OCTOBER 2018

TEXAS
The University of Texas at Austin

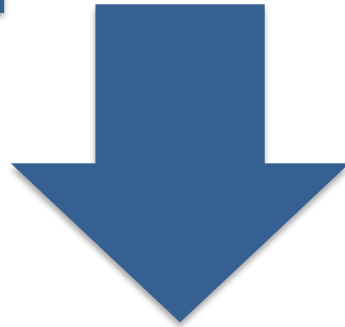# WHAT ENGINEERING INSTRUCTORS CAN DO TO REDUCE STUDENT RESISTANCE TO ACTIVE LEARNING

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Active Learning Usage in STEM

Research: Empirical research shows improvement in student learning, engagement, & interest

Adoption: STEM faculty are slow to adopt in their courses

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410-8415.

J. Froyd, M. Borrego, S. Cutler, M. Prince and C. Henderson, Estimates of Use of Research-Based Instructional Strategies in Core Electrical or Computer Engineering Courses, *IEEE Transactions on Education, 56*(4), 2013, pp. 393–399.
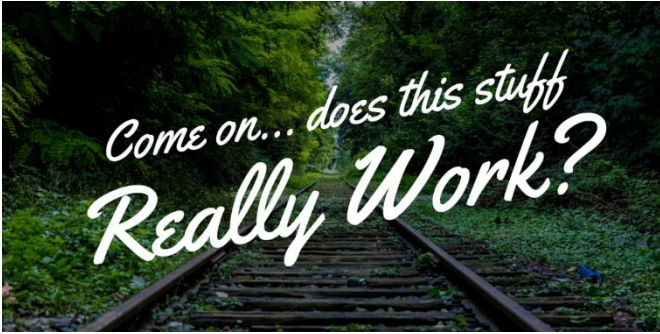
Discontinued Use of Active Learning
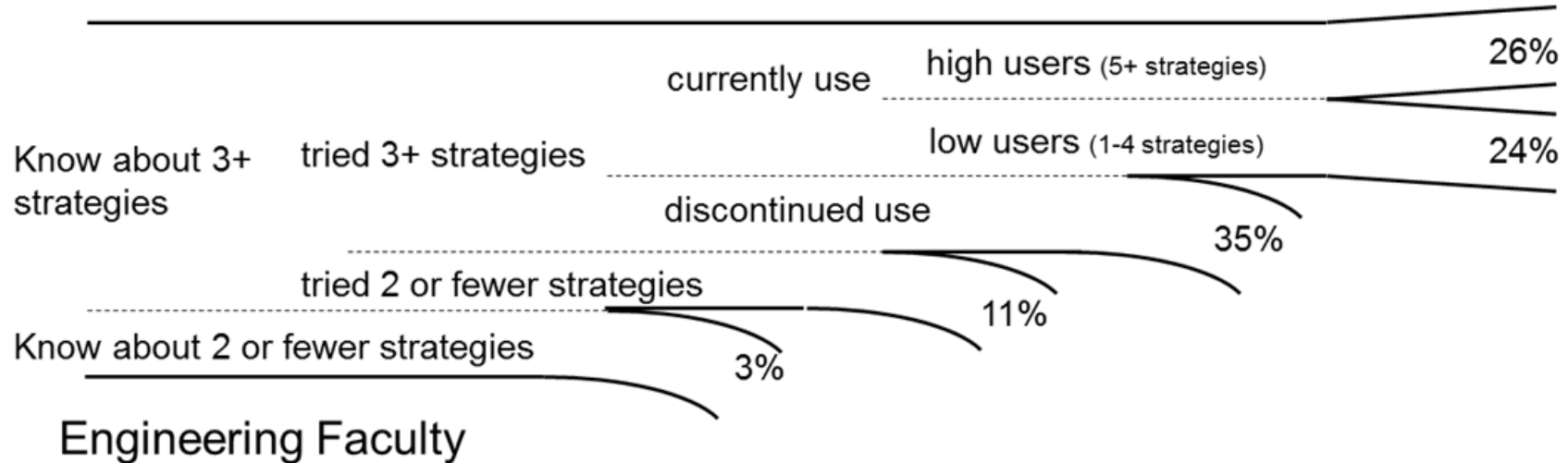
J. Froyd, M. Borrego, S. Cutler, M. Prince and C. Henderson, *Estimates of Use of Research-Based Instructional Strategies in Core Electrical or Computer Engineering Courses, IEEE Transactions on Education, 56(4), 2013, pp. 393–399.*

Barriers to Instructional Change

What ways could students show resistance to active learning in your classrooms?

Types of Student Resistance

Rush through the activity

Doing some-thing else
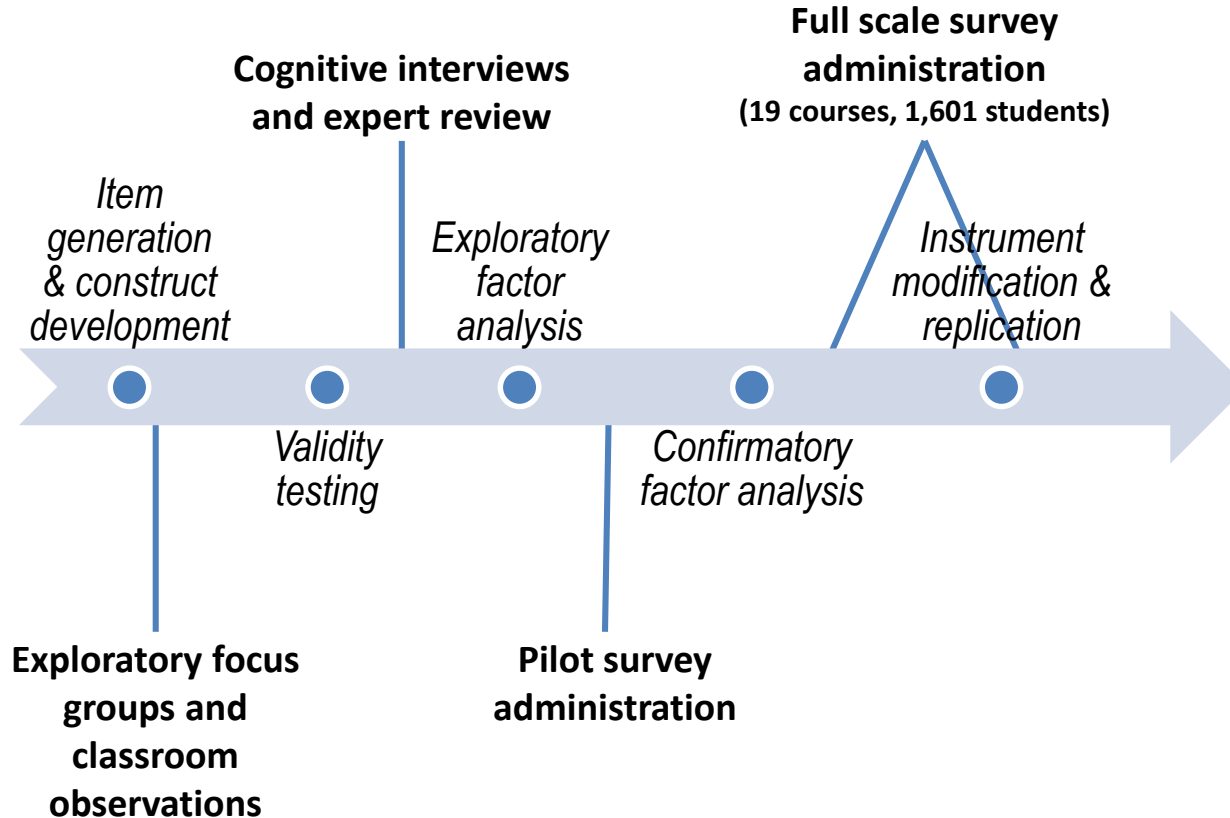
Vocal resist-ance*

Sit & talk about something else
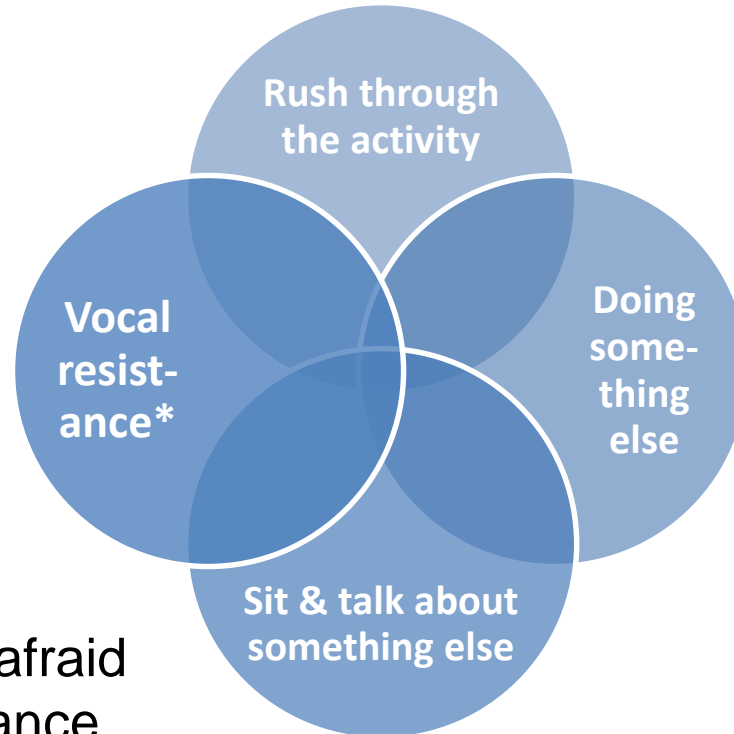
*Instructors are most afraid of public, vocal resistance

How do you measure resistance?

- No existing measurements available

- Creation of the Student Responses to Instructional Practices (StRIP) survey

- Implemented at the end of the semester

StRIP survey: Instrument development

Full scale survey administration
(19 courses, 1,601 students)

Cognitive interviews and expert review

Item generation & construct development

Exploratory factor analysis

Instrument modification & replication

Validity testing

Confirmatory factor analysis

Exploratory focus groups and classroom observations

Pilot survey administration

Creation of StRIP

- Observations in classrooms
  - How the instructor introduces active learning to students
  - How the instructor addresses student questions and concerns about the methods
  - Use of specific recommended strategies to reduce student resistance (faculty participation)
  - Evidence of three types of student resistance (student engagement)

Creation of StRIP

- Student focus groups (2 rounds)
  - Describe a typical engineering or science course to me. If I was sitting in the back of the room, what would I see?
  - Have you ever had a science or engineering course where your instructor tried to do something different? Tell me what they tried.

Validation: students have been asked to work together in groups, who is engaged/disengaged from the activity?

2. In this course, when the instructor asked you to do in-class, non-lecture activities (e.g., solve problems in a group during class or discuss concepts with classmates), how often did you react in the following ways?

	Almost never (<10% of the time)	Seldom (~30% of the time)	Sometimes (~50% of the time)	Often (~70% of the time)	Very often (>90% of the time)
a. I disliked the activities.	①	②	③	④	⑤
b. I did not actually participate in the activities.	①	②	③	④	⑤
c. I gave the activities minimal effort.	①	②	③	④	⑤
d. I felt positively towards the instructor because of the activities.	①	②	③	④	⑤
e. I tried my hardest to do a good job with the activities.	①	②	③	④	⑤
f. I distracted my peers during the activities.	①	②	③	④	⑤
g. I pretended to participate in the activities.	①	②	③	④	⑤
h. I felt the effort it took to do the activities was worthwhile.	①	②	③	④	⑤
i. I participated actively (or attempted to) in the activities.	①	②	③	④	⑤
j. I talked with classmates about other topics besides the activities.	①	②	③	④	⑤
k. I felt the instructor had my best interests in mind when asking me to do the activities.	①	②	③	④	⑤
l. I saw the value in the activities.	①	②	③	④	⑤
m. I felt the time used for the activities was beneficial.	①	②	③	④	⑤
n. I enjoyed the activities.	①	②	③	④	⑤
o. I surfed the internet, checked social media, or did something else instead of doing the activities.	①	②	③	④	⑤
p. I voiced my objections about the activities so the instructor could hear.	①	②	③	④	⑤
q. I rushed through the activities.	①	②	③	④	⑤
r. I planned to give the instructor a lower course evaluation because of the activities.	①	②	③	④	⑤
s. I complained to other students about the activities.	①	②	③	④	⑤

What are the things that may influence whether students resist active learning?

3. In this course, when the instructor asked you to do in-class, non-lecture activities (e.g., solve problems in a group during class or discuss concepts with classmates), how often did the instructor do the following things?

	Almost never (<10% of the time)	Seldom (~30% of the time)	Sometimes (~50% of the time)	Often (~70% of the time)	Very often (>90% of the time)
a. Clearly explained what I was expected to do for the activities.	①	②	③	④	⑤
b. Clearly explained the purpose of the activities.	①	②	③	④	⑤
c. Discussed how the activities related to my learning.	①	②	③	④	⑤
d. Solicited my feedback or that of other students about the activities.	①	②	③	④	⑤
e. Used activities that were the right difficulty level (not too easy, not too difficult).	①	②	③	④	⑤
f. Walked around the room to assist me or my group with the activities, if needed.	①	②	③	④	⑤
g. Encouraged students to engage with the activities through his/her demeanor.	①	②	③	④	⑤
h. Gave me an appropriate amount of time to engage with the activities.	①	②	③	④	⑤
i. Confronted students who were not participating in the activities.	①	②	③	④	⑤
j. Invited students to ask questions about the activities.	①	②	③	④	⑤

Research Findings

- Students **rarely resist in openly confrontational** ways
  - More likely to work on something else
- Measure SR in terms of three outcomes:
  - Participation
  - Distraction
  - Overall evaluation of instructor and course
- Instructor use of **strategies** to reduce student resistance was **most significant predictor** of student resistance
  - Gender of student or instructor, student expected grade, type of instruction, and class size were not significant

What types of Instructor Strategies?

Explanation
- Clearly explain purpose of the activities
- Discuss how activities relate to student learning
- Clearly explain what students are expected to do for activities

Facilitation
- Walk around the room to assist students with the activity
- Solicit student feedback about activities
- Encourage students to engage with activities through demeanor
- Develop a routine
- Deliberately design activities for engagement

- Students recall explanation strategies more frequently
- Facilitation strategies most influential in reducing resistance

Tharayil, S., Borrego, M., Prince, M., Nguyen, K. A., Shekhar, P., Finelli, C. J., & Waters, C. (2018). Strategies to mitigate student resistance to active learning. *International Journal of STEM Education*, *5*(1), 7.
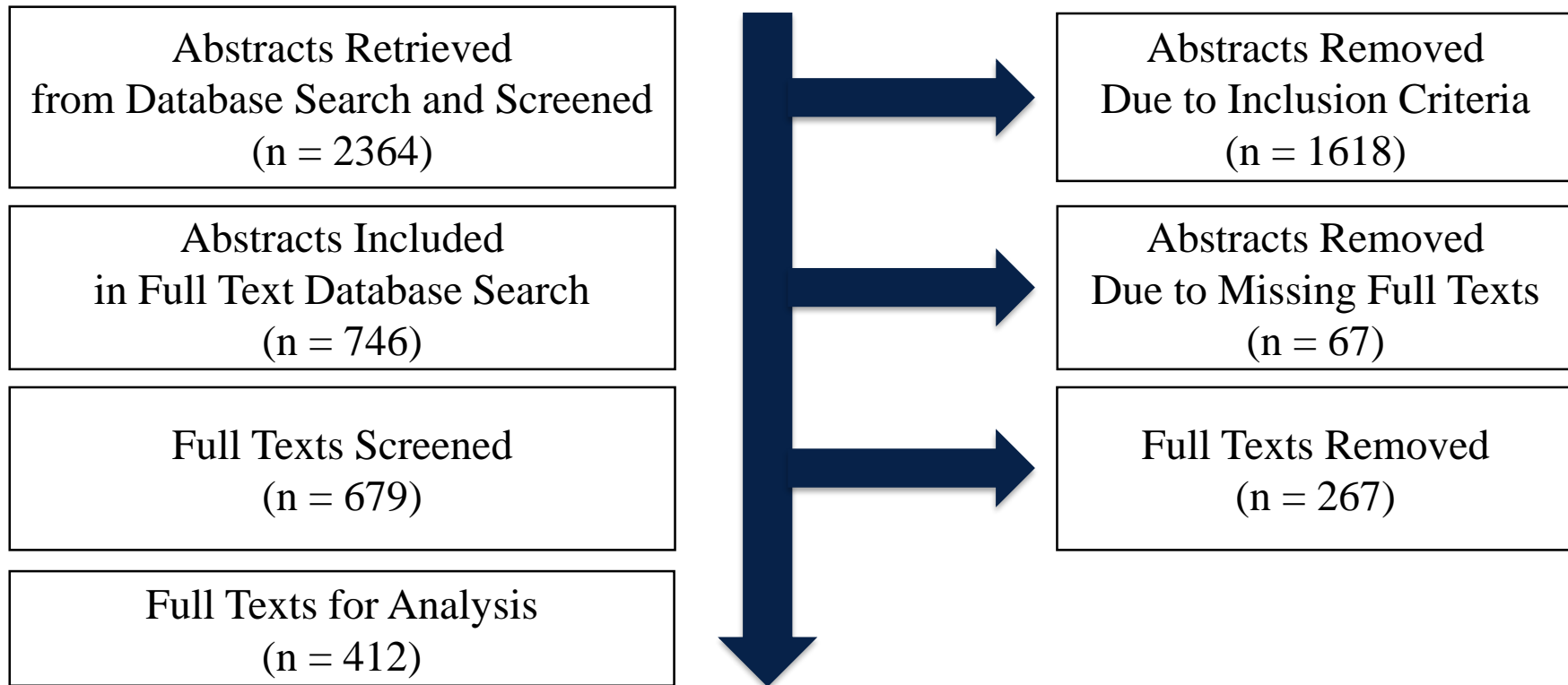
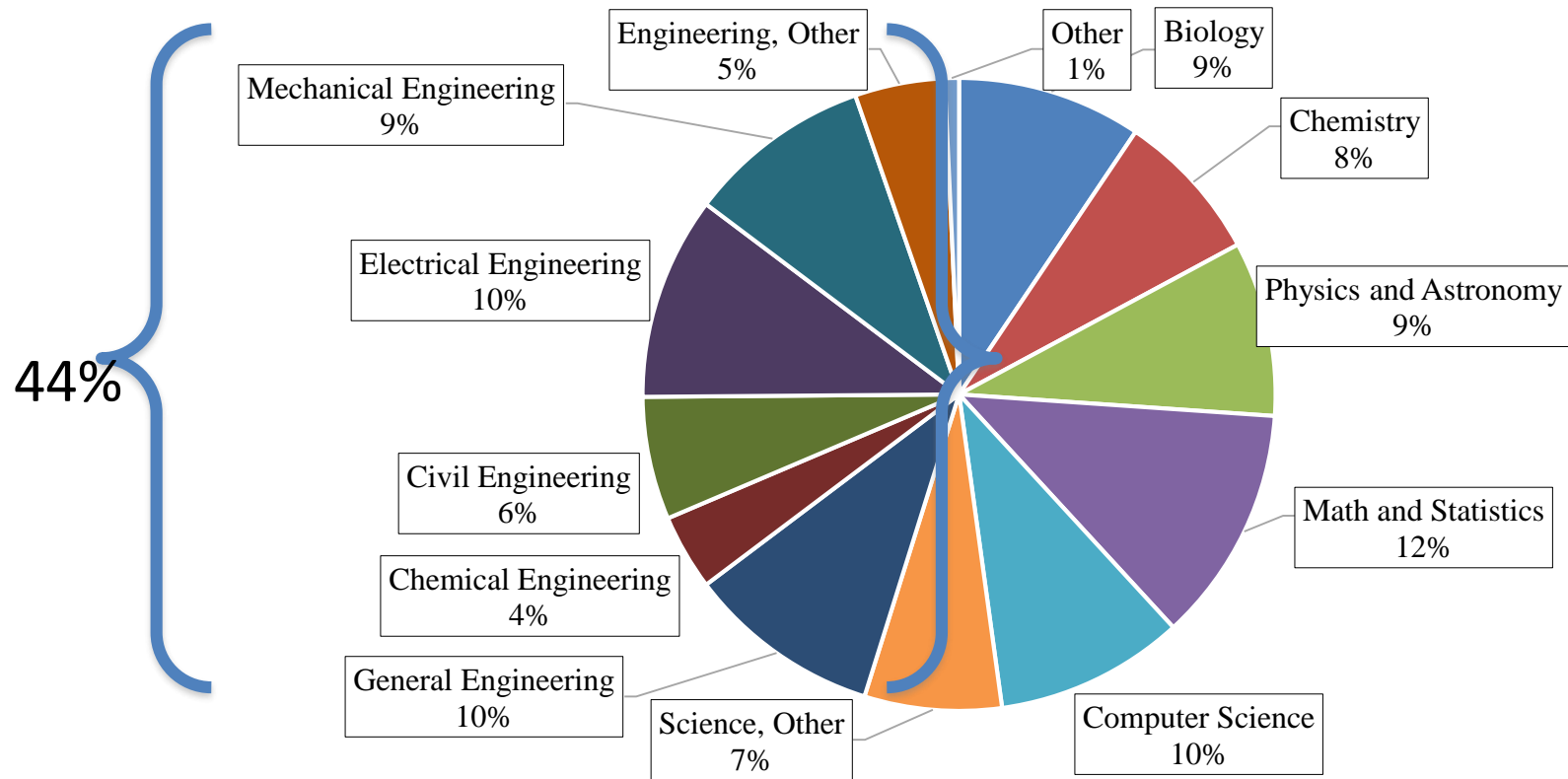# Systematic Review of the Literature

Inclusion criteria

- Describes an active learning intervention
- Includes some empirical evidence of ***affective student reaction*** to that active learning intervention
- In an undergraduate STEM education course
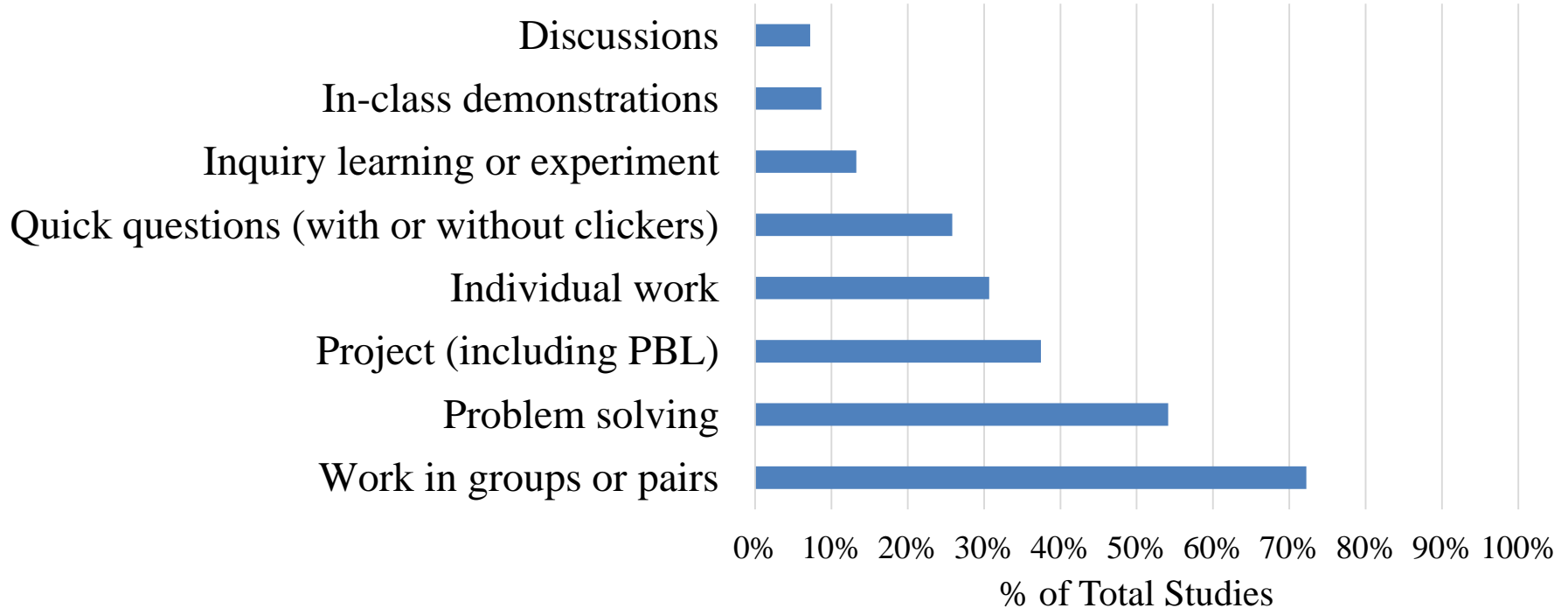- Published as a journal article or conference paper in English from 1990-2015
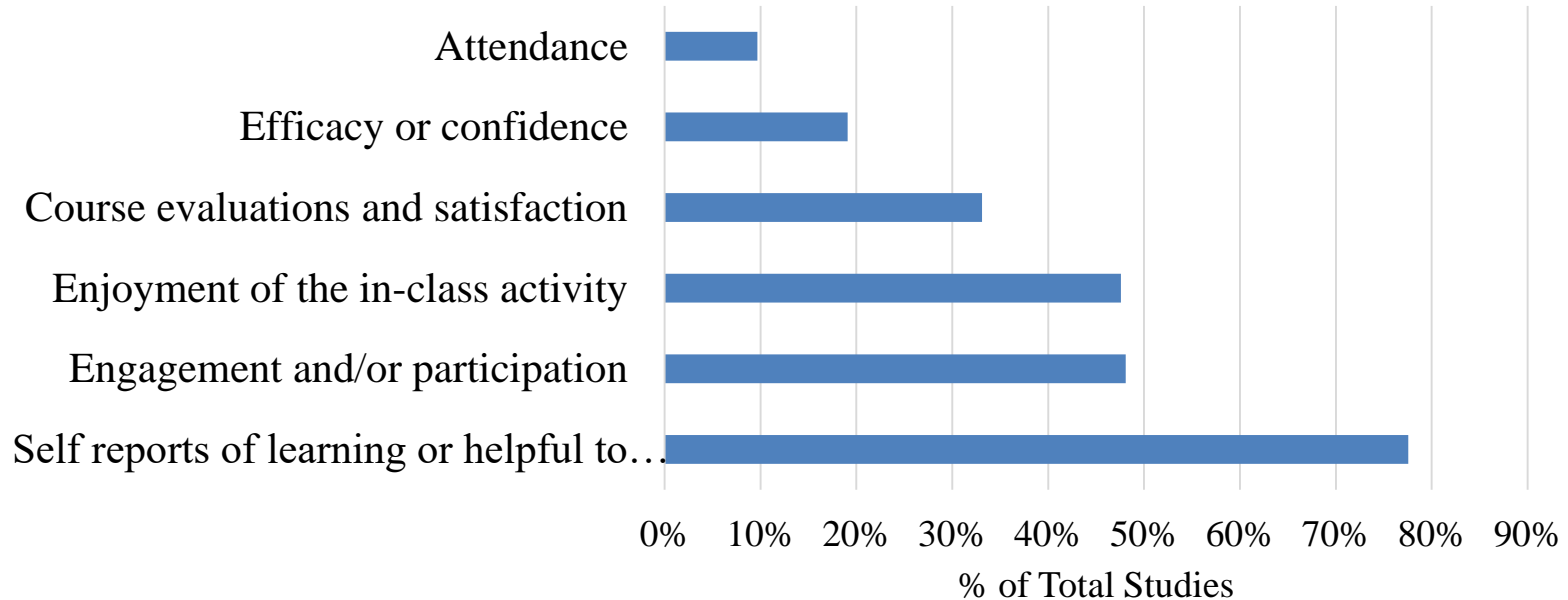
Systematic Review Methodology

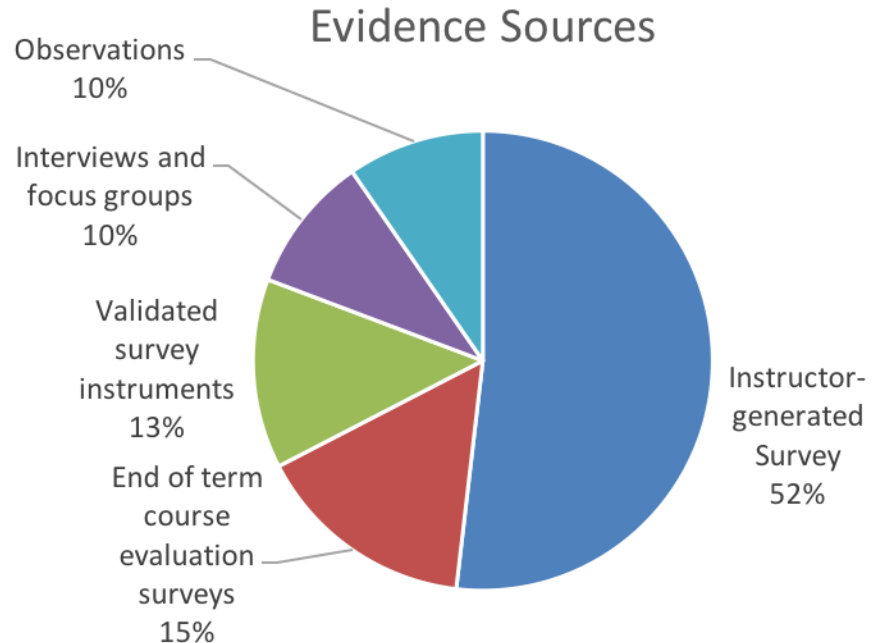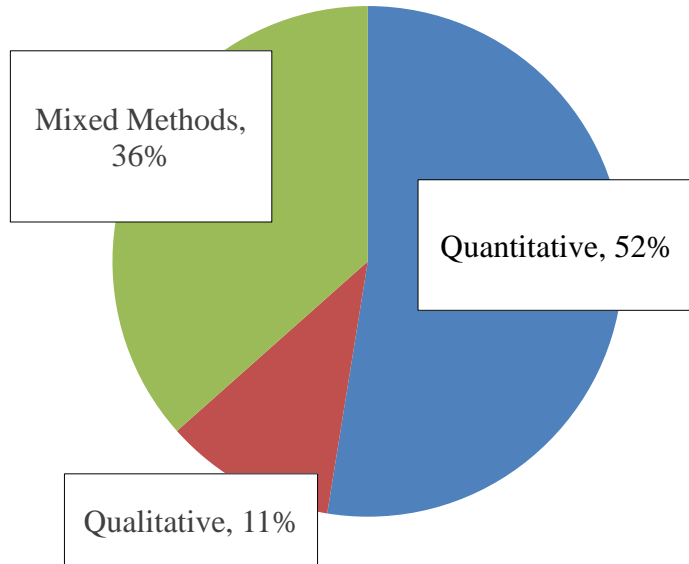|		
Abstracts Retrieved from Database Search and Screened (n = 2364)	→	Abstracts Removed Due to Inclusion Criteria (n = 1618)
Abstracts Included in Full Text Database Search (n = 746)	→	Abstracts Removed Due to Missing Full Texts (n = 67)
Full Texts Screened (n = 679)	→	Full Texts Removed (n = 267)
Full Texts for Analysis (n = 412)		

STEM Disciplines

44%

What affective responses are used to evaluate the effectiveness of active learning?

What evidence is used to measure these students' affective responses to active learning?

Mixed Methods, 36%

Quantitative, 52%

Qualitative, 11%

Evidence Sources

Observations 10%

Interviews and focus groups 10%

Validated survey instruments 13%

End of term course evaluation surveys 15%

Instructor-generated Survey 52%

How are contextual features of a course connected with positive or negative student affective responses?

Affective Response to Active Learning

- 2%
- 14%
- 42%

Legend:
- Mostly Positive
- Mixed/Neutral
- Negative or Mostly Negative
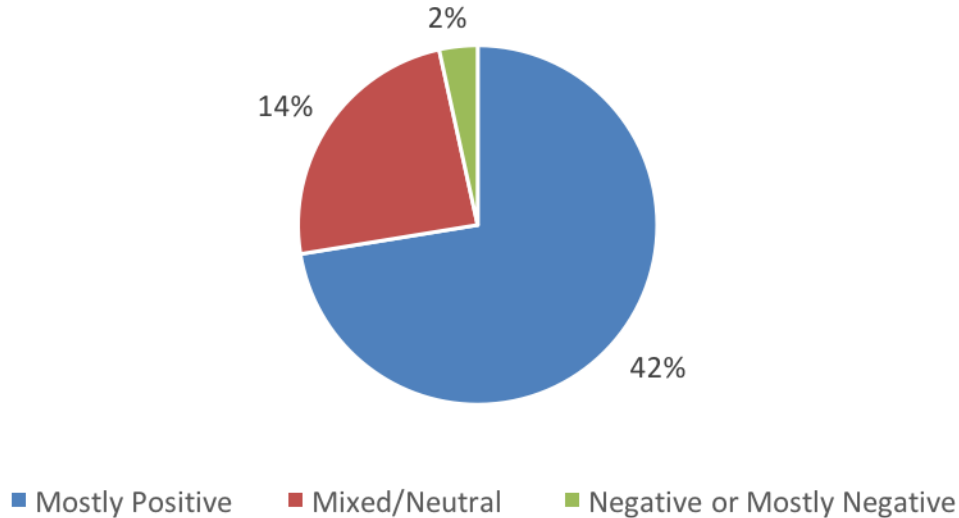
No Statistically Significant Differences

Course Features

- **Course Level**
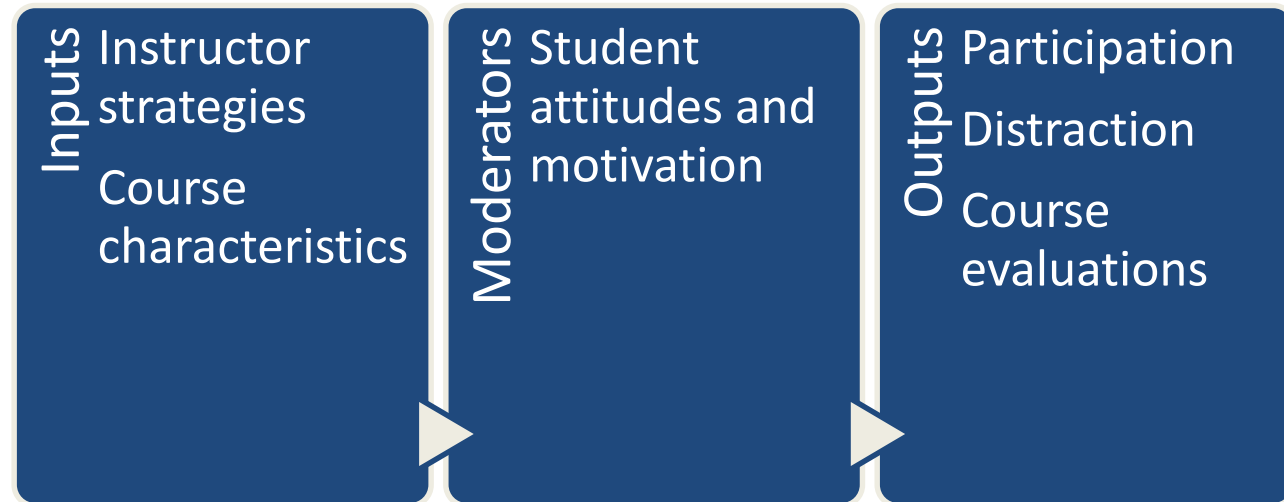- **Active Learning Type**
- **Class Size**
- **Discipline**

Deeper analyses of selected studies

1. Additional strategies to reduce student resistance to active learning (34 papers)
   A. Get feedback from students, reflect and revise
   B. Be persistent for multiple semesters
   C. Prepare, prepare, prepare
2. Why and how do students react negatively? (53 papers)
3. Resources for Instructors Wishing to Study Resistance to Active Learning

Next Steps

- Faculty development workshops
- Investigate whether strategies can be taught

Will be

looking

for

volunteers

Inputs	Moderators	Outputs
Instructor strategies Course characteristics	Student attitudes and motivation	Participation Distraction Course evaluations

Acknowledgements

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