

Impact of Predictive Learning Analytics with Formative Learning Feedback on Exam Failure Rates

FANTASTIC – Feedback based on Analytics of Teaching and Studying meets Individual Coaching

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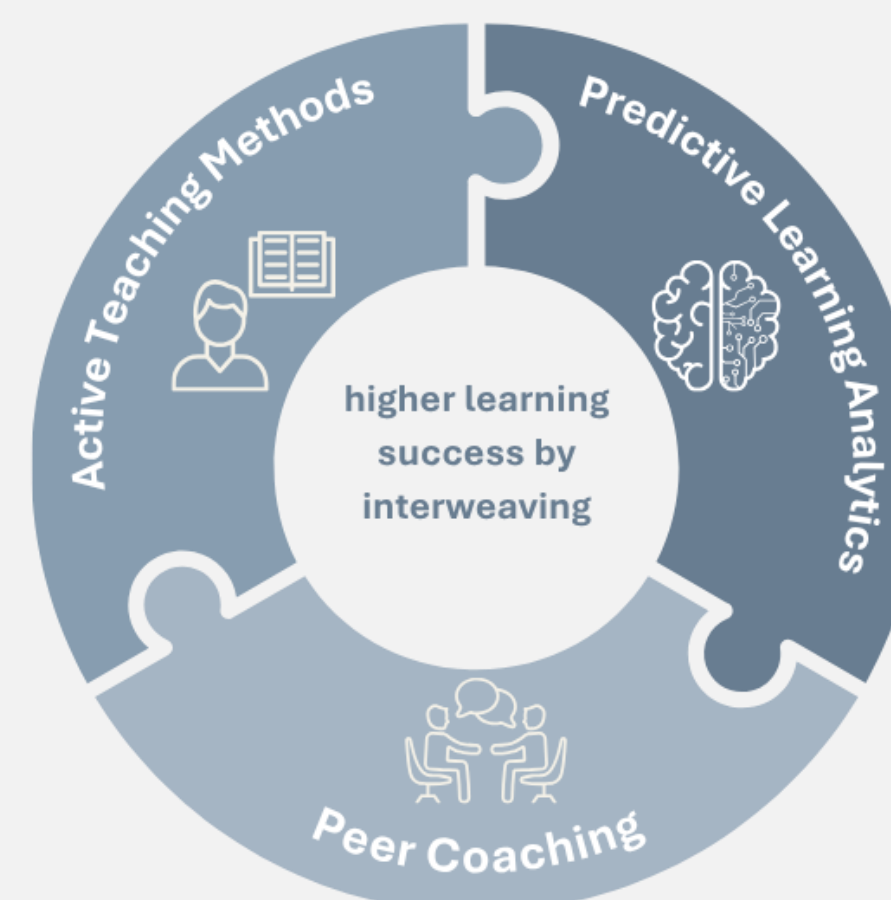
MOTIVATION

- Heterogeneity of prior knowledge requires adaption of both: teaching and learning methods
- Predictive learning analytics offers promising approaches to enhance learning processes and mitigate these shortcomings

GOALS

- Development of sustainable study behaviours
- Promotion of learning progress
- Increase in exam pass rates

APPROACH

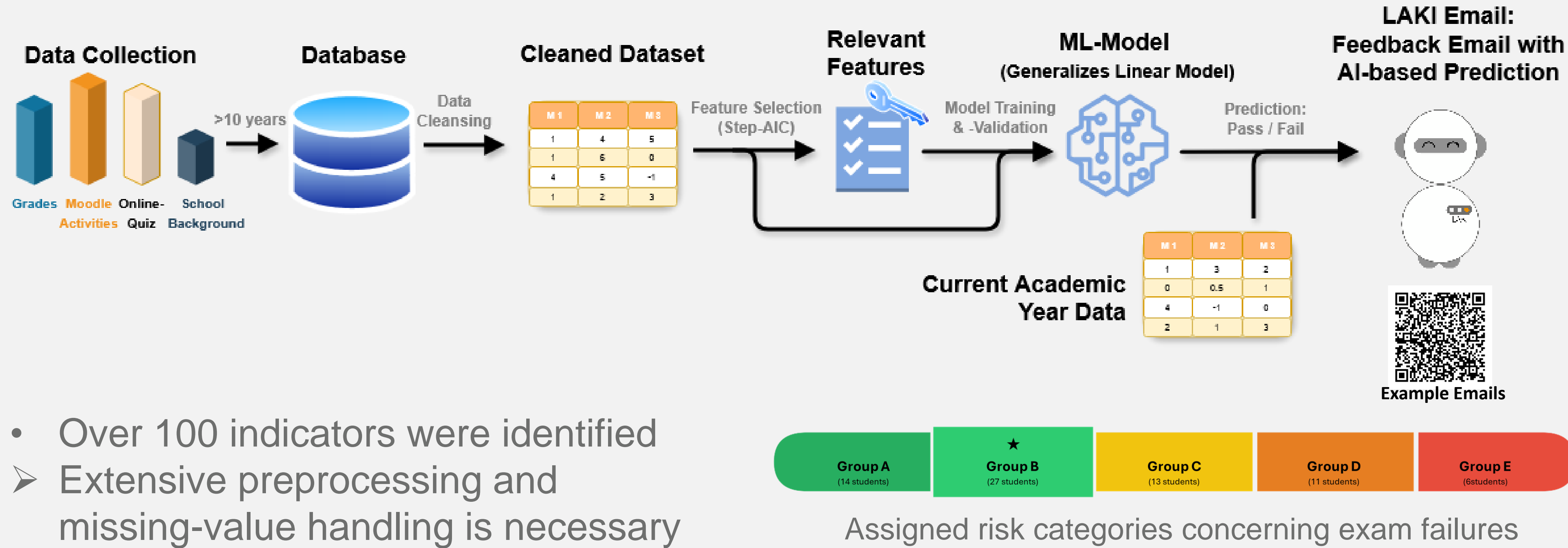


COURSE DESIGN & DATA SET

- Physics course for Industrial Engineering, largely unchanged since 2014
- Just-in-Time-Teaching / Peer-Instruction (Inverted Classroom with Online quiz)
- 10-15% bonus for Online quiz
- Training data for the ML model from 2014/15 – 2019/20, 431 „true freshmen“
- AI predicts exam results in 2024 & 2025

AI DESIGN

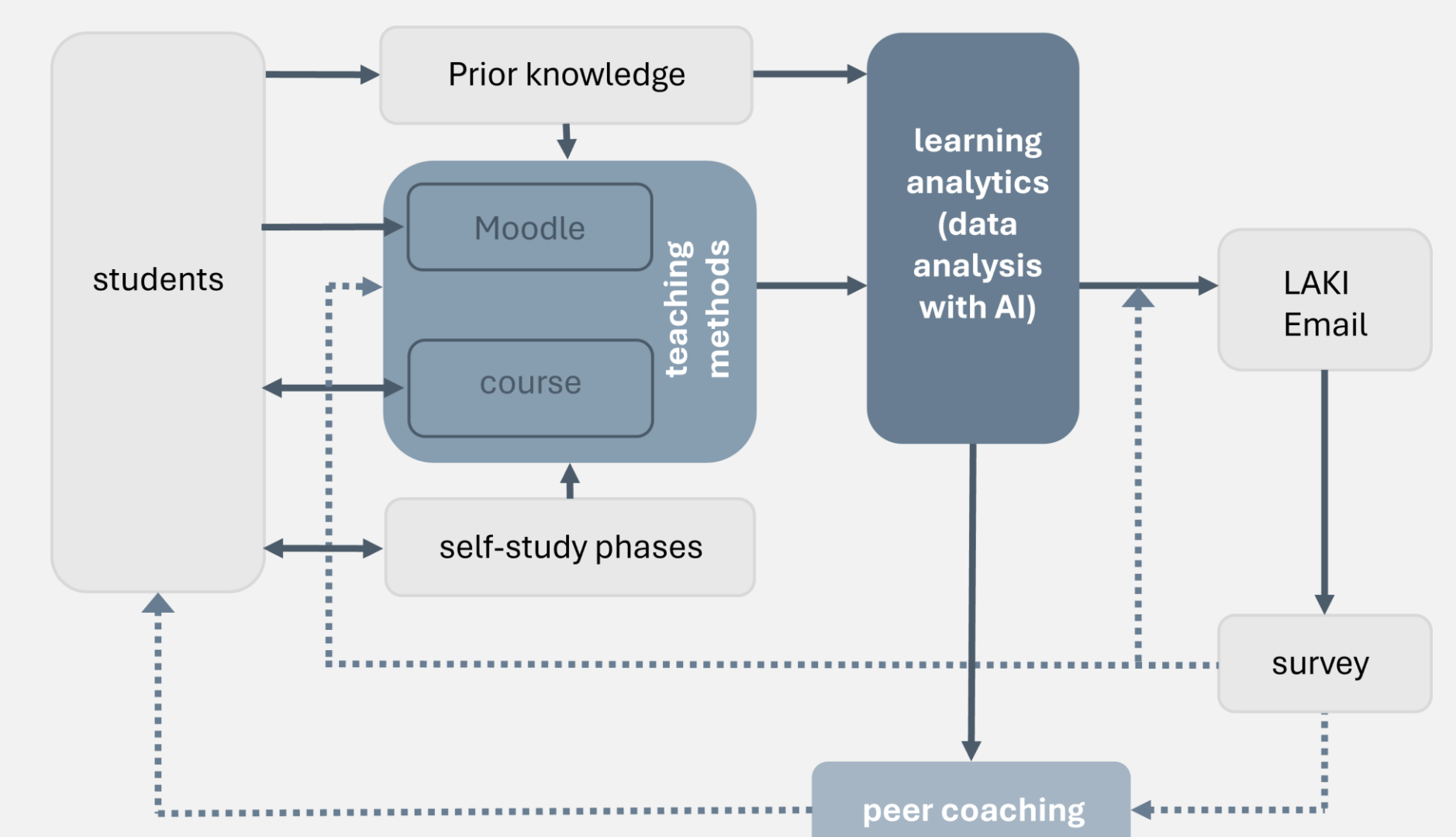
Predictive Learning Analytics



- Over 100 indicators were identified
- Extensive preprocessing and missing-value handling is necessary

FEEDBACK DESIGN

- Feed Up: Learning objectives
 - Feed Back: Learning status & AI prediction
 - Feed Forward: Next steps
- (Based on Hattie & Timperley (2007))



RESULTS & EFFECTIVENESS

Professional Development

Prediction models achieved high performance, with metric ranges from 0.7 to 0.9:

	Sensitivity (Recall)	Specificity	Accuracy	Precision	F1 (class0)	F1 (class1)
AI Model 2024	0.74	0.71	0.72	0.67	0.74	0.70
AI Model 2025	0.62	0.91	0.77	0.87	0.81	0.72

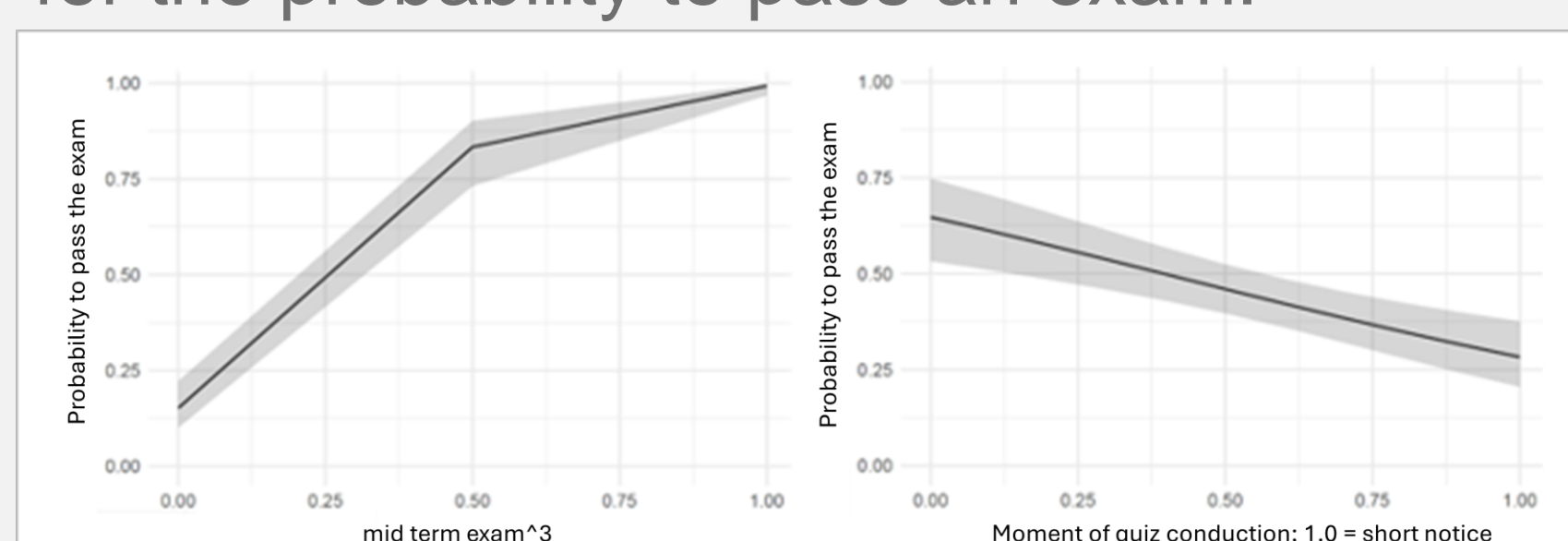
(388 data for training, 43 data for testing)

Comparing exams with and without LAKI Emails shows a significant improvement respectively a trend of improvement:

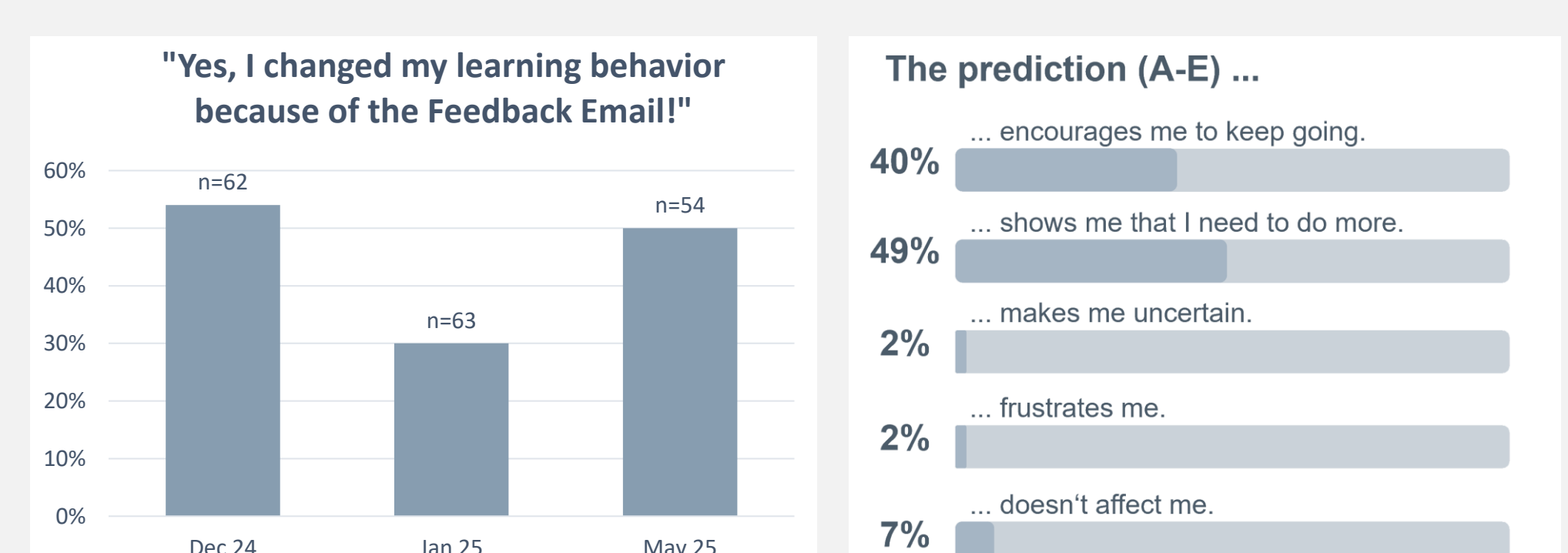
	øFR 2014-2023 no LAKI	øFR 2024-2025 LAKI	FR Decrease absolute	FR Decrease relative
All exams	39.1	30.6	8.5	22%
Freshmen only	31.3	24.0	7.3	23%
All exams w/o bonus	47.4	35.2	12.2	26%
Freshmen w/o bonus	41.8	27.2	14.6	35%

- 2024: significant ($p < 1\%$) reduction of failure rate (Junker et al. 2025)
- 2025: no reduction of failure rate (AI model indicates a weaker cohort)
- Reduction of failure rate of first-year students: 2014-2023 without AI vs. 2024 – 2025 with AI: 31% \searrow 24% (Junker et al. 2026)

Effect plots showing the impact of two indicators for the probability to pass an exam:



Personal Development



Rated by students as particularly effective/helpful:

- AI-based prediction (70%)
- Learning status graphics (88%)
- Feedback texts (85%)
- Motivating effect (80%)

KEY SUCCESS FACTORS

Team interdisciplinarity

This combines subject expertise, technical competence & pedagogical know-how → high-quality, and well-accepted solutions.

Regular Student Surveys

They engage students in process development → increase acceptance & demonstrate implementation of recommendations.

Active Teaching Methods



JITT, PI, Tutorials: Schäffe et al., 2023

DISCUSSION

Effectiveness is difficult to measure without a comparison group as in medical research.

Additional influencing factors are:

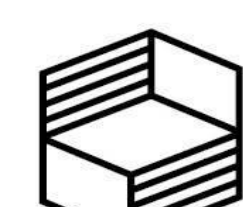
- Increasing use of generative AI by students for preparatory online quizzes
- Weaker prior knowledge in mathematics

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- See also: <https://www.solaresearch.org/publications/>
- THRO (2022). <https://www.th-rosenheim.de/en/die-hochschule/labore/labore-ang/scale-up-room>



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