

- 2019 Student Research Symposium -

Effects of Discussion Strategies and Learner Interactions on Performance in Online Mathematics Courses: An Application of Learning Analytics



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Introduction

Problem Statement & Possible Solution



Problem

- High failure rates in college math courses; **higher in online math courses**



What we know

- In mathematics learning contexts, a few studies found that the use of online discussions helped in
 - **decreasing math anxiety**
 - **increasing achievement outcomes**
- Learners performed better in **“effectively designed and structured online discussions”**



Challenges in Practice & Research

- Instructors seldom design/implement structured online discussions
- Prior studies tended to focus on **students' discussion behaviors** rather than instructor involvement
- Little research in mathematics learning contexts

Mathematics
Learning



Instructional
Design



Online Discussions



Question: What discussion design works best in online math courses?

Research Purposes

For online introductory mathematics courses:

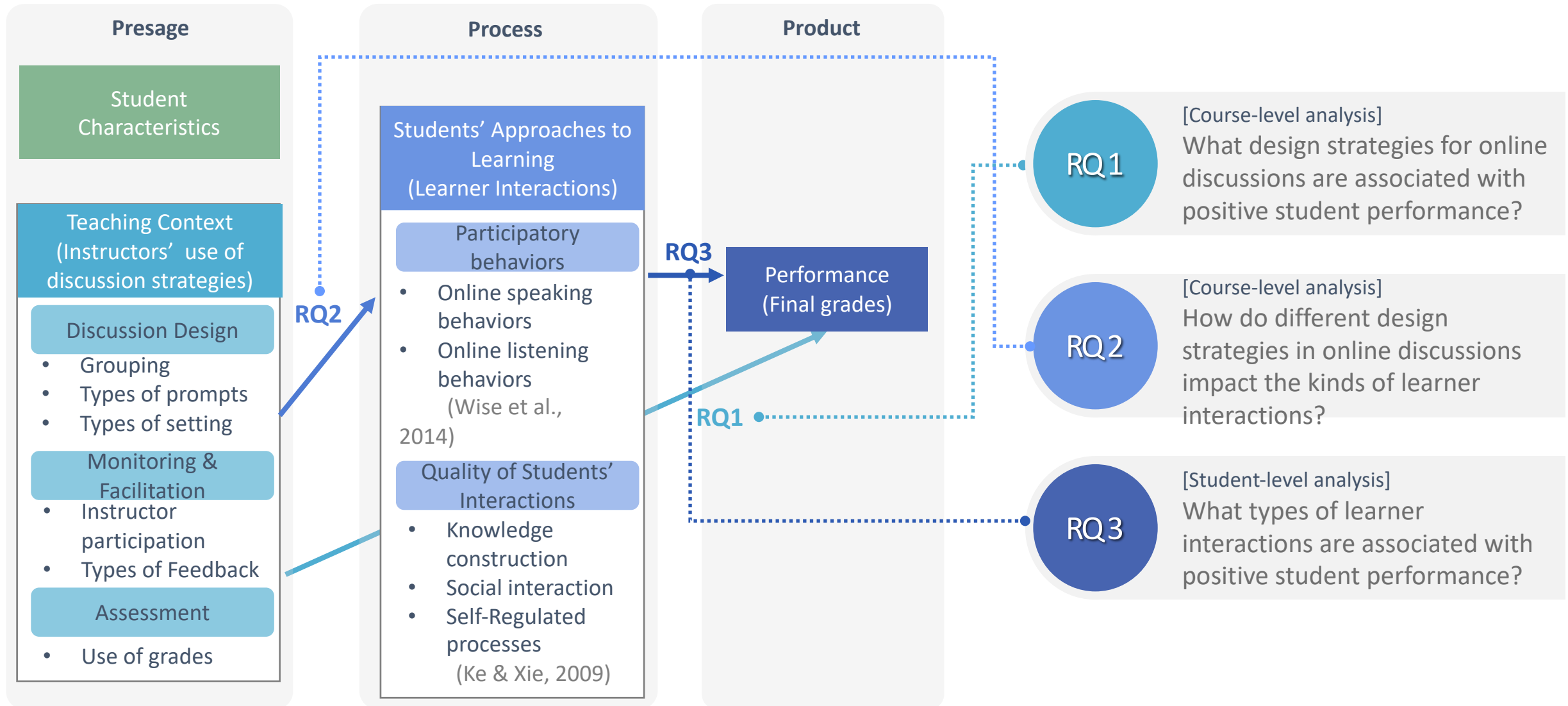
01

Exploring **instructors'** use of **discussion strategies** that enhance meaningful learner interactions and performance

02

Investigating **learner behaviors** and **interaction patterns** that lead to better performance

RESEARCH QUESTIONS



METHODS

Research Context & Sample



Canvas Learning Management System (LMS) used at a public university located in the western U.S.



Sample for the study

Courses

of courses
N = 72

of instructors
N = 11

Students

of students
N = 2,869

Unique #
N = 2,404

Activities (Discussion topics) (N = 703)

Events/Actions (Discussion messages)

- Instructors: 1,284 messages
- Students : 20,884 messages

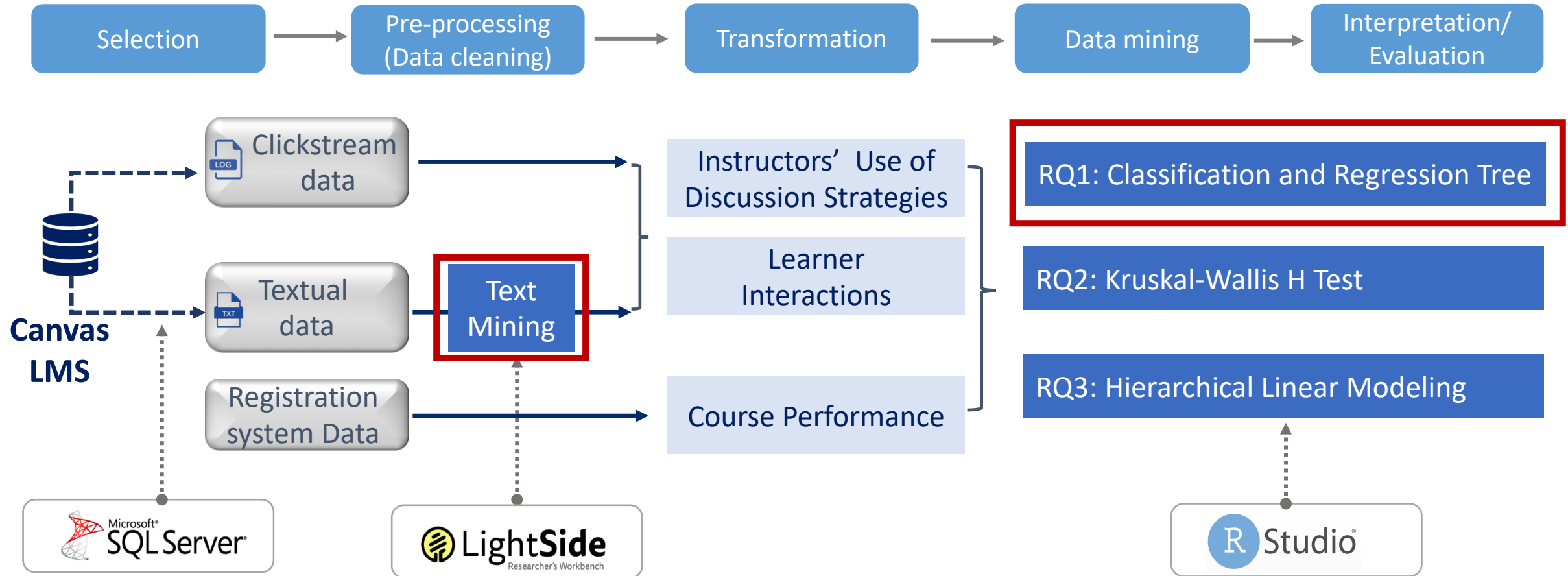


- Fully online introductory (0 and 1000 levels) math/statistics courses offered between 2011 fall and 2015 summer
- Courses that used online discussions

METHODS

Workflow & Data Analysis Methods

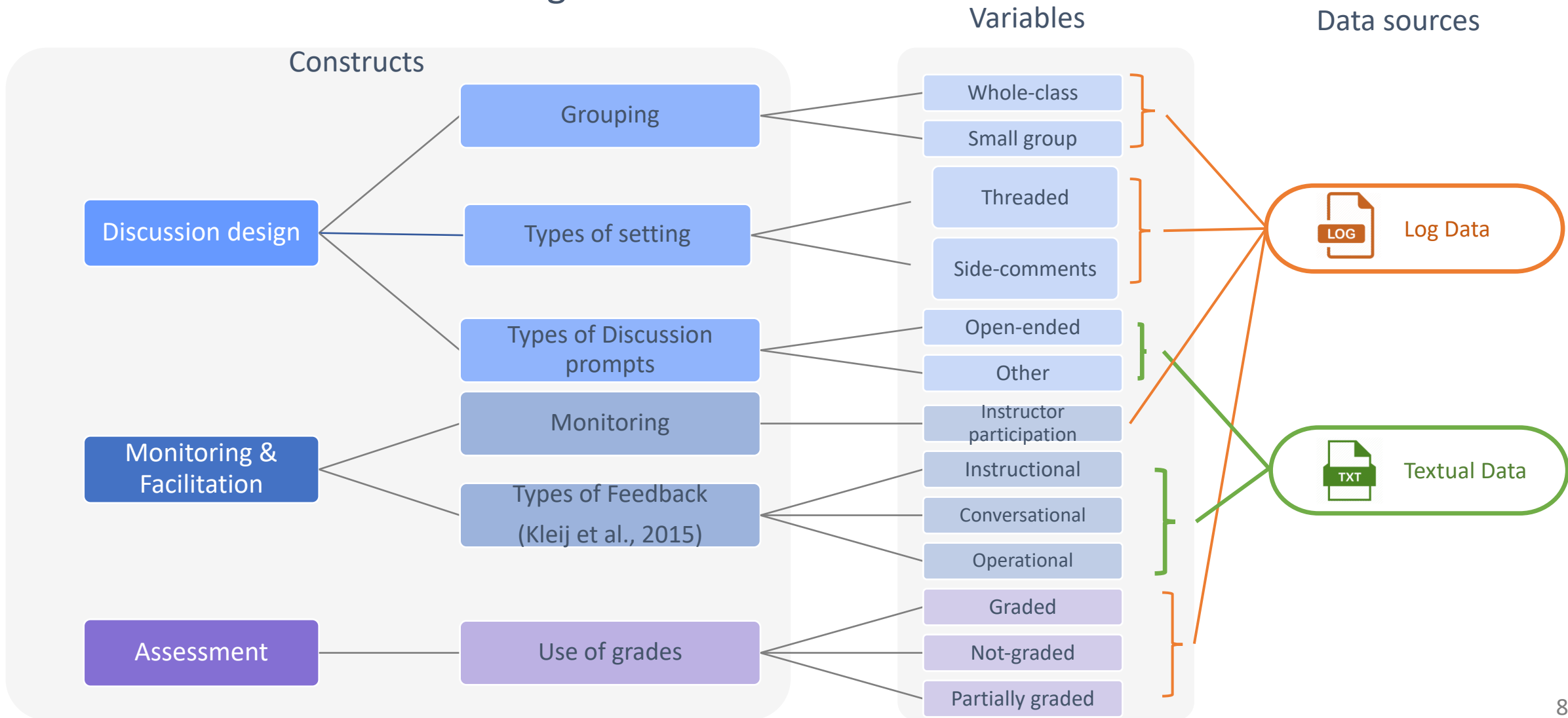
Knowledge Discovery in Databases (KDD) Process



METHODS

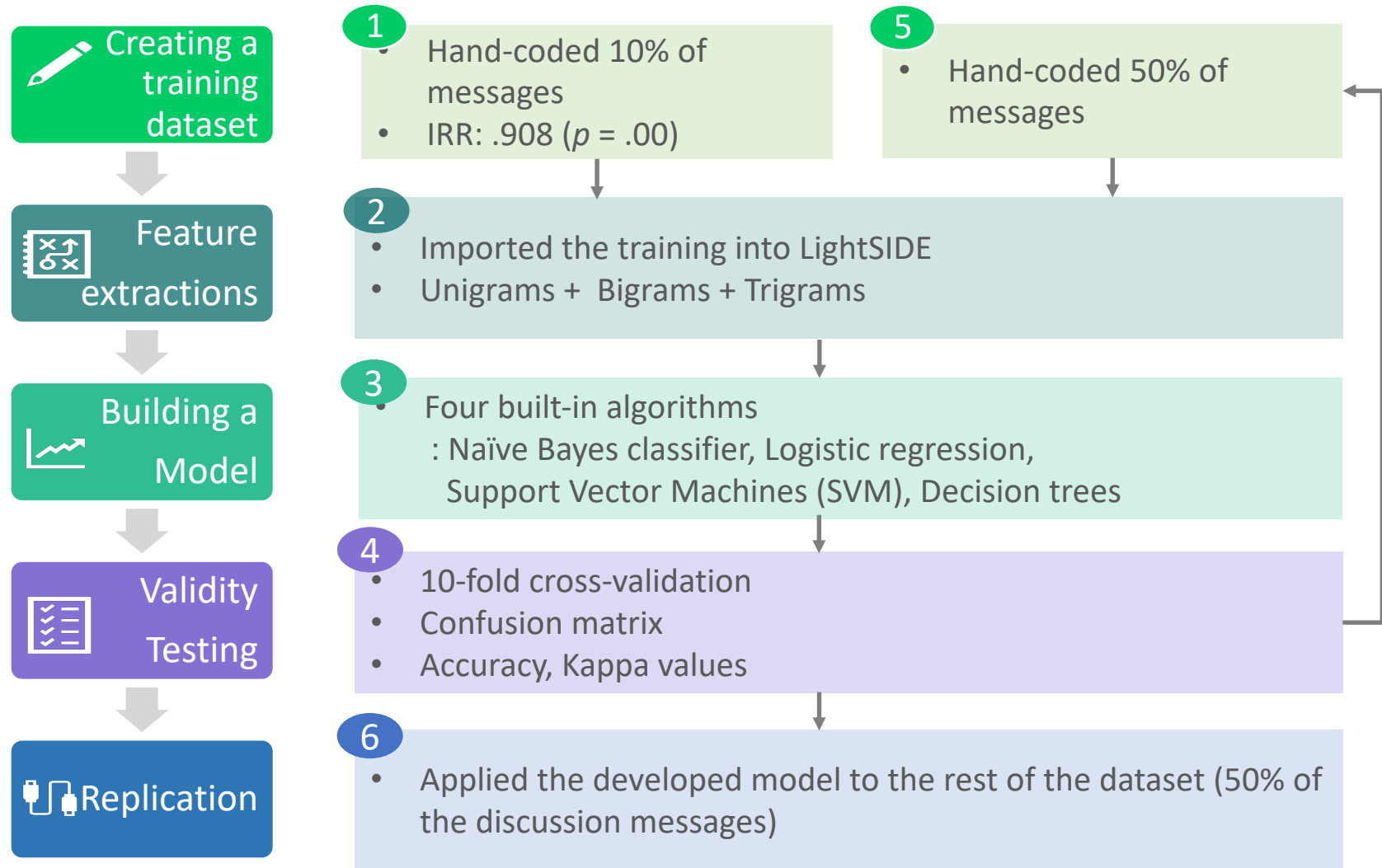
Measurement

Instructor' Use of Discussion Strategies



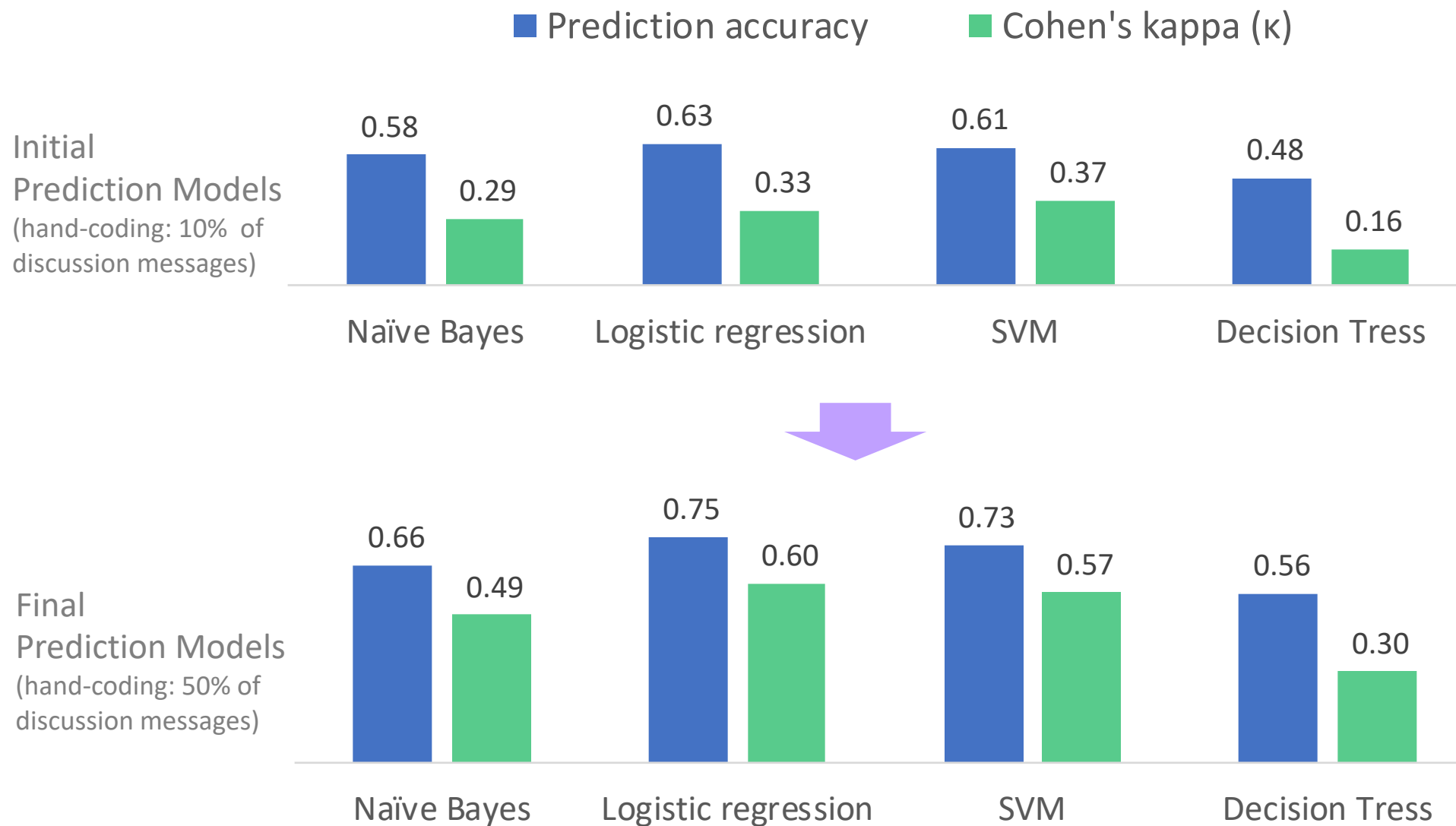
METHODS

Data Pre-processing (Text mining)



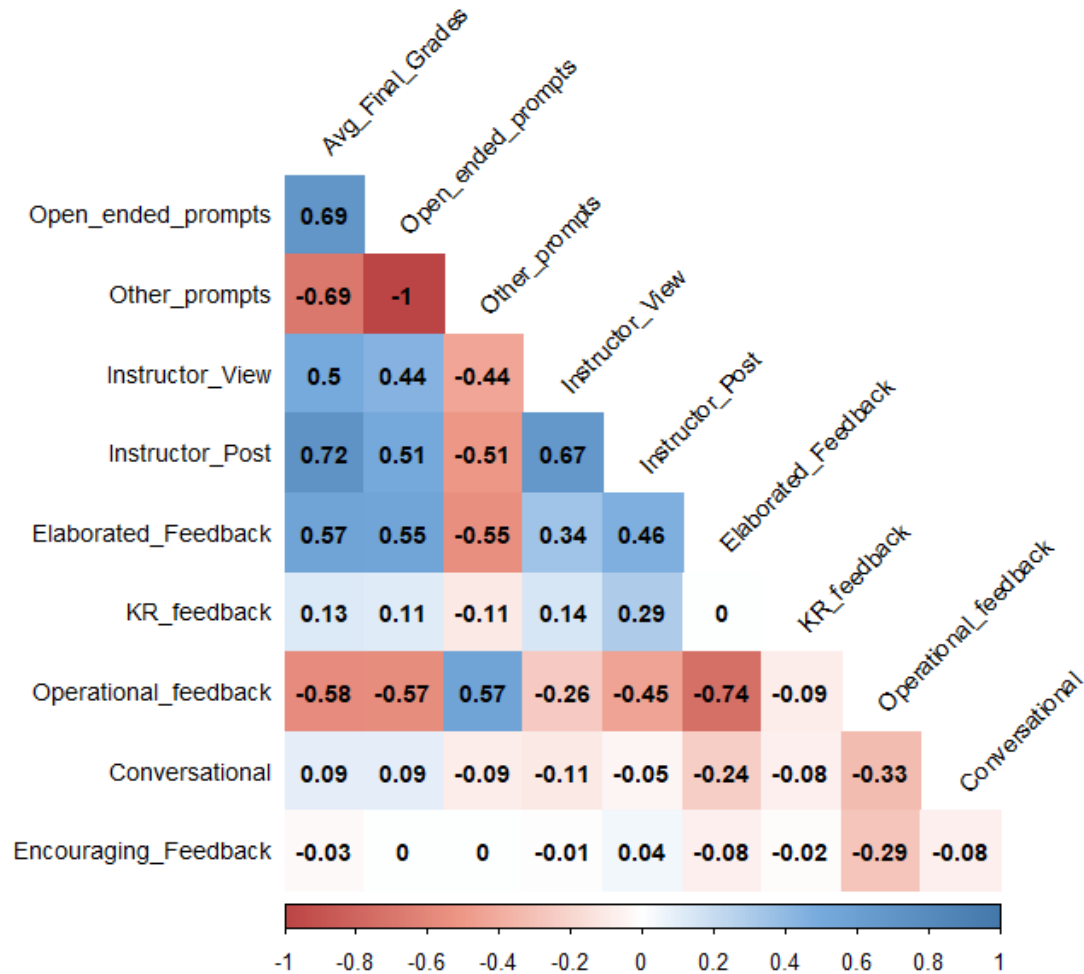
PRELIMINARY RESULTS

Semi-automated Content Analysis



PRELIMINARY RESULTS

Correlation analysis

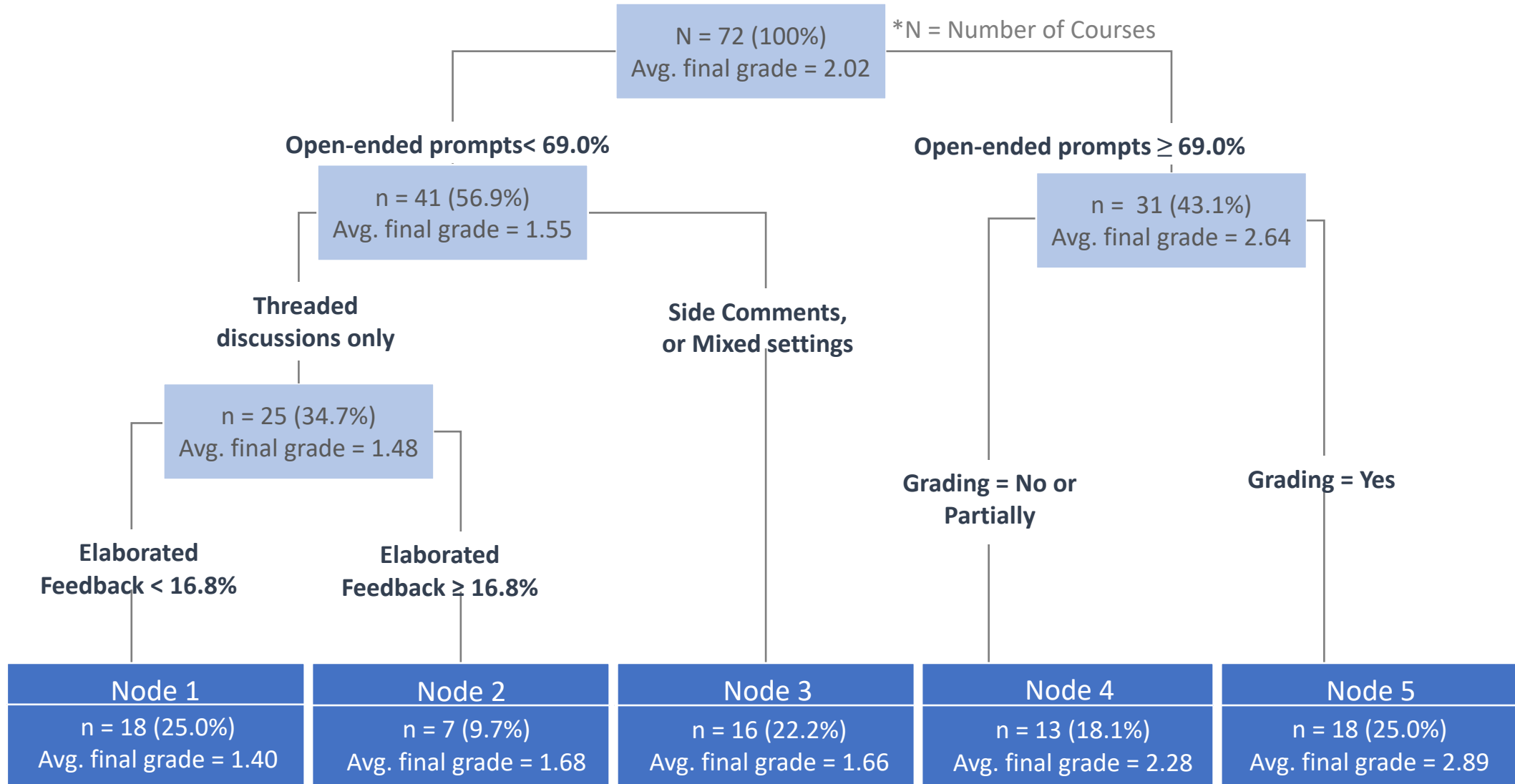


*Included continuous variables only

- “Instructors’ posts” showed the strongest positive correlation with the students’ average final grades ($r = .72$, $p < .05$).
- The ratio of “open-ended prompts” ($r = .69$, $p < .05$) and the ratio of “elaborated feedback” ($r = .57$, $p < .05$) showed the significant and positive correlations with the average final grades.
- The ratio of “other prompts” ($r = -.69$, $p < .05$) and the ratio of “operational feedback” ($r = -.58$, $p < .05$) showed the significant and negative correlations with the average final grades.

PRELIMINARY RESULTS

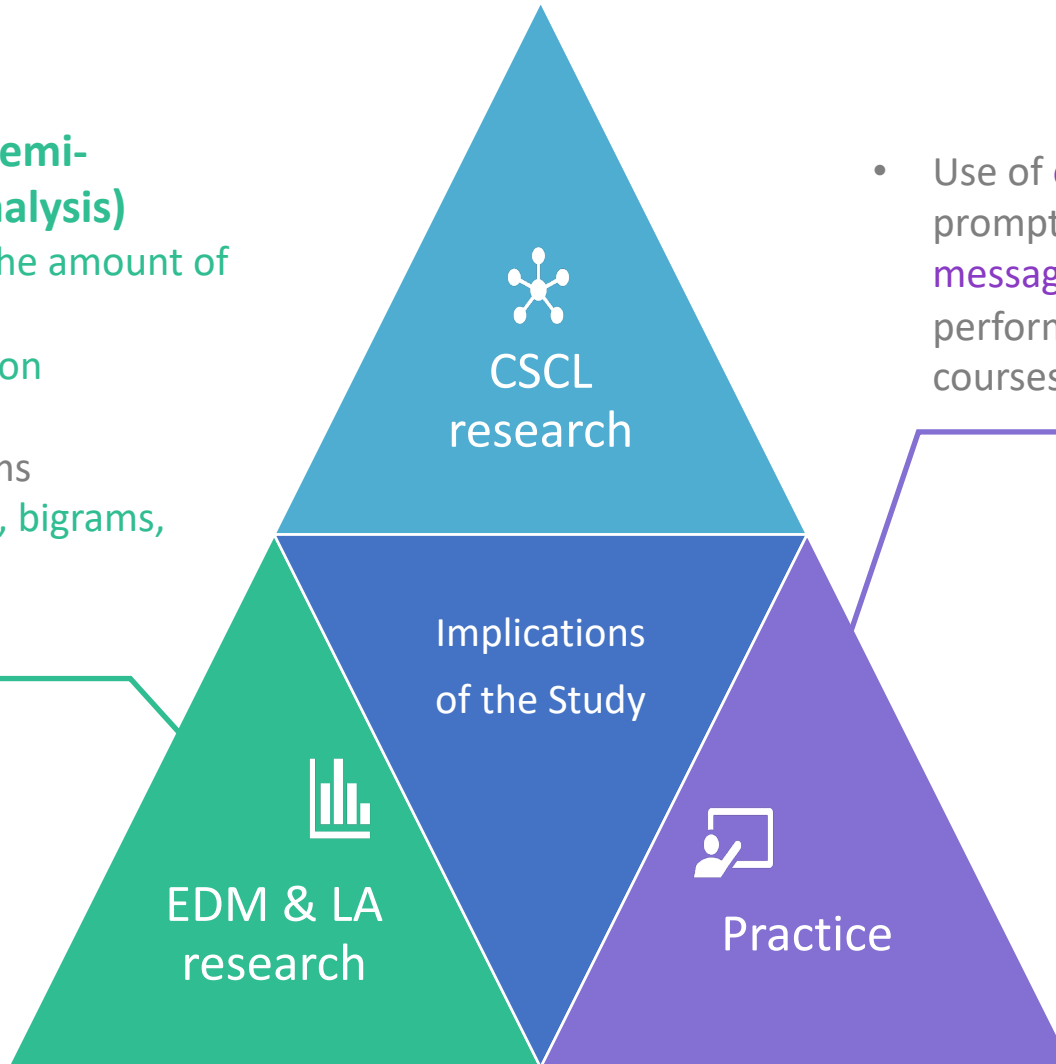
RQ1: Classification and Regression Tree (CART)



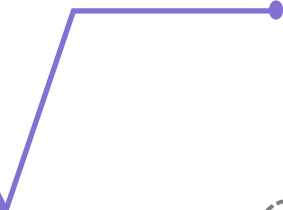
Lessons Learned & Future Work

- **Text mining (semi-automated analysis)**

- Importance of the amount of hand-coding
- Logistic regression outperformed other algorithms
- Use of unigram, bigrams, trigrams altogether



- Use of open-ended discussion prompts and grading students' messages will lead to better student performance in online mathematics courses.



Future Work

- Validation of the CART analysis results
- RQ2: Statistical Analyses (Kruskal-Wallis H Test)
- RQ3: Hierarchical Linear Modeling (HLM)
- Interpretation and evaluation of the results



Thank you

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