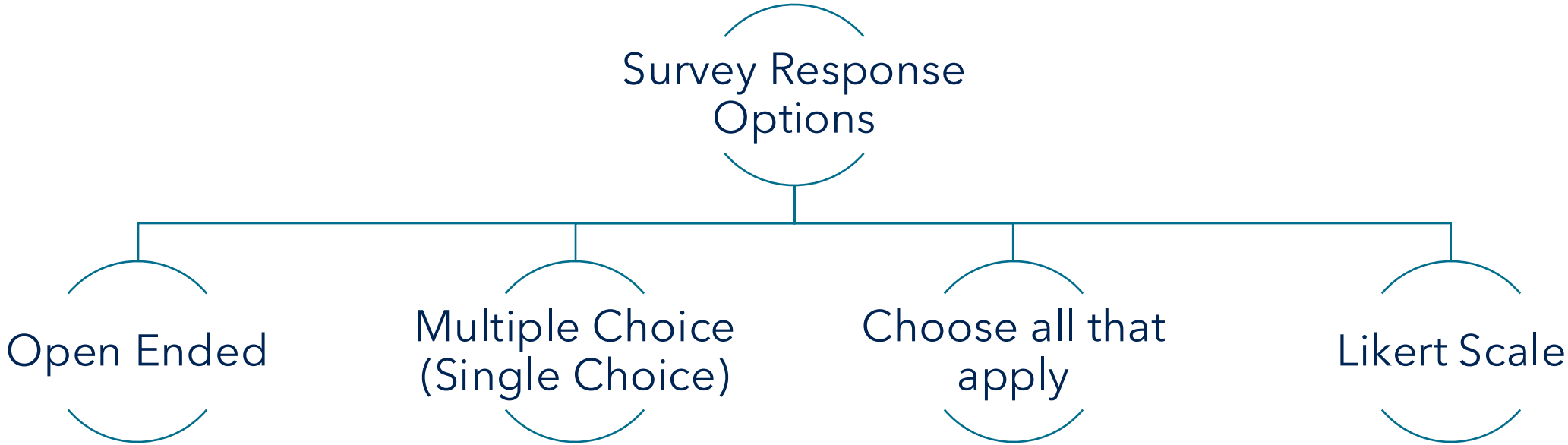
Considerations for Response Options



Good for exploring complex phenomenon through the students' words.

Good for capturing phenomenon that are mutually exclusive at scale.

Good for capturing phenomenon that may be co-occuring.

Good for capturing phenomenon (behaviours, attitudes, beliefs about learning) along a dimension (SA – SD). Also mutually exclusive.

Consider different cognitive biases in survey responses

Satisficing: when respondents provide minimally acceptable answers instead of ones that are representative of what is being researched

- Choosing the mid-point response, the don't know option. Etc.
- This can be mitigated by reducing ambiguity in the questions, response options, and in reducing survey fatigue

Social Desirability Bias: when respondents self-edit their answers to conform to social norms, "look good", or avoid consequences of being honest

- In SoTL, the power-dynamics between instructors and students can affect their responses in teaching and learning surveys

Good survey questions...

Are relevant to your research

Are specific and clearly written

Considers recall/respondent effort

Sampling Strategies

- Probability Sampling
  - **Simple random sampling:** randomly select students to be in your sample; everyone has a random change of being selected
  - **Stratified random sampling:** You randomly select students within different strata; e.g. selecting students within business, arts, humanities, and sciences, so that there is no overrepresentation from one discipline

Sampling Strategies

- Non-Probability Sampling
- **Convenience sampling:** selecting students who are easily accessible; a department surveying their work-study students
- **Purposeful sampling:** selecting students who dropped the course to understand how to better support their course retention

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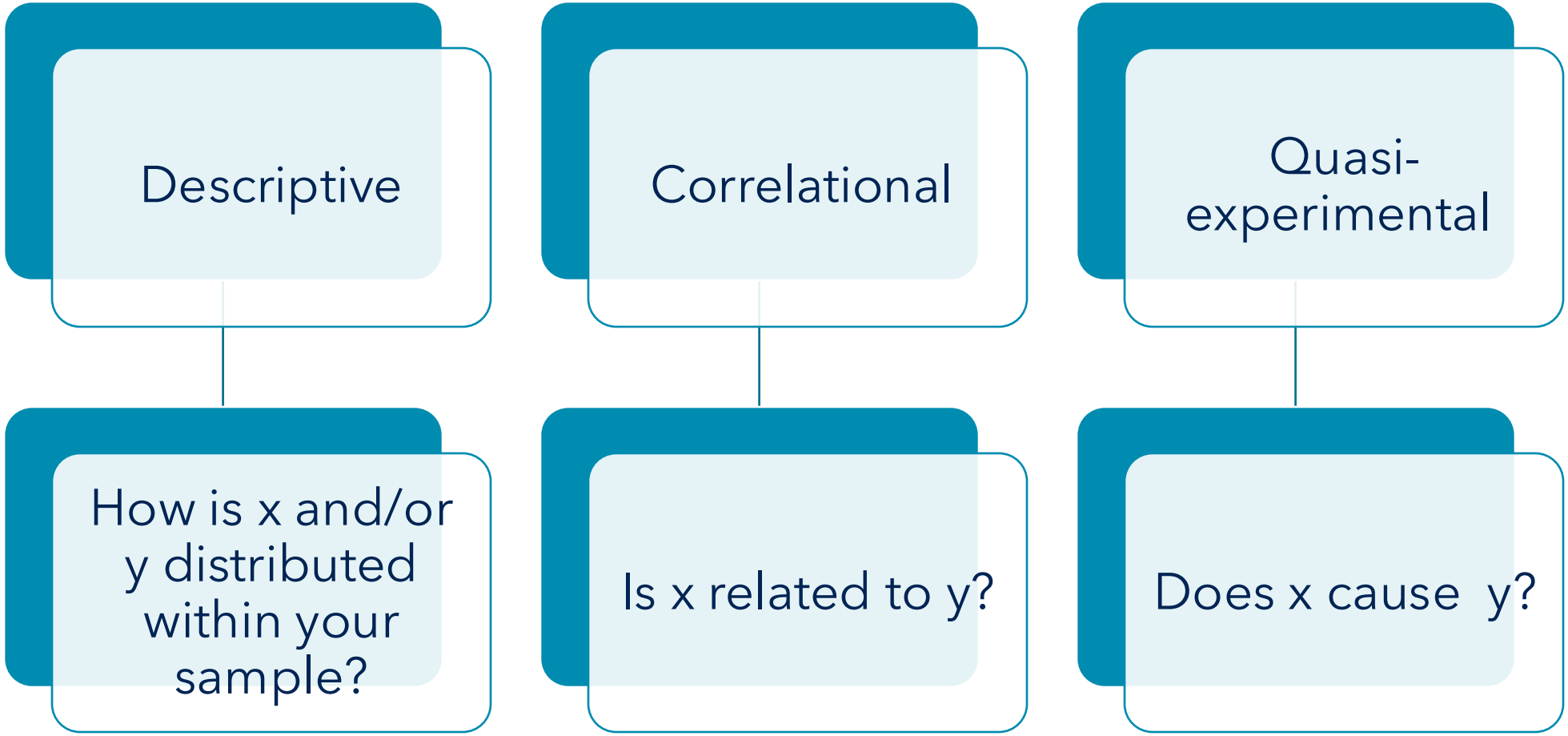
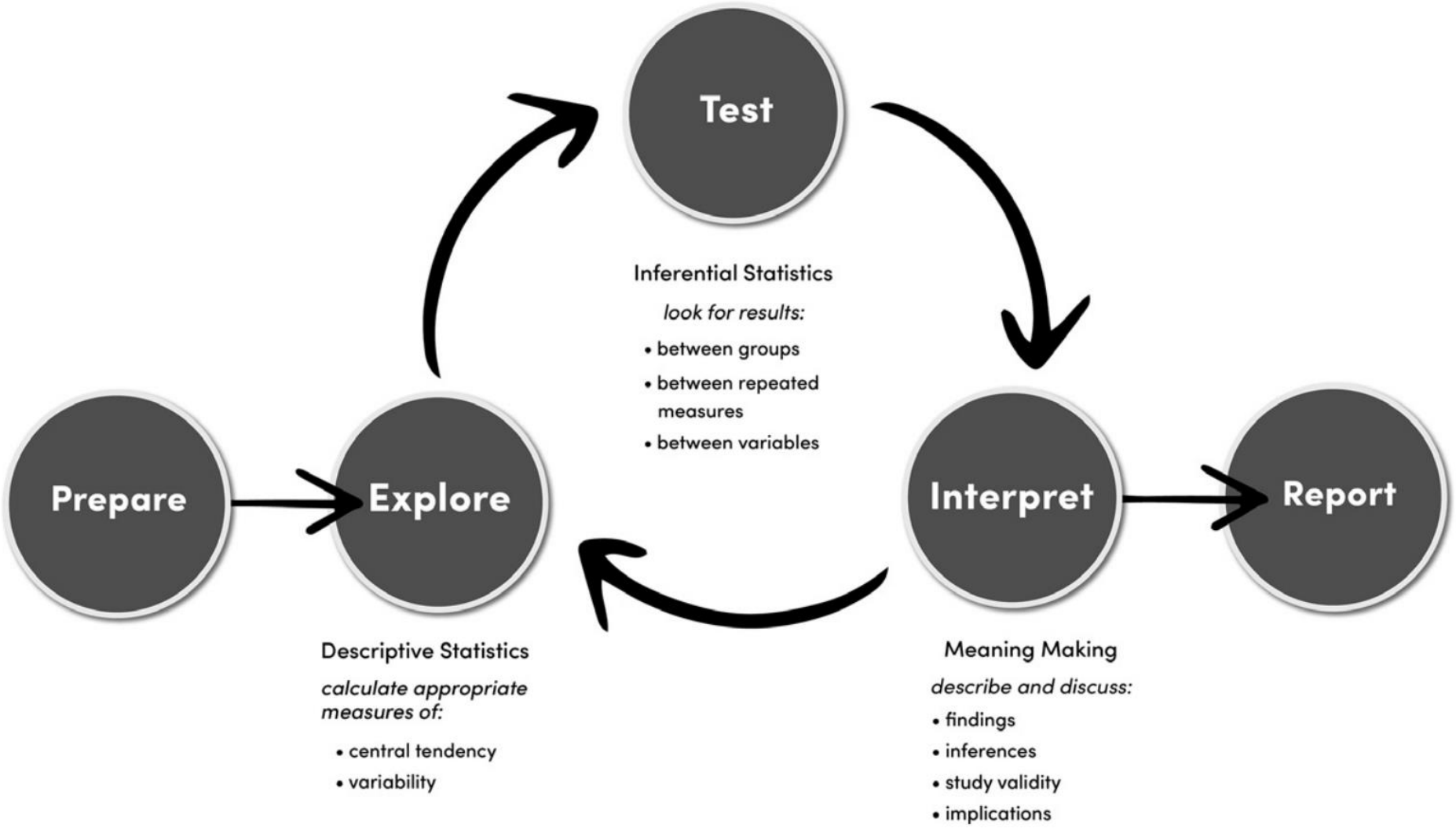
Break & Questions?

Quantitative Research Designs



(Yeo et al., 2024)

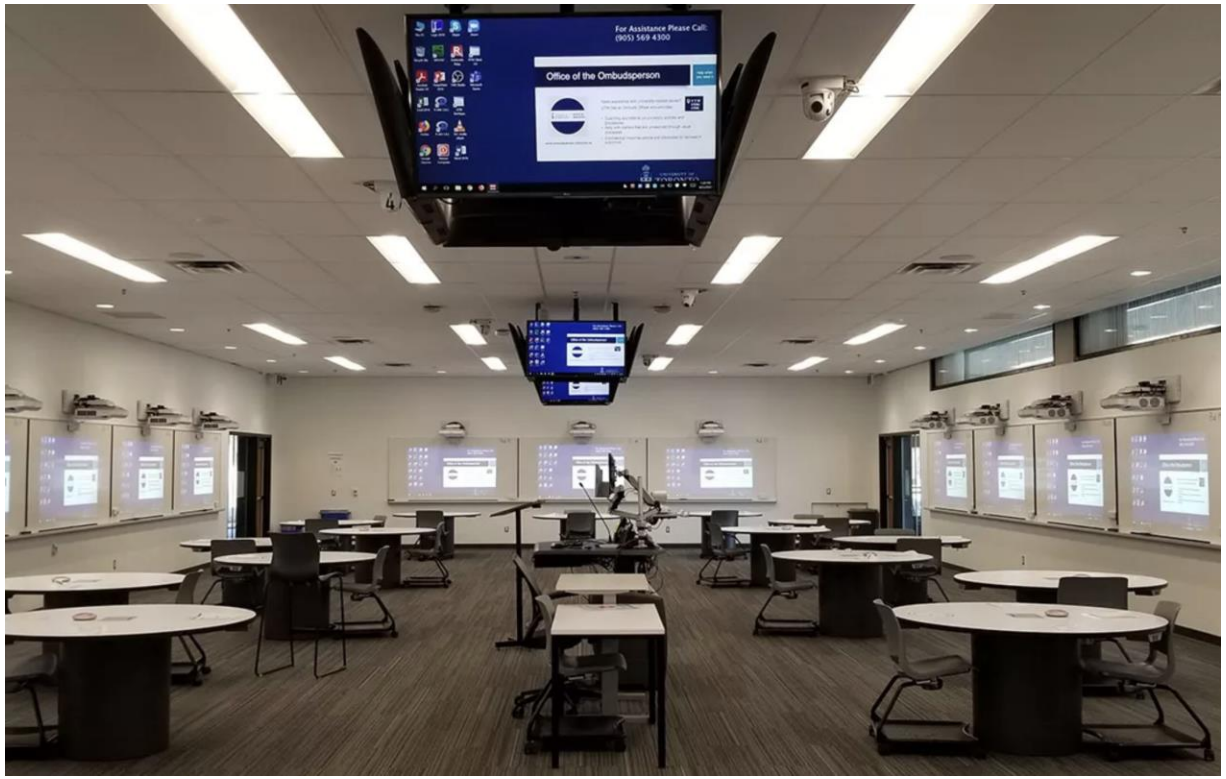
Quantitative Analysis



(Yeo et al., 2024)

Study 1: Analyzing the Effects of Active Learning Classrooms in CS2

- Examine the effects of **learning space** in CS2
- **Quasi-experimental** setup with 529 participants across five lecture sections over one academic year



Naeem Syeda, A., **Engineer, R.,** & Simion, B. (2020, February). Analyzing the effects of active learning classrooms in cs2. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (pp. 93-99).

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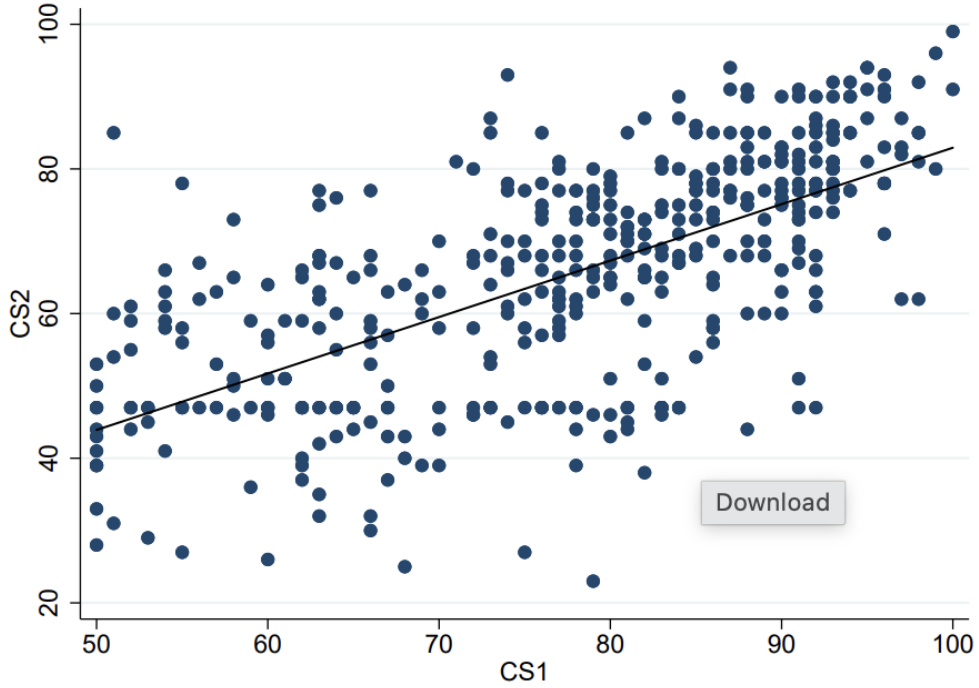

Figure 1: Scatterplot of CS1 vs CS2 grades.

Table 4: Summary of ratings from survey responses.

Section	Responders	technology		hear_instr		get_help		desk_conducive	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
L101	65	8.3	2.1	8.8	1.6	8.9	1.3	8.3	2.1
L102	98	8.1	2.3	8.4	2.1	8.2	2.2	7.8	2.5
L103	72	7.7	2.1	8.0	1.9	8.7	1.9	8.4	1.5
L104	29	8.5	1.9	9.2	1.4	8.6	1.6	8.2	1.9
L105	72	8.4	1.9	8.8	1.5	8.8	1.8	7.6	2.2

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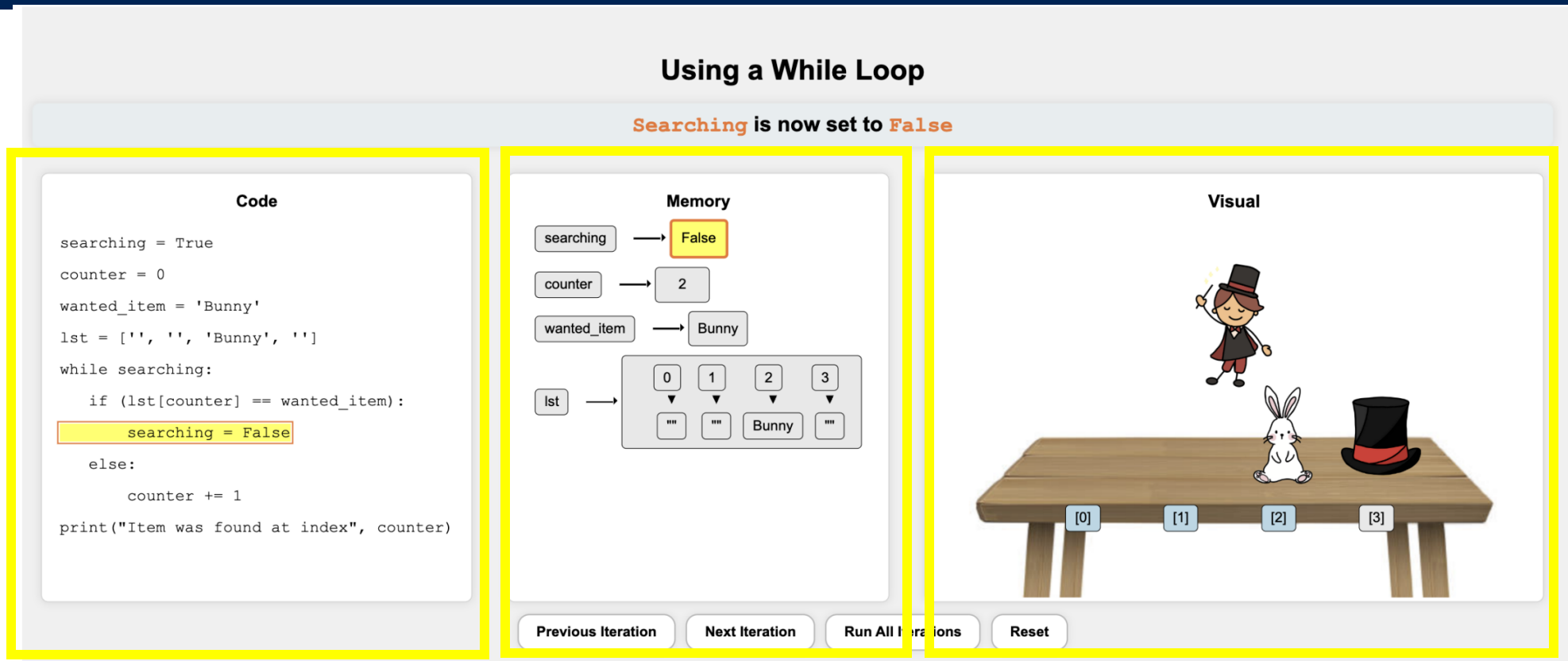
Study 2: Evaluating Multiple Coordinated Views in Introductory Programming



Sibia, N., Osorio, V. R., Wen, J., **Engineer, R.**, Bernuy, A. Z., Petersen, A., ... & Nobre, C. (2025). From Code to Concept: Evaluating Multiple Coordinated Views in Introductory Programming. *arXiv preprint arXiv:2509.26466*.

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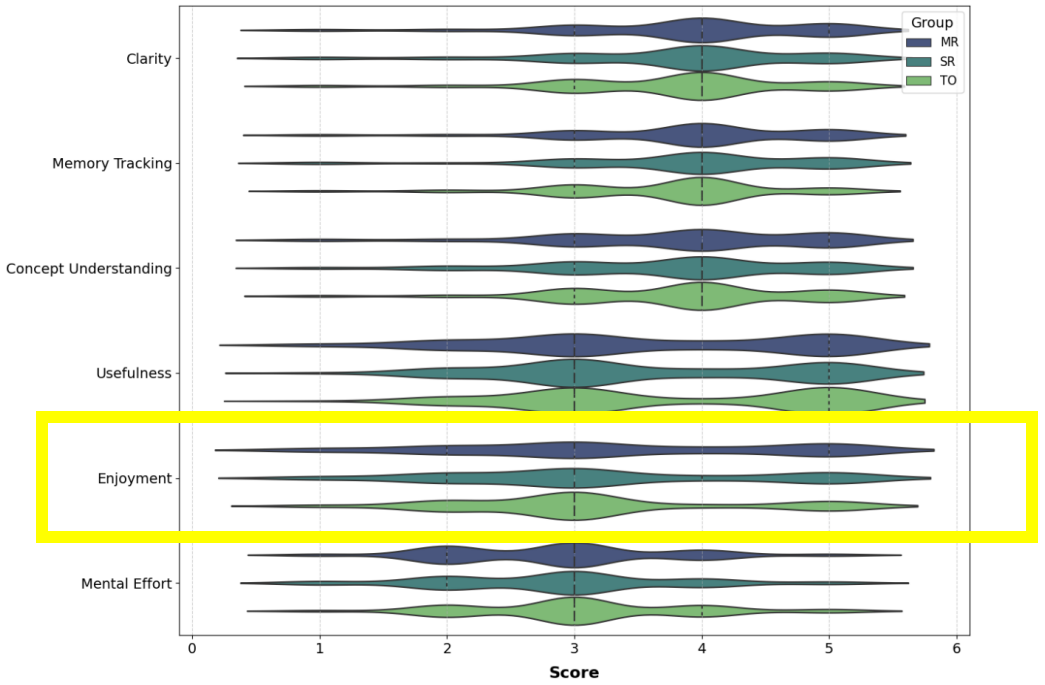

Fig. 3: Differences in final cognitive load and engagement outcomes by representation type. Notes: The x-axis denotes participants' self-reported mental effort on a 7-point scale (1 = very low effort, 7 = very high effort). The y-axis (violin width) indicates the distribution density of responses. We also overlay engagement scores, measured on a 5-point scale (1 = low, 5 = high).

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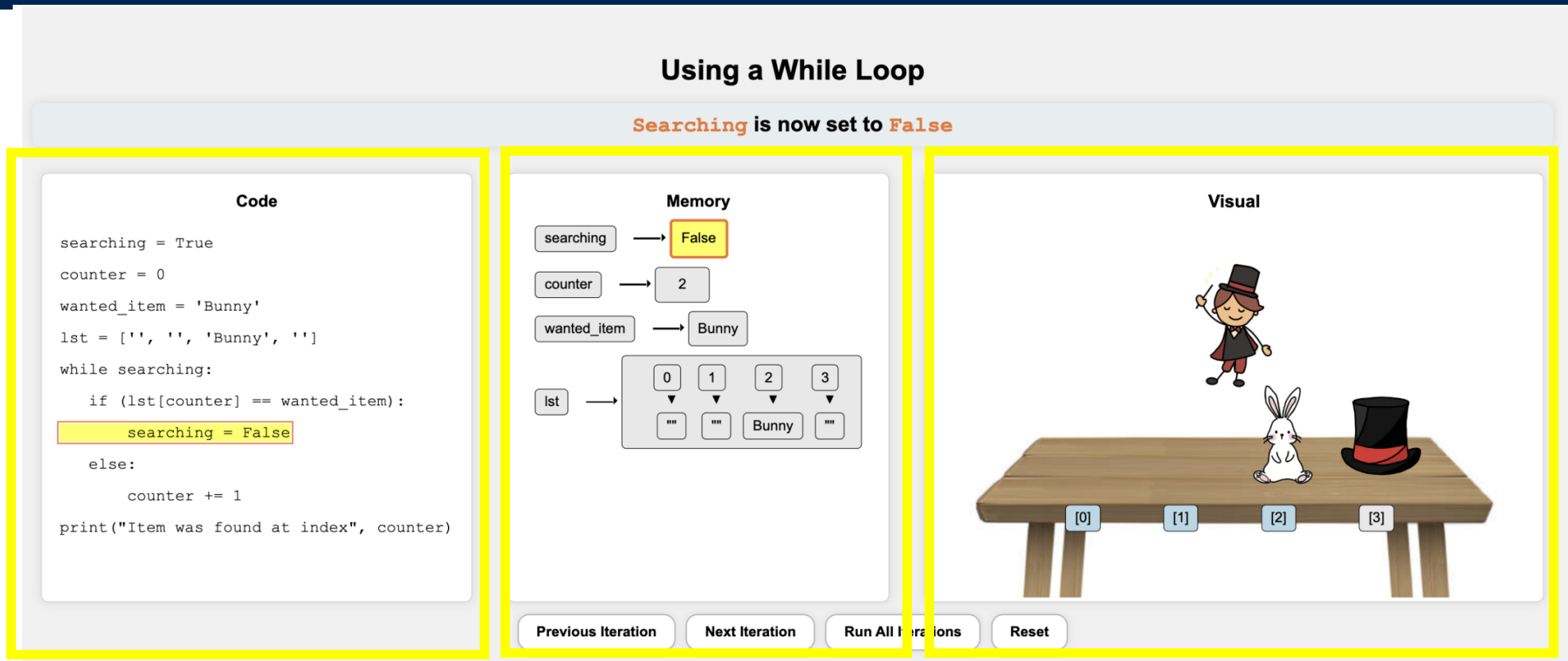

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Study 3: Fairness in Group Formation and Allocation

Systematic Literature Review on how students form groups in Computer Science and related fields

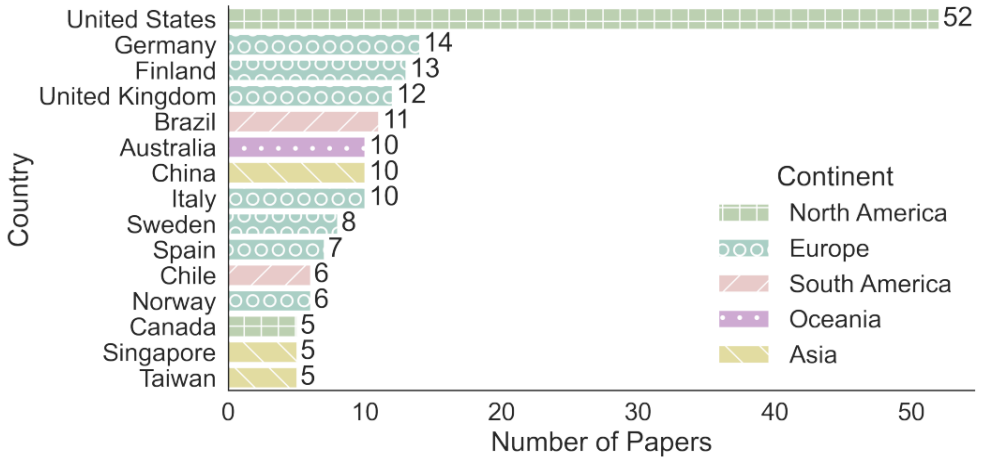
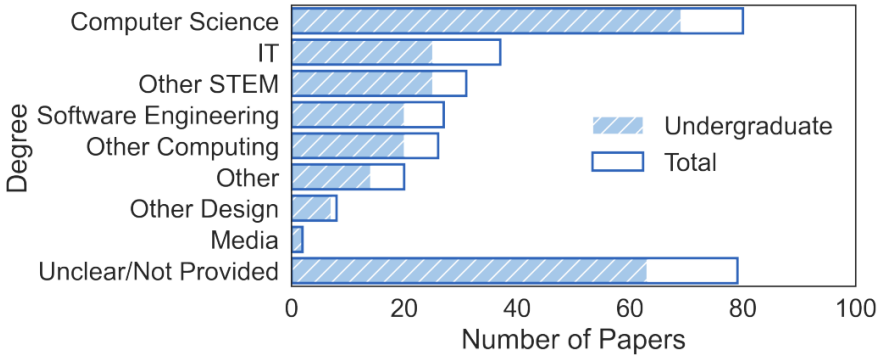


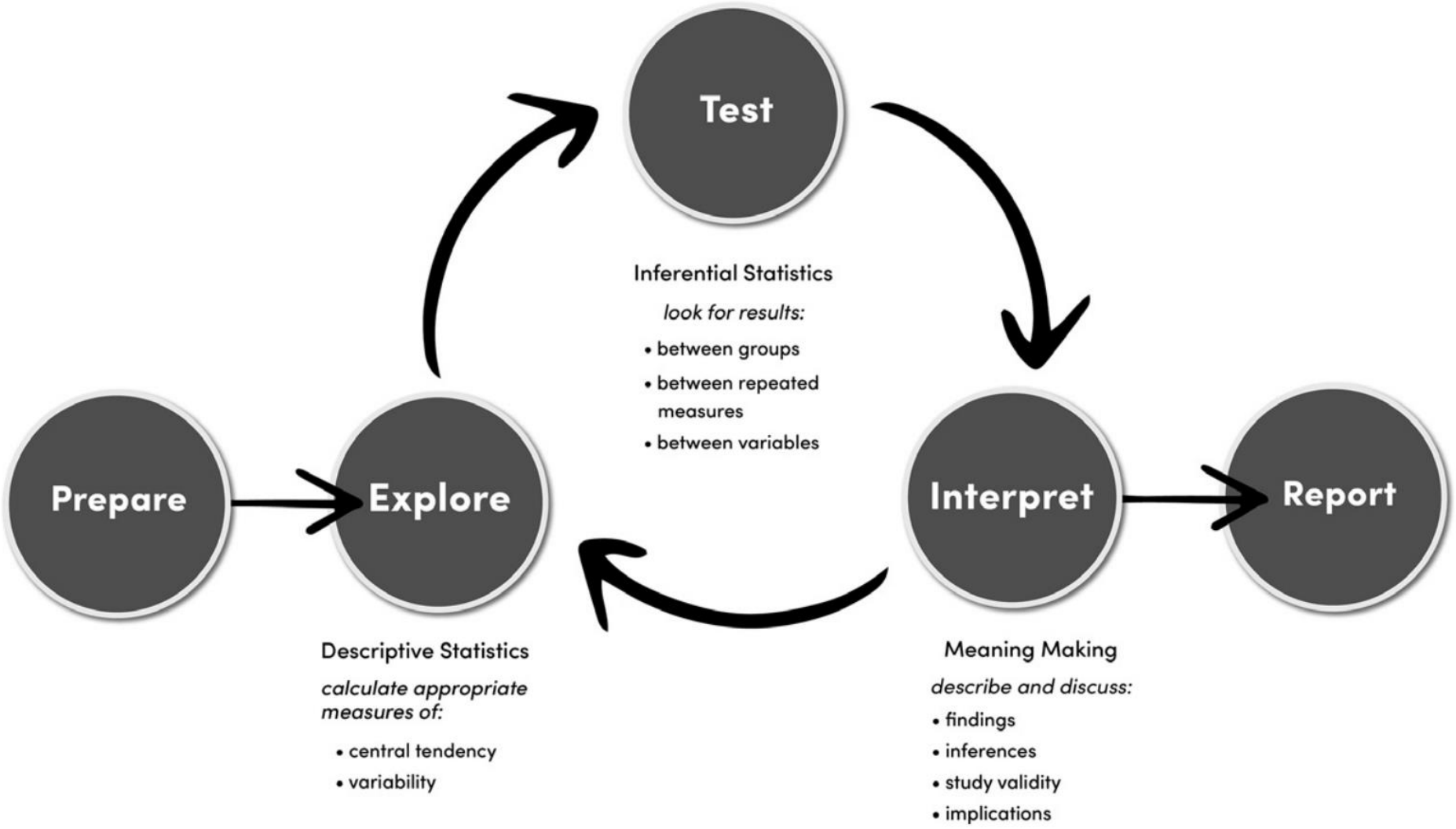
Table 17: Type of student by group size.

Region	Level	Pair	Small	Medium	Large
Europe	Undergraduate	4	29	11	3
	Both	1	19	6	5
	Total	5	48	17	8
North America	Undergraduate	3	30	4	2
	Postgraduate	–	1	–	–
	Both	1	6	1	–
	Total	4	37	5	2
Rest of the World	Undergraduate	1	40	7	3
	Both	3	11	1	2
	Total	4	51	8	5
Total		16	136	30	15



Forshaw, M., Alexandru, C. A., Bentley, C., González-Zelaya, V., Ajanovski, V., Bikanga Ada, M., Brooks, J., Burridge, J., Chao, A., **Engineer, R.**, Glebova, O., Islam, T., Kiyohara, M., Ko, S.-H., Kristbergsson, E. S., Peltsverger, S., Russell, S., Samary, M. M., Steenbergen, M., & Wortmann, C. (2025). Fairness in Student Group Formation: Perspectives, Priorities, Compromises, Mechanisms, and Tooling. *Proceedings of the 2025 Working Group Reports on Innovation and Technology in Computer Science Education*, 217–276. https://doi.org/10.1145/3760545.3783973

Quantitative Analysis



(Yeo et al., 2024)

Limitations of Quantitative Data

- Learning can only be "imperfectly" known, because our measures of learning are not direct, they are indirect
- The analysis of quantitative SoTL data are contingent on the quality of their measurement instruments (validity and reliability)
- SoTL is contextual and so generalizability claims must be carefully considered

Next Session:

Qualitative Research Methods in SoTL

Faculty Co-facilitator:

Prof. Nelesi Rodrigues

Assistant Professor,

Institute for the Study of University Pedagogy University of Toronto, Mississauga

Online on Thursday, May 14th, 2026

11:00 am – 1:00 pm on Microsoft Teams

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Thank you!
Any Questions?

Please feel free to reach out to eddev.utm@utoronto.ca or amanda.brijmohan@utoronto.ca

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Workshop Feedback for the "Scholarship of Teaching & Learning (SoTL) Series 4"

SAGE Surveys

- The SAGE Handbook of Survey Methodology
- http://methods.sagepub.com/book/the-sage-handbook-of-survey-methodology
- *Ch. 16: Designing Questions & Questionnaires

- The SAGE Encyclopedia of Social Science Research Methods https://methods.sagepub.com/reference/the-sage-encyclopedia-of-social-science-research-methods

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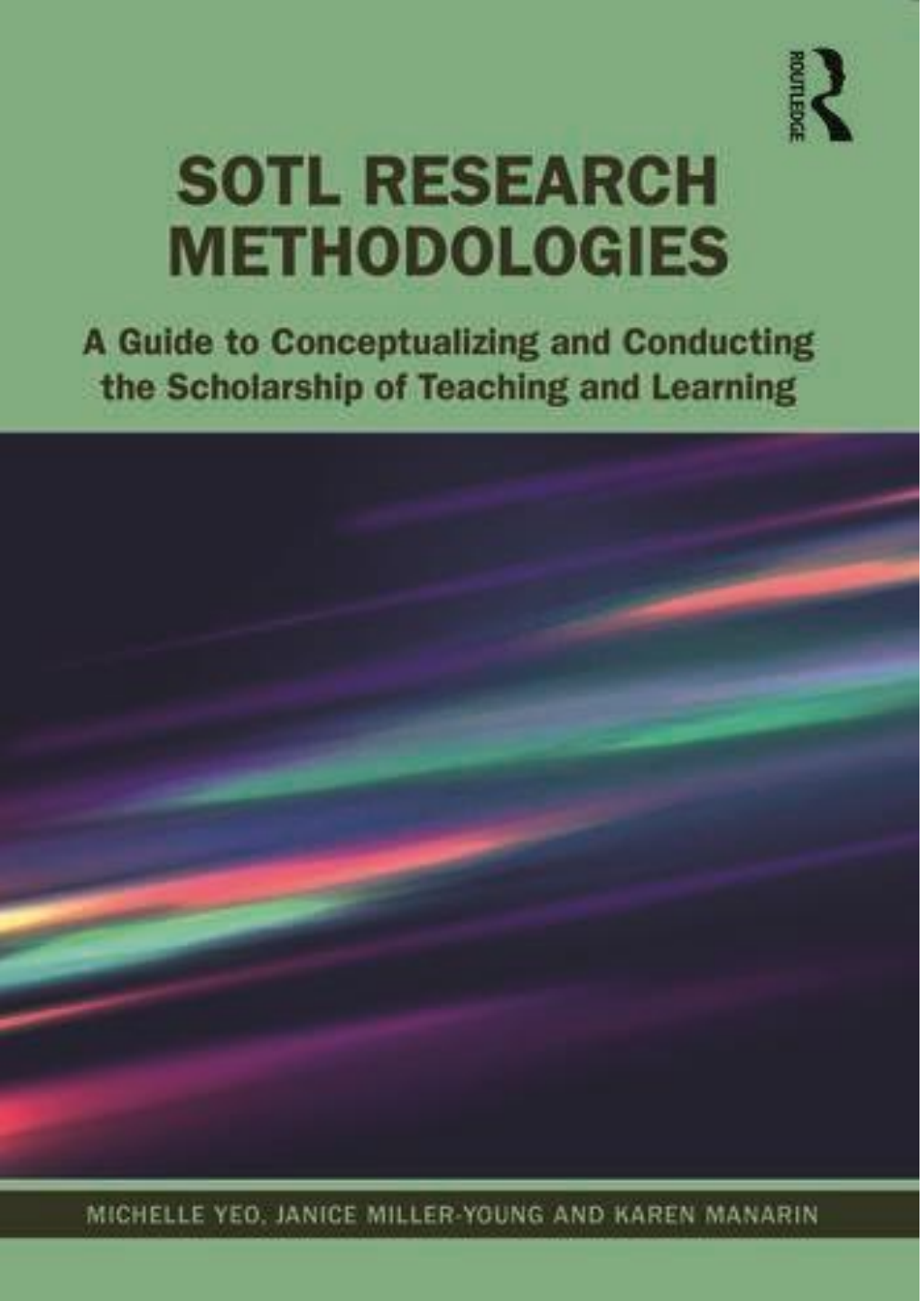

- Available through U of T libraries at this link
- Yeo, M., Miller-Young, J., & Manarin, K. (2024). *SoTL Research Methodologies: A Guide to Conceptualizing and Conducting the Scholarship of Teaching and Learning*. Routledge.