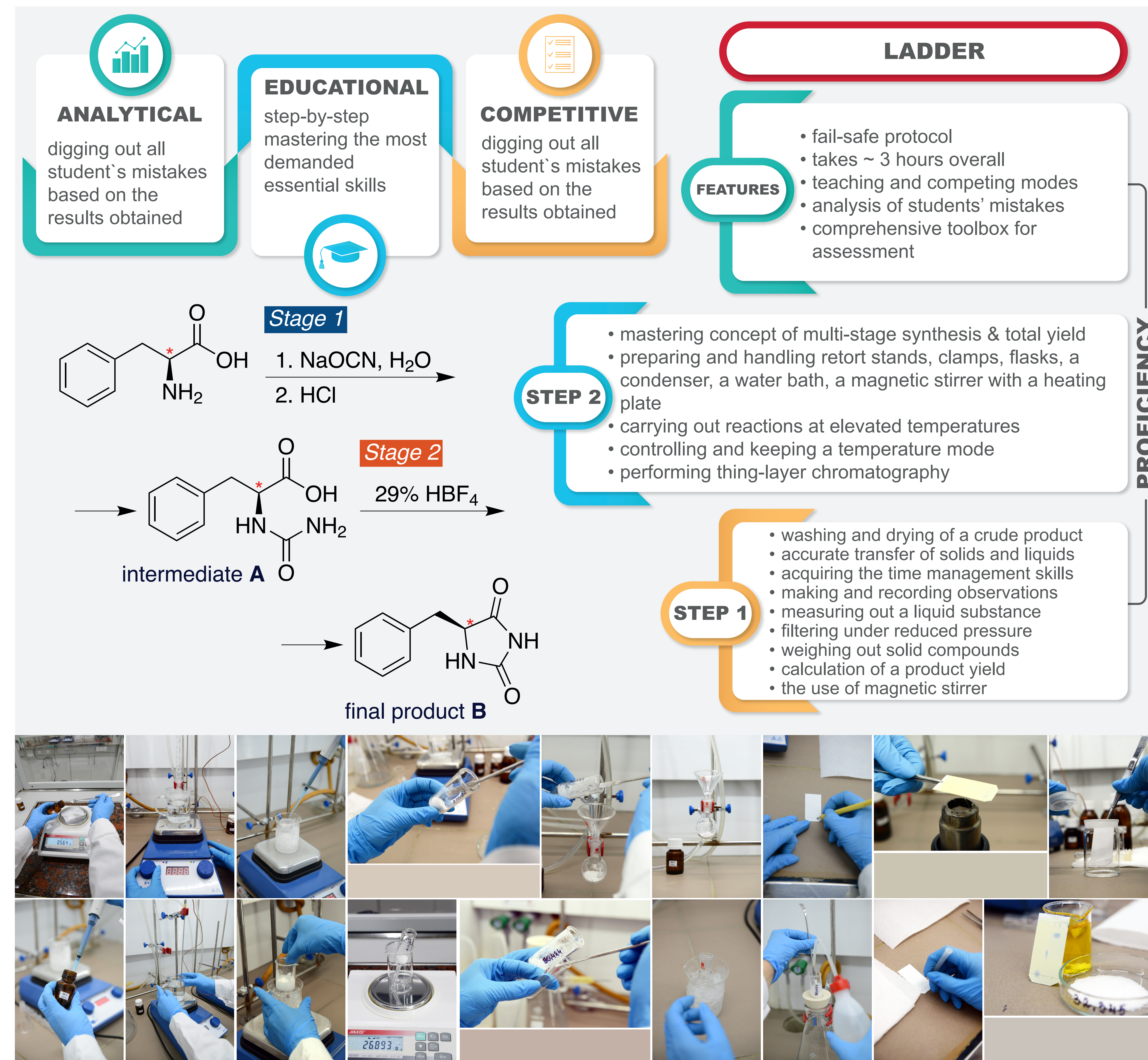


Introduction to multistage procedures – another step to qualified synthetic chemist



S. Ryabukhin, A. Lyapunov, L. Muravska, O. Vitsenko, D. Lega, V. Makhankova, D. Volochnyuk

Overview of the experimental work and its cornerstones



Design of the experiment and inspection of possible mistakes

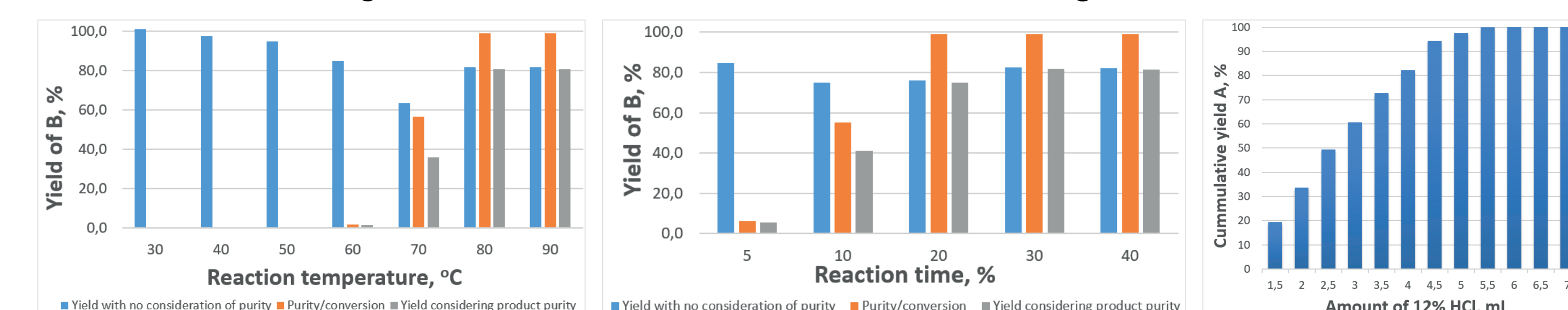
- introductory chemistry
- 2018-to-2023 years
- "competition" and education modes
- first-year undergraduates
- 194 undergraduates
- introduction to RAMP
- laboratory instruction
- grading approach designed

The experimental details were thoroughly optimized regarding both steps of the protocol

- this allowed us to comprehensively examine the impact of various parameters on the synthesis efficiency and use them further to analyze the students' results:

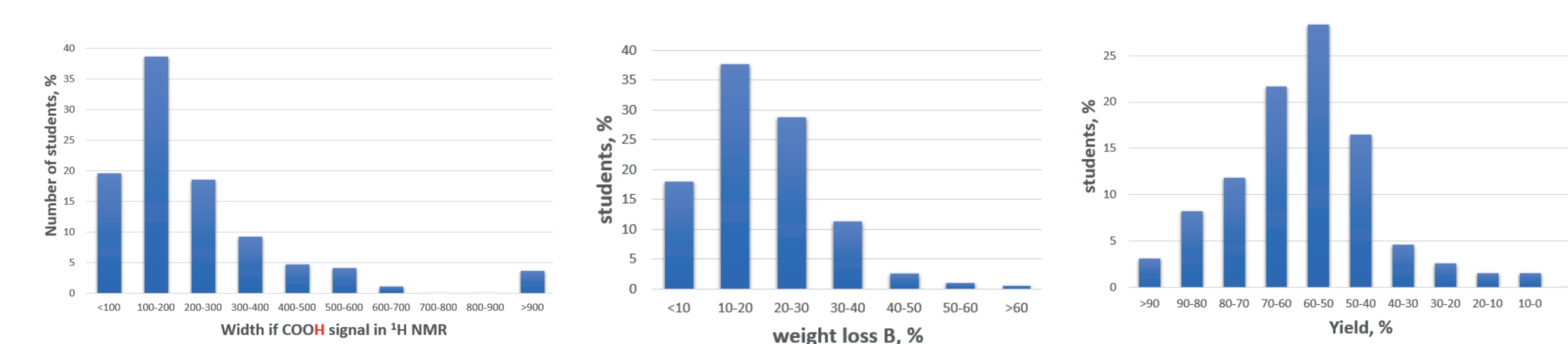
THE PROTOCOL DETAILS INSPECTED: DEVIATIONS FROM THE PROTOCOL TESTED:

- sodium cyanate excess
- operating temperature (stages 1 & 2)
- reaction time (stages 1 & 2)
- acid utilized at stage 2
- amino acid and cyanate misweighed
- insufficient amount of the acid taken
- more/less tetrafluoroboric acid used
- careless handling of the reaction mixtures



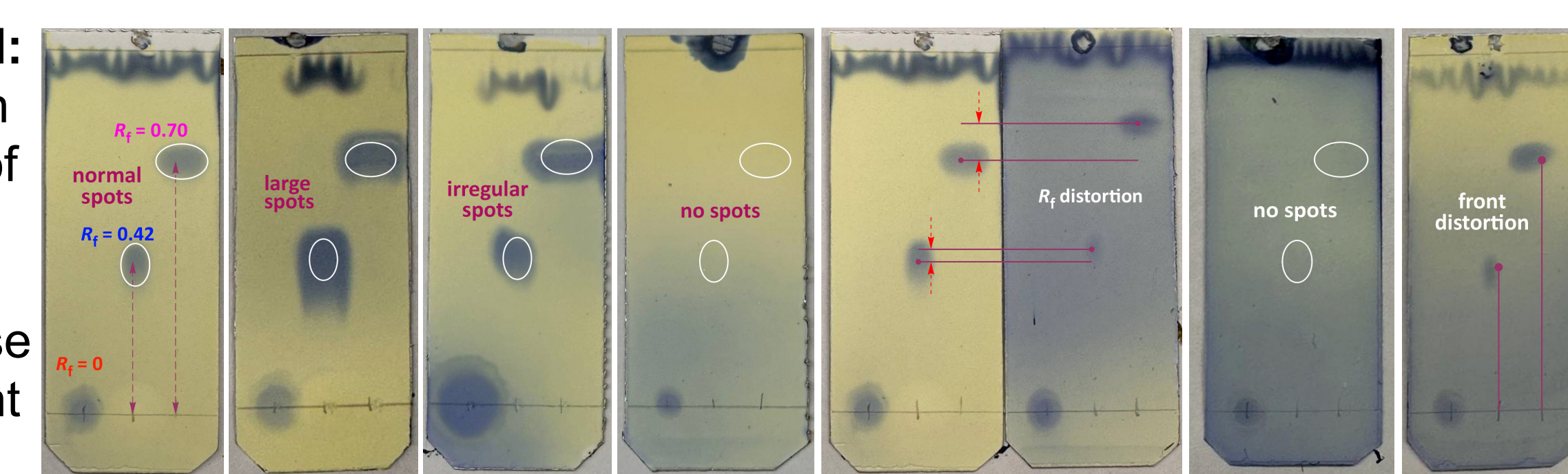
GRADING APPROACH

- 'yield', 'purity', and 'dryness' were chosen as reliable and easy-to-measure parameters mirroring the effectiveness of students' performance
- all the qualities were assessed using trapezoid-shaped dependences
- the proposed complex approach to assessment may be advantageous in eliminating double mistakes occurring at different stages and leading to seemingly perfect results



Problems with TLC covered:

- low concentration
- high concentration
- wide spot of a compound
- not enough eluent
- more eluent than needed
- a plate is too close to the chamber wall
- eluent has reached the top edge



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