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An Automated Feedback System to Enhance Computational Thinking Process

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The team

Turaj Ashuri (PI)

- Developed the automated feedback system.
- Lead the study.

Amir Ali Amiri (Co-PI)

- Conducted the surveys.
- Analyzed the data.

Importance of feedback to students' work

- A key element of a successful learning process.
- The biggest contributor to course satisfaction in several engineering courses.
- Feedback types:
  - Summative (outcome or binary-based).
  - Formative (process based).
- Summative feedback as the most common one.

Challenges of formative feedback

- Time consuming.
- Not scalable to large class sizes.
- Student's work dependent.
- Difficult to standardize.
- Difficult to apply automation.

Challenges of feedback for computer programing courses

- Require extensive formative feedback.
- Time sensitive to be of use to students.
- Highly iterative due to the nature of coding.
- Programing language dependency.

Study objectives

- Develop an automated system to provide early formative feedback.
- Quantify the relationship between receiving early formative feedback and students' success outcomes.
- Improve students' learning experiences and better course satisfaction and evaluation.

Study goals

- Enhance institutional effectiveness by providing the data required to make an evidence-based change across the engineering curricula.
- Increase students' learning success using a novel automated feedback system.

Methodology: automated feedback

- A collection of over 40+ common mistakes made by engineering students while coding.
- Implemented in Python programming language.
- Highly automated and accessible.
- Easy adaptable to other programing languages.

Methodology: study setup 1

- MET 2501: Engineering Computation with MATLAB in Spring 22.
- A group of 9 students for both the control and study group.
- A class project assigned to all students.
- Study group to submit their project early and by the end of February, March and April to receive automated feedback.
- Control group to submit their project by the end of April but allowed to seek help during the semester if needed.

Methodology: study setup 2

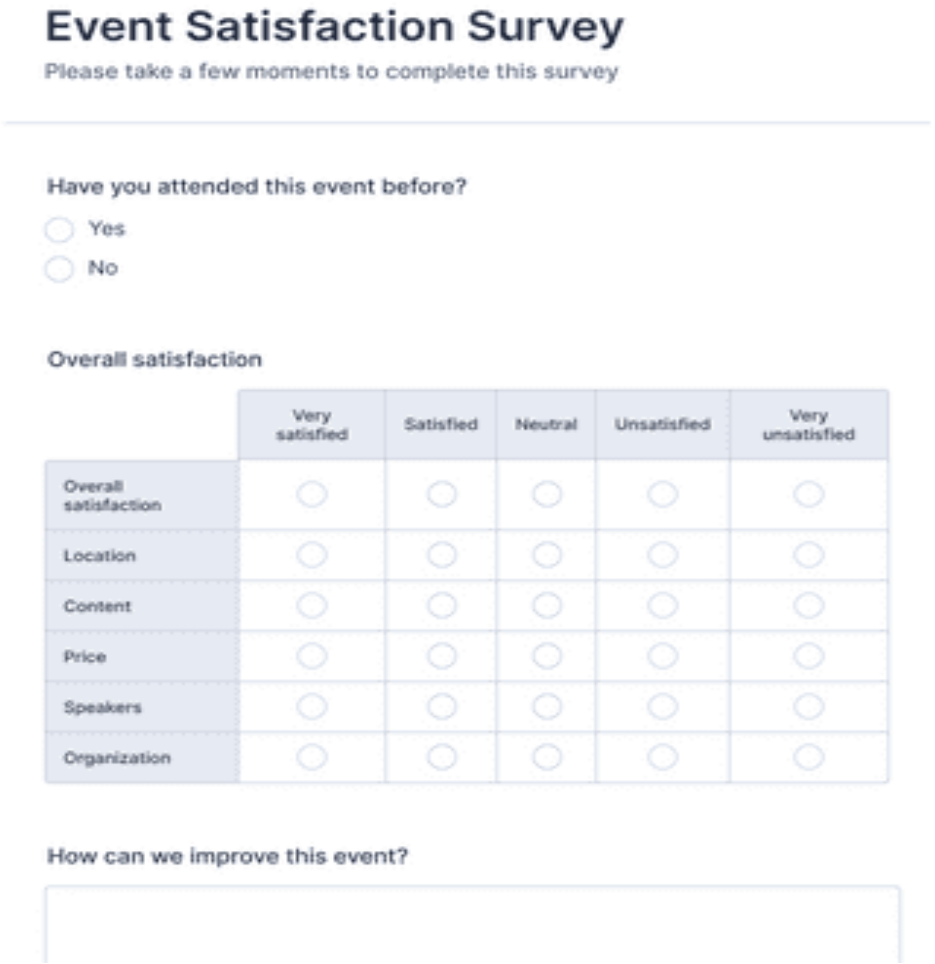
- For both the study and control group:
  - A similar GPA.
  - A similar standard deviation.
  - Equal number of male and female students.
  - The same project given.
  - The same course materials taught.

Methodology: study setup 3

- For study group, 3 surveys after each automated feedback system.
- For both groups, a final comprehensive course evaluation.
- Study consent and survey in BlueX and the final comprehensive course evaluation in BlueX and Blue Explorance.

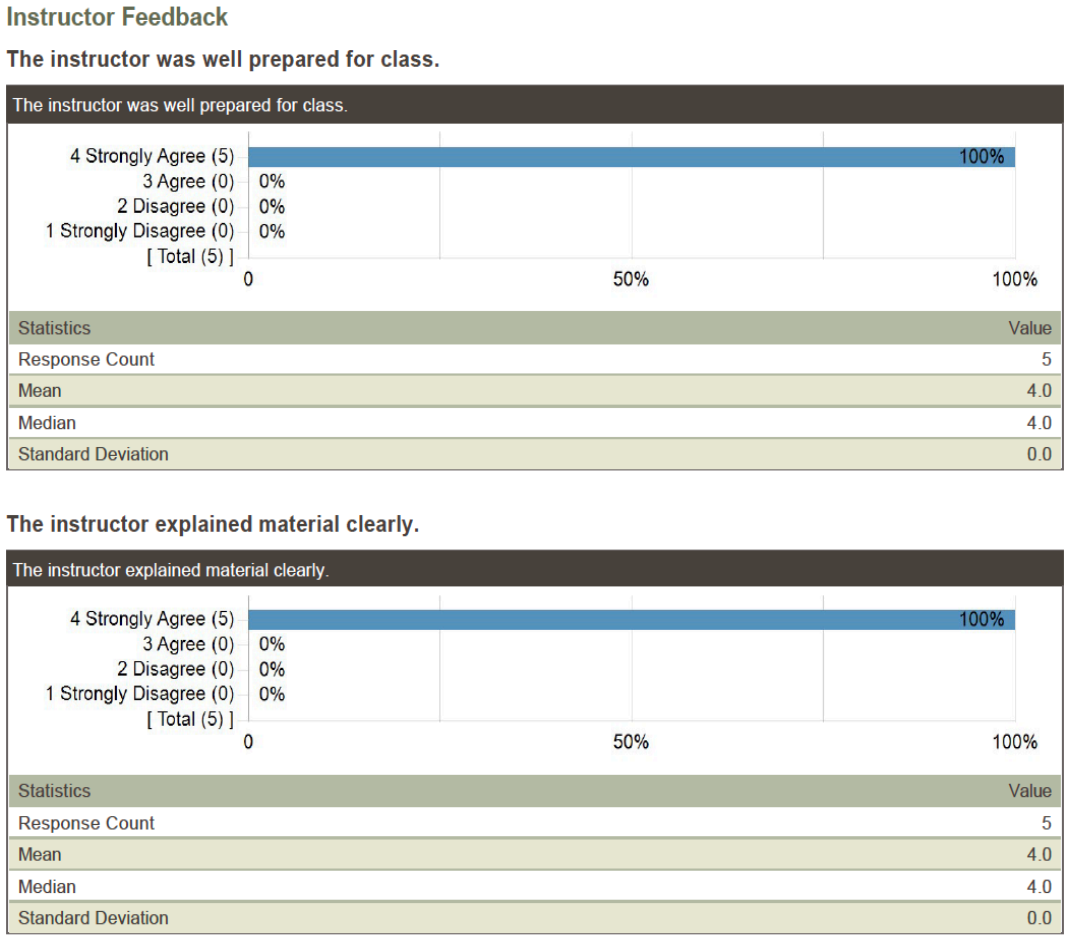
BlueX: a survey software for anyone

- A simple and easy survey tool with:
  - MS Office-like GUI.
  - Minimal training and easy to learn.
  - Edit and preview as you work.
  - Suitable for any surveying needs.
  - Automated postprocessing and analytics of survey results.
  - Customizable to user needs.



Blue Explorance: a course evaluation tool

- A widely used course evaluation software with:
  - Visually attractive GUI.
  - Rich statistics.
  - Best-in-class integration with student information.
  - Designed to handle the most complex evaluations.
  - Customizable to user needs.



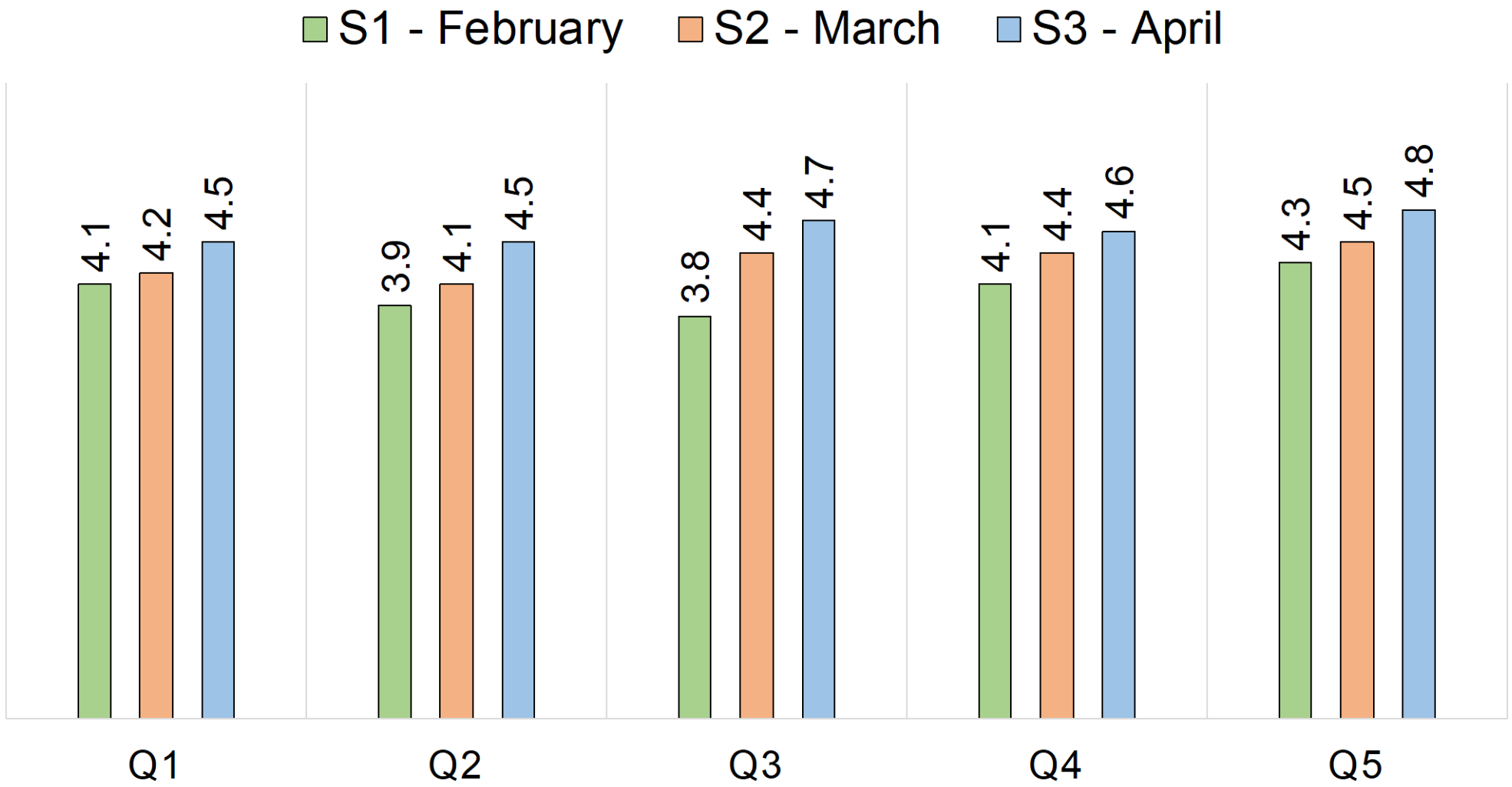
Survey questions (Likert scale)

- Q1: How comfortable are you with computer programing?
- Q2: Does the project help you to better understand the materials?
- Q3: Does the automated feedback system help you to better understand the materials?
- Q4: How satisfied are you with the automated feedback system?
- Q5: Overall, how satisfied are you with this class?

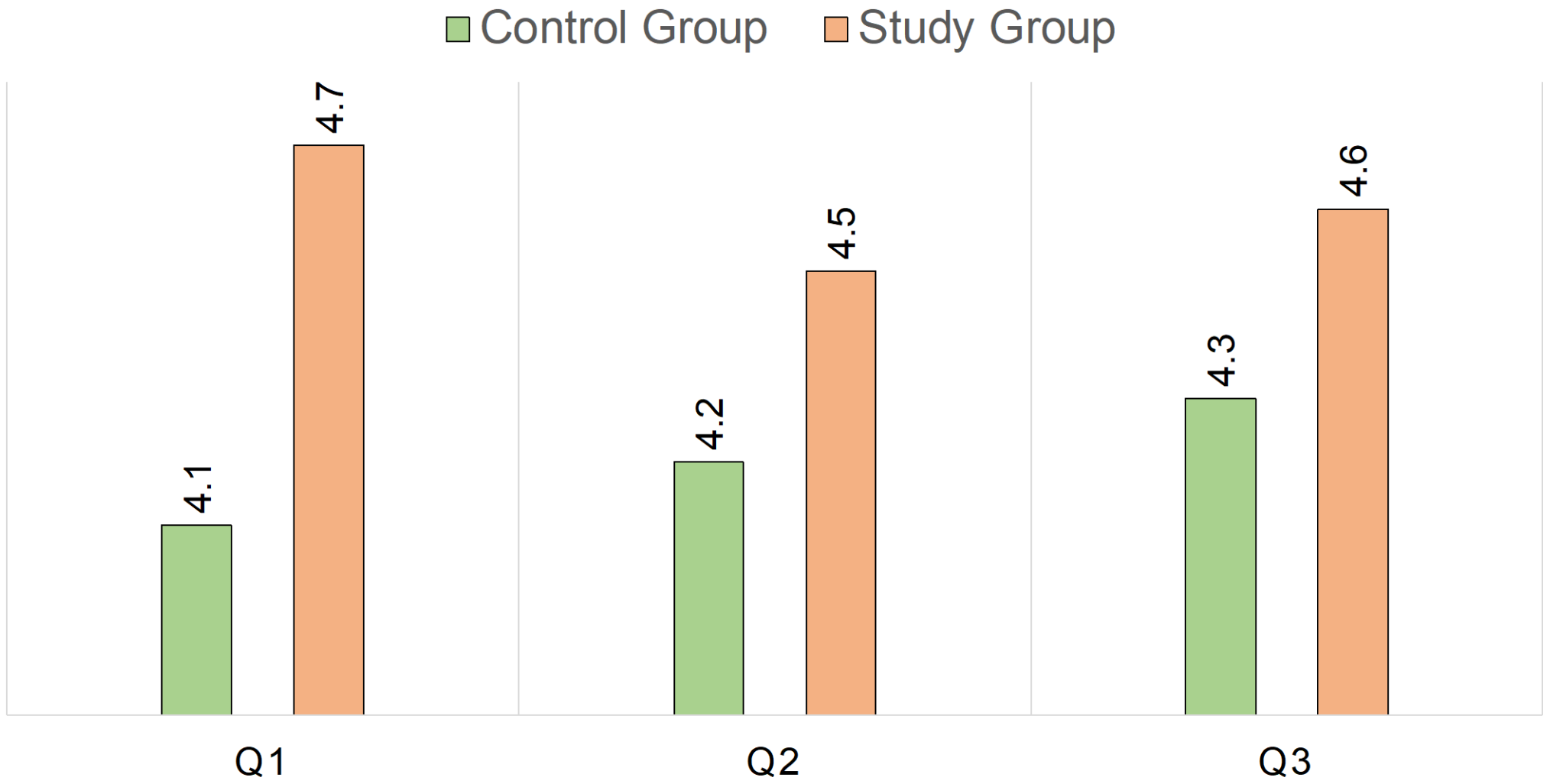
Final course evaluation (Likert scale)

- 10 total questions addressing different aspect of students' success.
- The 3 important questions being:
  - Q1: The project was interesting and provided me deeper understanding of the subject matter.
  - Q2: Overall, I am satisfied with the class.
  - Q3: I would recommend the instructor to others.
- 2 open-ended questions:
  - Please comment on one thing you like about this course.
  - Please comment on the one thing you want to change in this course.

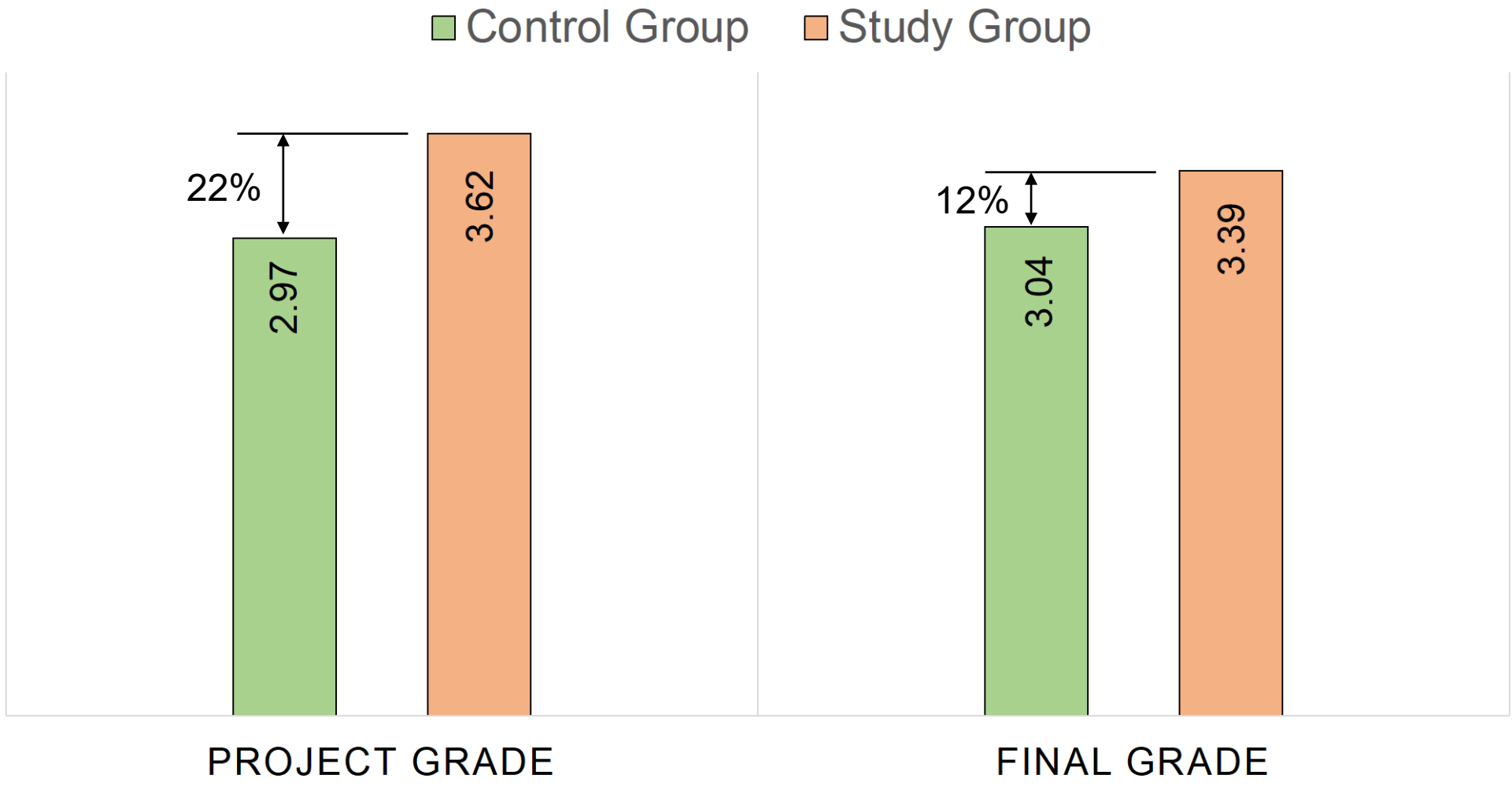
Survey results from study group



Final course evaluation results



Summary grade statistics of the two groups



Samples of open-ended student comments

- Comment on what students liked:
  - *“Constant feedback + help in class.”*
  - *“The ability to use a program to solve complex problems.”*
- Comment on one thing to change:
  - *“I would not change anything.”*
  - *“I didn't like how the project was one uniform project.”*

Study limitations

- Small pool of students (n = 18).
- No access to indicators such as gender to better understand the students' learning difficulty.
- Few students in the study group not responsive to all intermediate deadlines.

Conclusion

- The data (surveys and final course evaluation) suggest that the automated feedback system raises students' learning success.
- The data support the enhancement of institutional effectiveness in dealing with the challenges associated with the computer programing courses.

Acknowledgment

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The content of this study do not represent the official views of Bluenotes Explorance.

Thank You!

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