

Disparity Between Textbook Examples and What Young Students Find Interesting

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Motivation

- Teaching goal: Easier for students to understand programming materials
 - Increased interest in coding literacy
 - Diverse student backgrounds
 - Rapidly changing technology contexts
- Thought: More relatable contexts should make it easier and interesting for learners
 - Less cognitive load for learners
 - More engaged during class



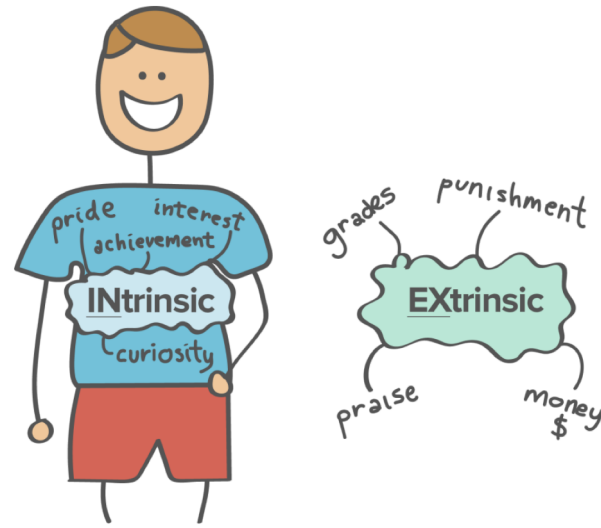
Related Literature

- Intrinsic motivation
- Interest-based learning
- Java textbooks studies

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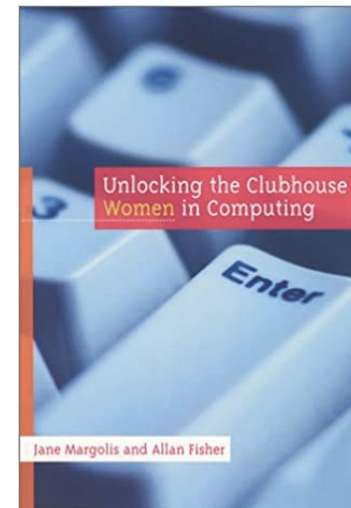
- Intrinsic motivation
 - Self-Determination Theory
 - Conflicting results on academic performance where studies mostly used cross-sectional designs
 - Longitudinal studies in Taylor et al. (2014) show strong positive relationship between intrinsic motivation and academic performance
 - Werner & Girnat (2020) found strongest association between practical aspect of computing with intrinsic motivation for highschoolers

- Interest-based learning
- Java textbooks studies



Related Literature

- Intrinsic motivation
- Interest-based learning
 - Long history to propose interesting programming exercises
 - SIGCSE started gathering Nifty Assignments in 1999
 - Studies that target specific student populations:
 - Women (Fisher & Margolis 2002; Alvarado & Dodds 2010), non-majors (Forte & Guzdial 2005)
 - Real world technology use, interdisciplinary, diverse contexts
- Java textbooks studies



Related Literature

- Intrinsic motivation
- Interest-based learning
- Java textbooks studies
 - Few studies analyze textbook content and comparisons, usually across programming languages
 - Textbook selection method somewhat arbitrary
 - We have 0 to 3 overlaps with these texts
 - A recent study polled textbook preferences from CS education community and best seller lists on Amazon and Barnes & Noble
 - We have 6 overlaps with these texts

Research Questions

1. What topics are used in CS1 textbooks?
2. What topics are students interested in?
3. How much overlap is there between these two sets of topics?

Our Approach

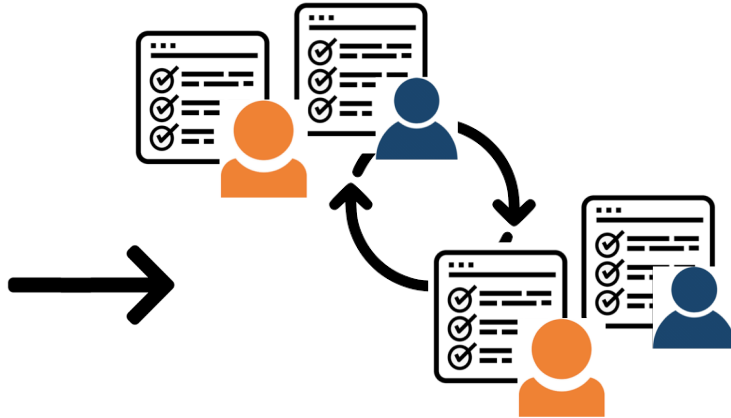


CS1 Textbooks

Our Approach

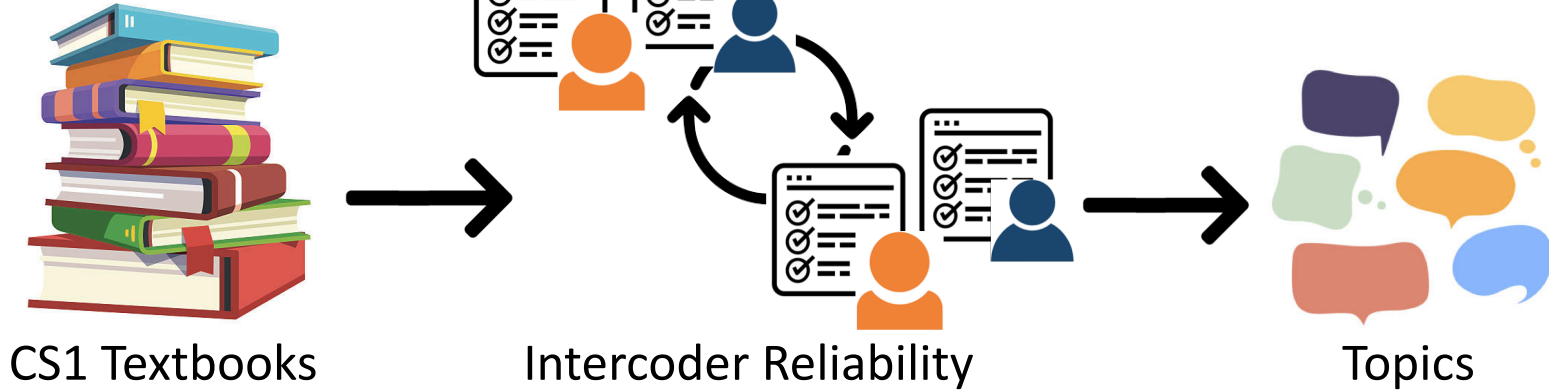


CS1 Textbooks

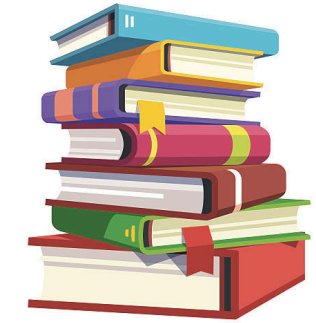


Intercoder Reliability

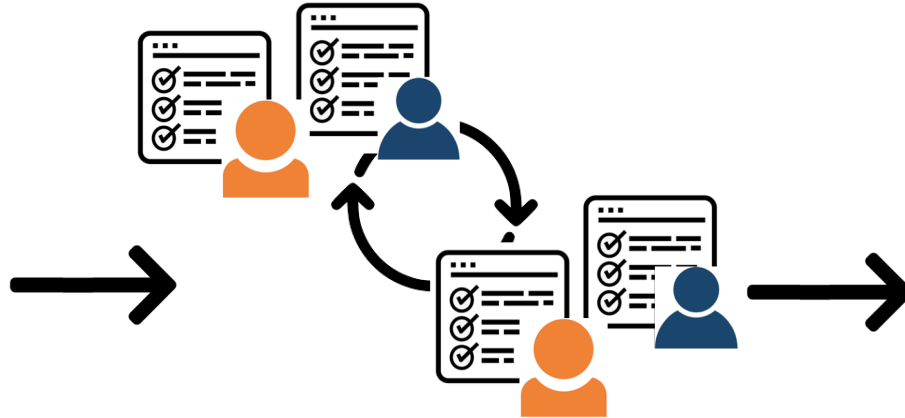
Our Approach



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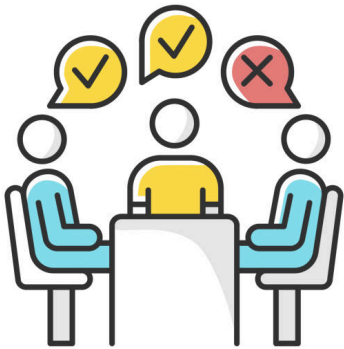


CS1 Textbooks

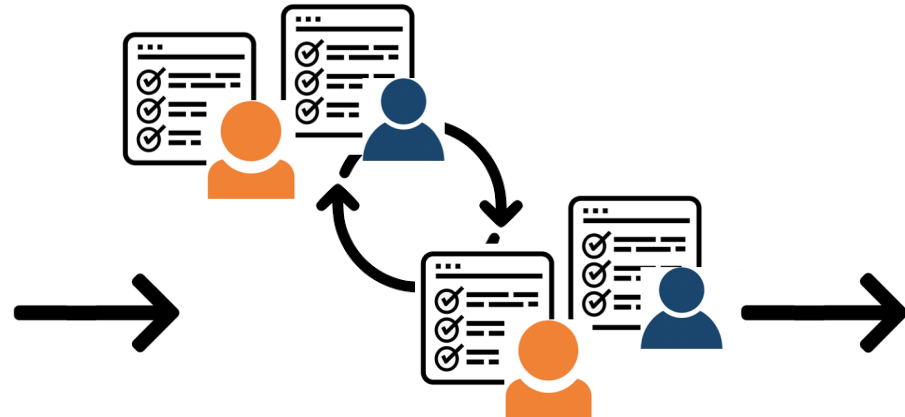


Intercoder Reliability

Topics



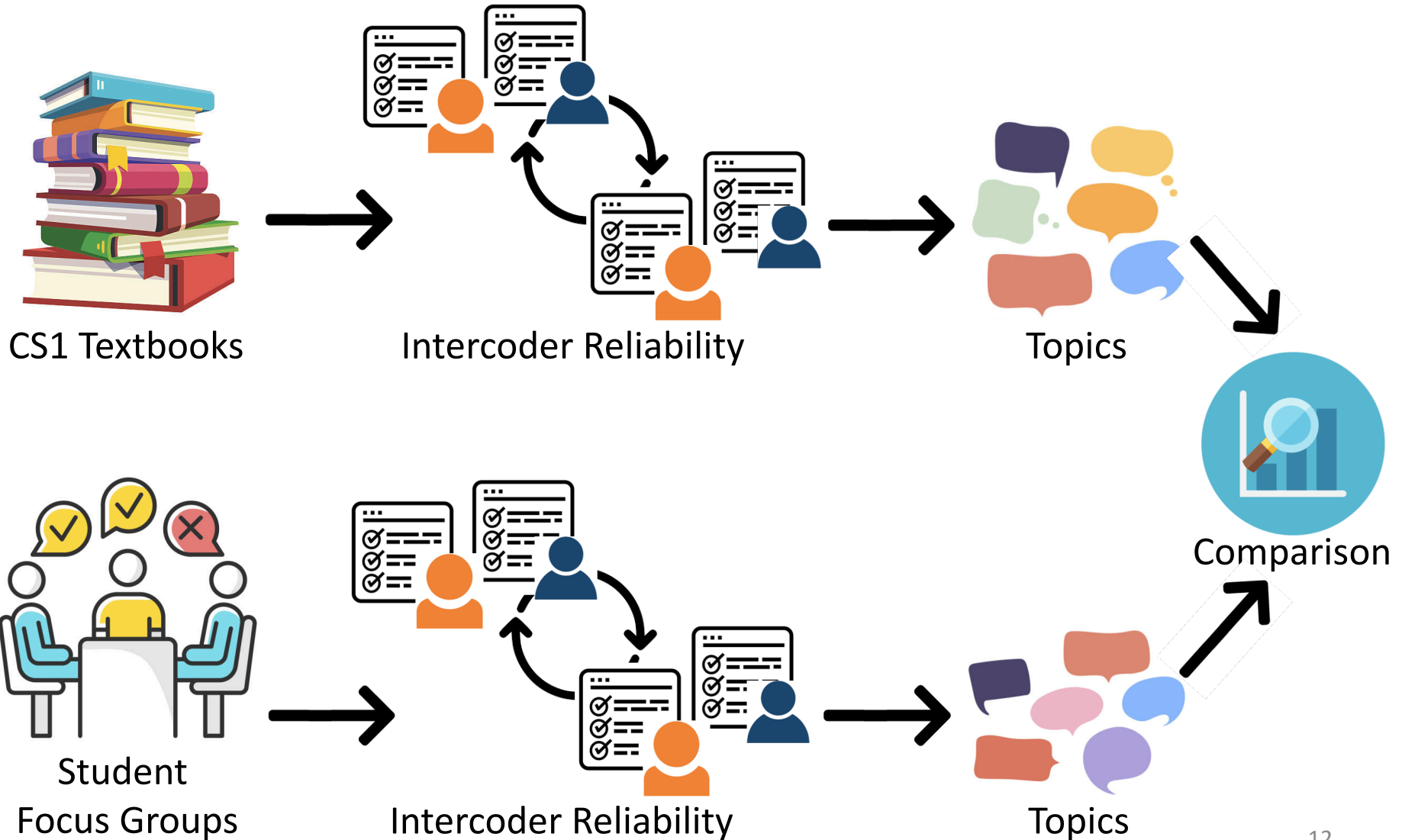
Student
Focus Groups



Intercoder Reliability

Topics

Our Approach



Textbook Analysis

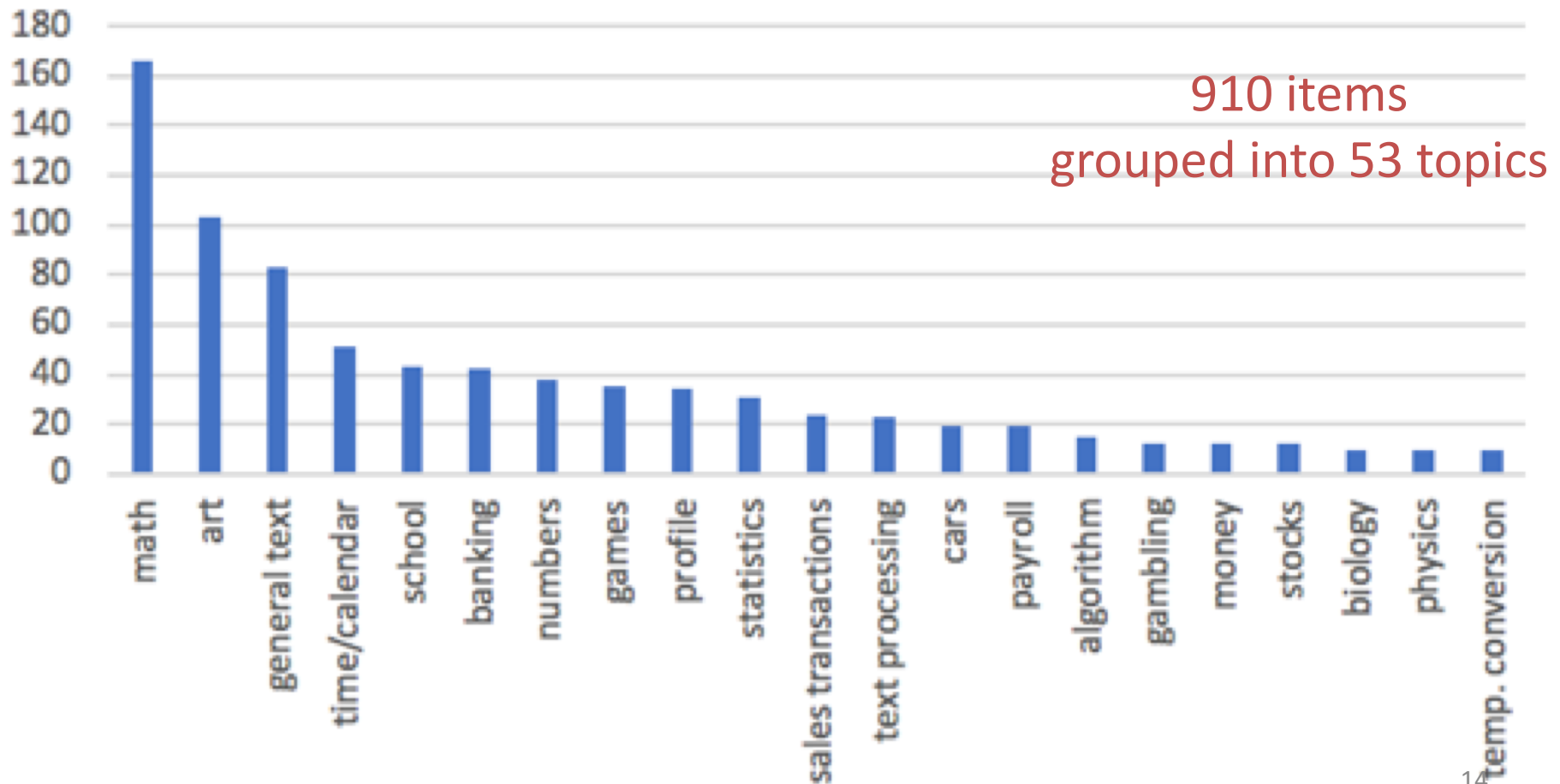


- Online syllabus tool to identify textbooks in CS1 courses (Becker & Fitzpatrick 2019)
 - North American universities that teach Java (Canada: 4, USA: 38)
 - Identified 12 unique & public Java textbooks
- Chapter topics:
 - Variables/statements, conditionals, loops, predefined classes, methods, arrays, objects/classes
- Categorized all coding examples in these chapters
 - Intercoder reliability: 85% agreement on 10% of examples

Results: Textbook Analysis



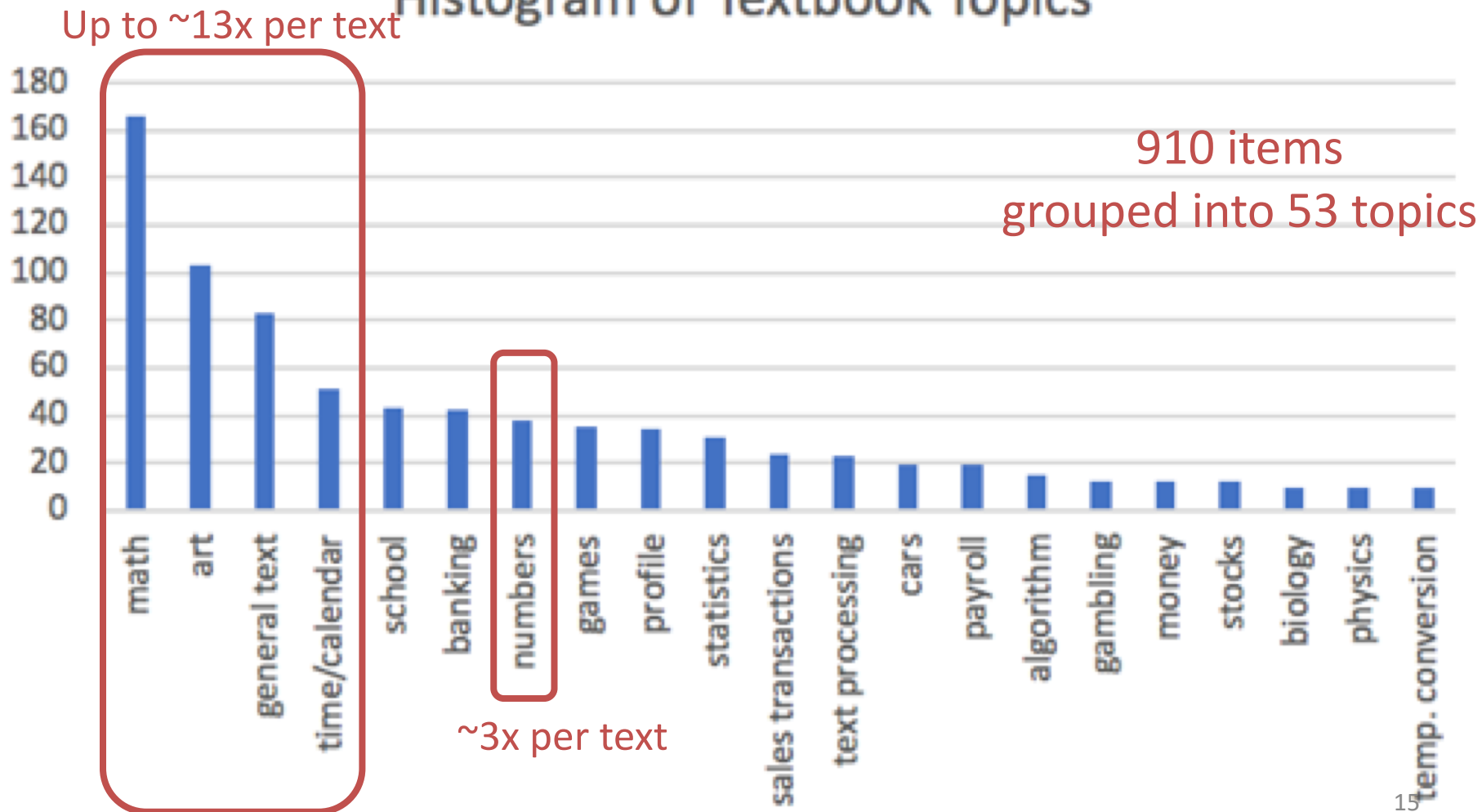
Histogram of Textbook Topics



Results: Textbook Analysis



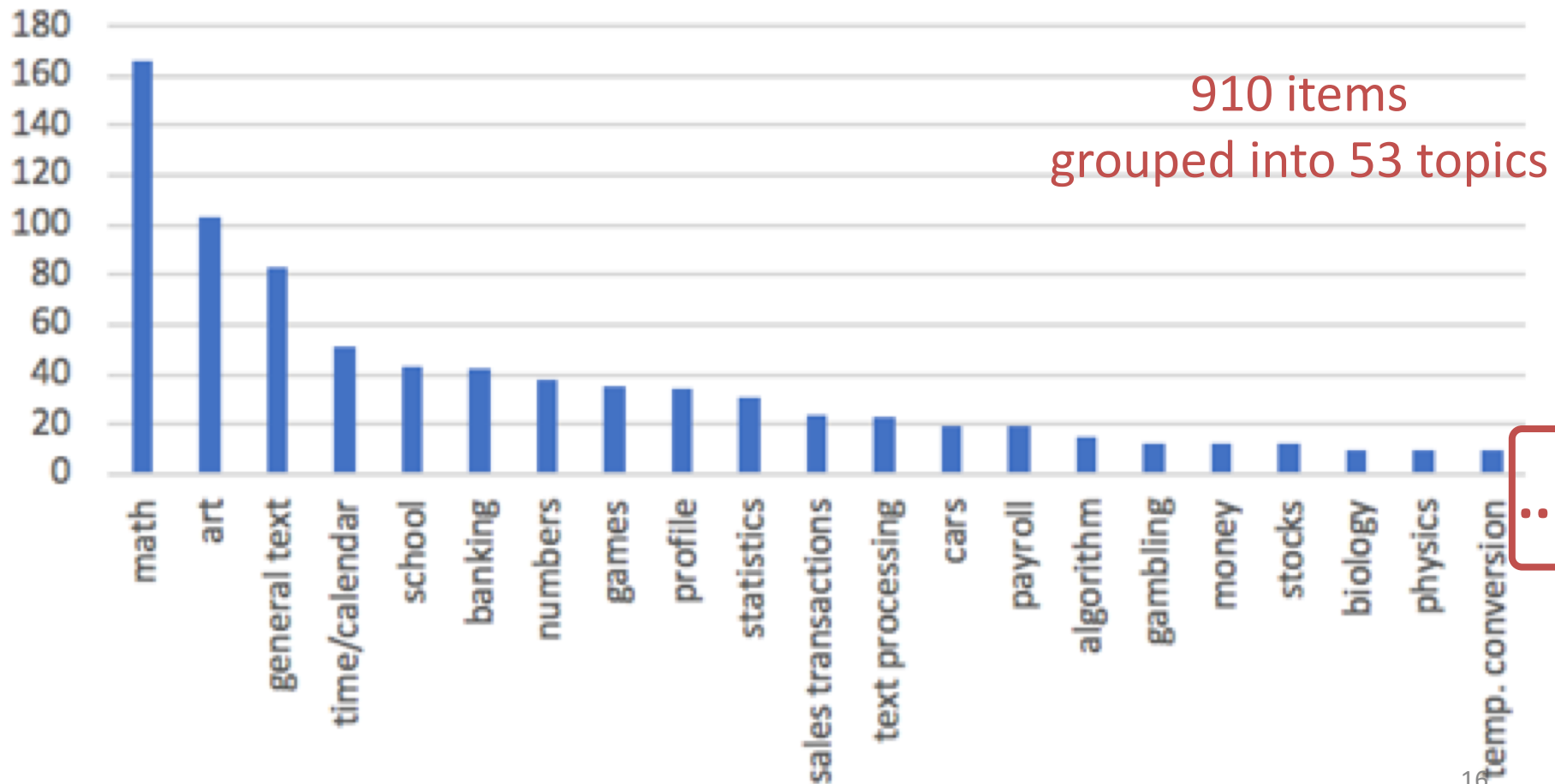
Histogram of Textbook Topics



Results: Textbook Analysis



Histogram of Textbook Topics



Student Focus Groups

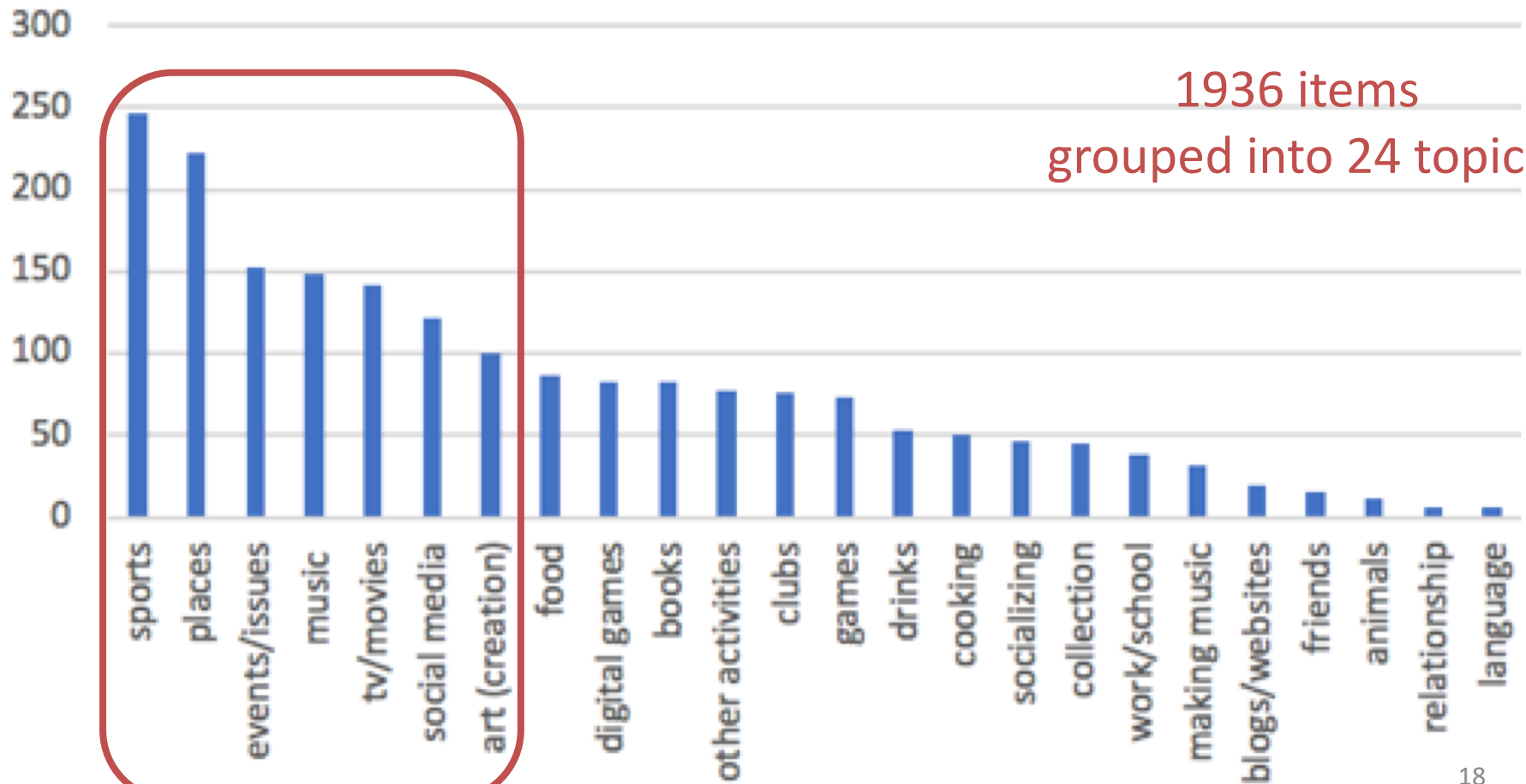


- Volunteer sampling of students
 - 6 one-hour sessions with 26 participants
 - Demographics:
 - 18 males, 8 females
 - 69% post-millennials
 - 85% upper-level undergraduate
 - 41% CS majors
- Responses to 27 open-ended questions
 - Brainstormed sticky notes individually
 - Shared, categorized, aggregated
- Categorized all sticky notes
 - Intercoder reliability: 92% agreement on all the data

Results: Student Groups



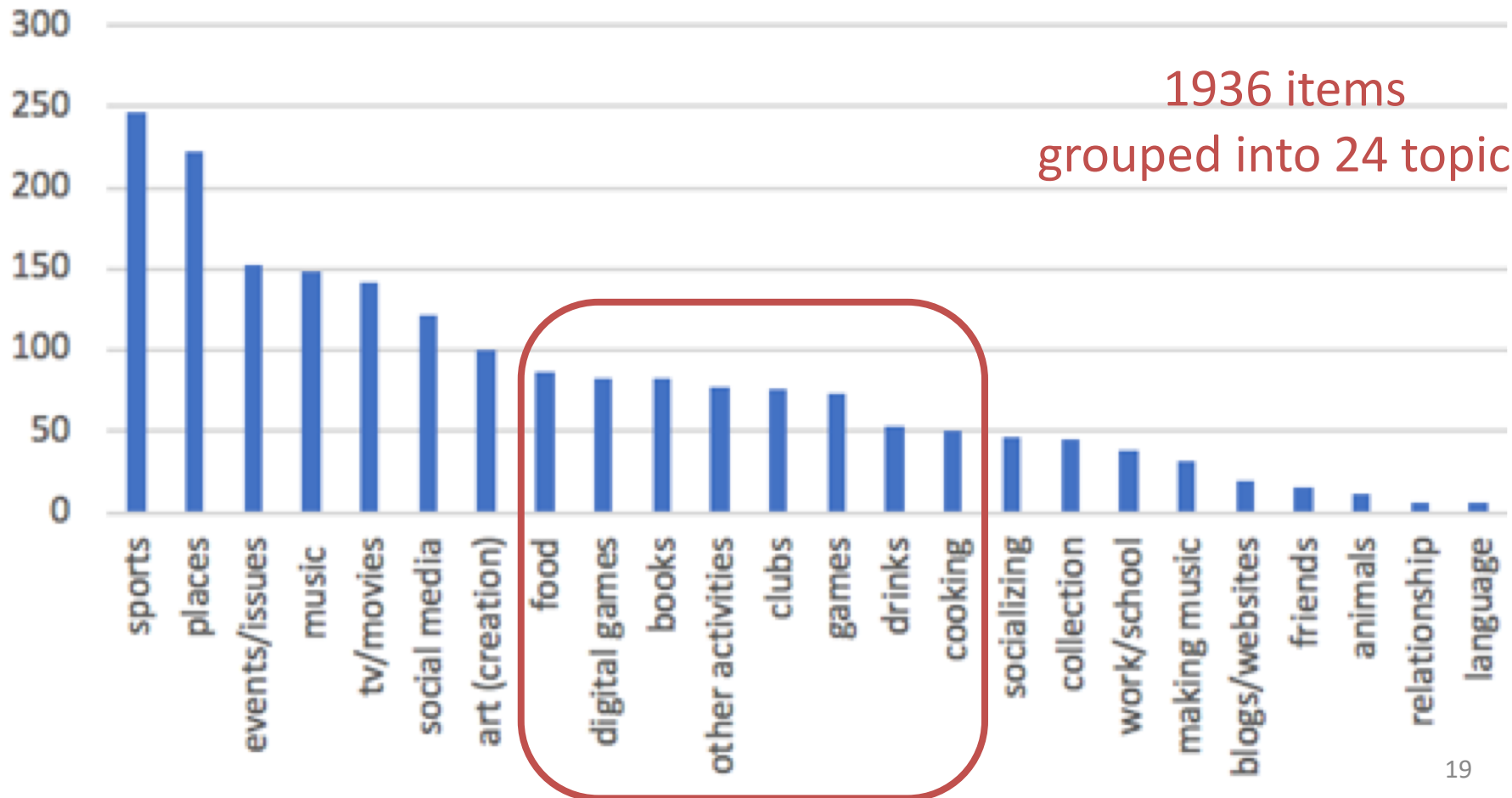
Histogram of Focus Group Topics



Results: Student Groups



Histogram of Focus Group Topics



Overlap Comparison



- Many topics were identical or somewhat overlapped
- No coverage from any textbook:
 - Social media, digital games, drinks, cooking, socializing, making music, relationships
 - 7/24 of the topics (29%)
 - 295/1936 of the items (15%)
- No mention from any student:
 - General text, time/calendar, banking, numbers, profile, statistics, sales transaction, text processing, cars, payroll, algorithm, money, stocks, temp. conversion, file utility, house, colors, astronomy, encryption, survey, astrology, game theory, weather, wedding
 - 23/53 of the topics (47%)
 - 457/910 of the items (50%)

Overlap Comparison



- E.g., Consider the Math topic
 - Covers 18% of all the textbook examples
 - But only 0.05% of the student data
- Measure overlaps between two statistical samples
 - **Bhattacharyya coefficient** ranges in [0,1]
 - Formula for discrete distributions:
$$BC(p, q) = \sum_{x \in X} \sqrt{p(x)q(x)}$$
 - Result = 0.4452, a strong difference between the two sets

Summary

- To answer research questions:
 - Examined topics used in CS1 textbooks
 - Contrasted those to student interests
 - Rare textbook topics touches on student interest
 - Common textbook topics were never mentioned (50%)
 - Still 1/3 student topics (15%) not covered by any text
- Results are limited by representativeness
- Paper provided some pedagogical examples
- Ultimate goal to inspire other educators