
Invention and Learning Activities in Biology 112: Developing Creative Thinking and Problem Solving Skills in First Year Biology Students.

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Biology 112 Activities

- In an effort to promote problem solving, teamwork, and creative thinking, two types of weekly tutorial activities were designed to accompany Biology 112 (a large lecture based course): ***Invention Activities**** and ***Learning Activities***.
- The Biology 112 students were invited to volunteer to participate, although they did not know which type of activity group they would be joining.

*Invention activities are based on the work of Daniel Schwartz, Stanford University.

Biology 112 Activities

Invention Activities	Learning Activities
<ul style="list-style-type: none">■ Present the students with fictitious problems that do not appear to be related to biology, but analogous to problems that living cells must overcome.■ Have more than one possible solution.■ The related lecture material has not yet been covered but is introduced in the lectures following the activity.■ Goal: to prime the students to learn the related lecture material.	<ul style="list-style-type: none">■ Present the students with problem sets that are clearly related to lecture material.■ Have one correct solution.■ The related lecture material has already been recently covered (or is currently being covered) in class.■ Goal: to reinforce the lecture material by requiring the students to apply knowledge from class to tackle biological problems.

The Activity Format

- Both types of activities use a 50 minute format:
 - Students work on the given problem for about 30 minutes in fixed groups (three or four students per group).
 - A facilitator is always present to provide aid.
 - For the learning activities, aid is given by answering questions and clarifying material.
 - For the invention activities, aid is given by providing guidance and giving feedback to the students without providing a “solution” to the problem.
 - Each group is required to present their work in two ways:
 - The group writes out the complete solution on large flipchart paper.
 - Learning activity students record all information (individually) in a provided workbook. Invention activity students are required to each provide a written paragraph summarizing their group’s invention.
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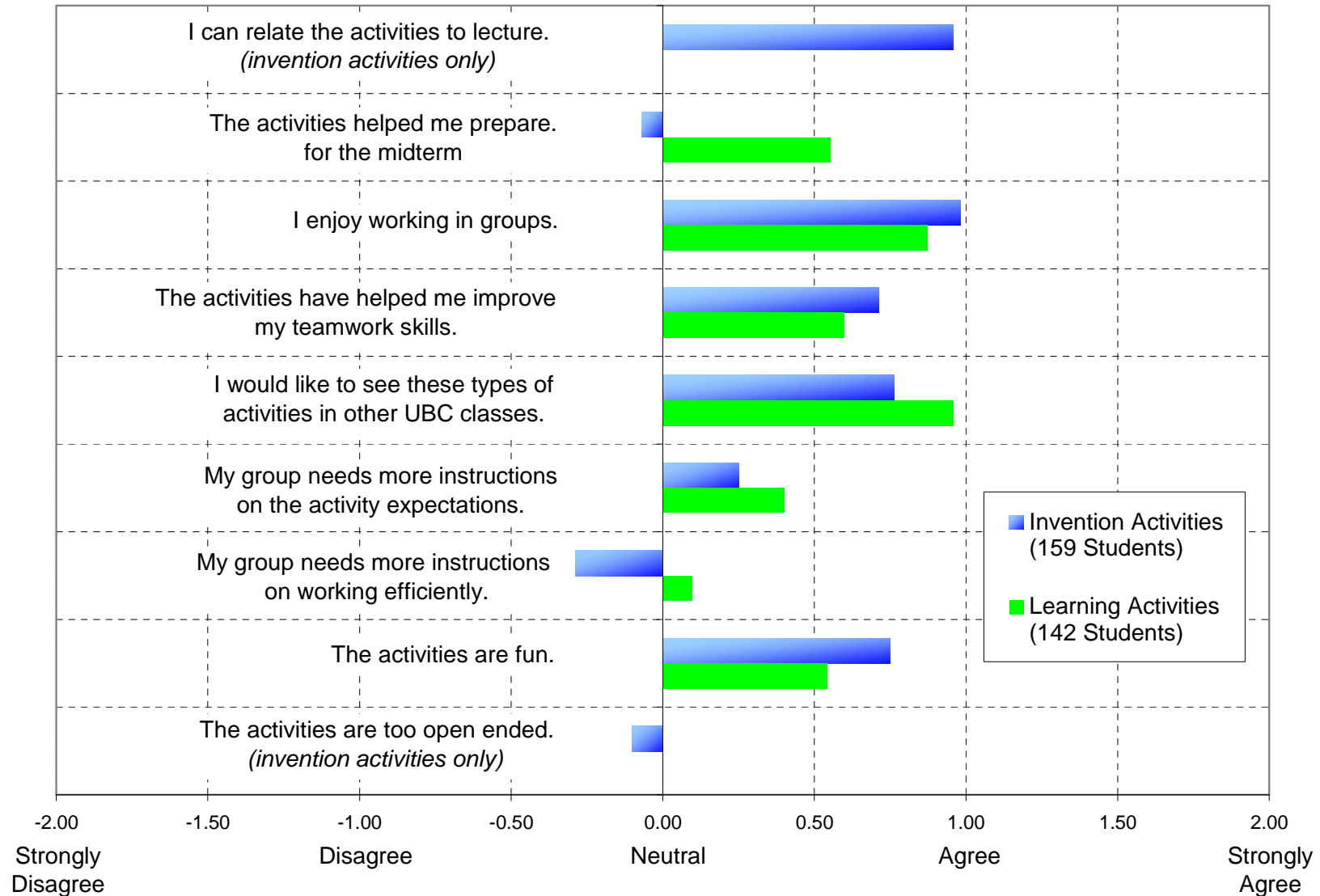
The Activity Format

- The format, continued:
 - Each group must carry out a mini-presentation to the other activity groups.
 - Learning activity students present their group's solution (or part of the solution depending on the time remaining).
 - Invention activity students present their group's invention.
 - In the final 10 minutes the facilitator provides explanation (learning activities) or relates the problem to upcoming lecture material (invention activities).
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Assessments

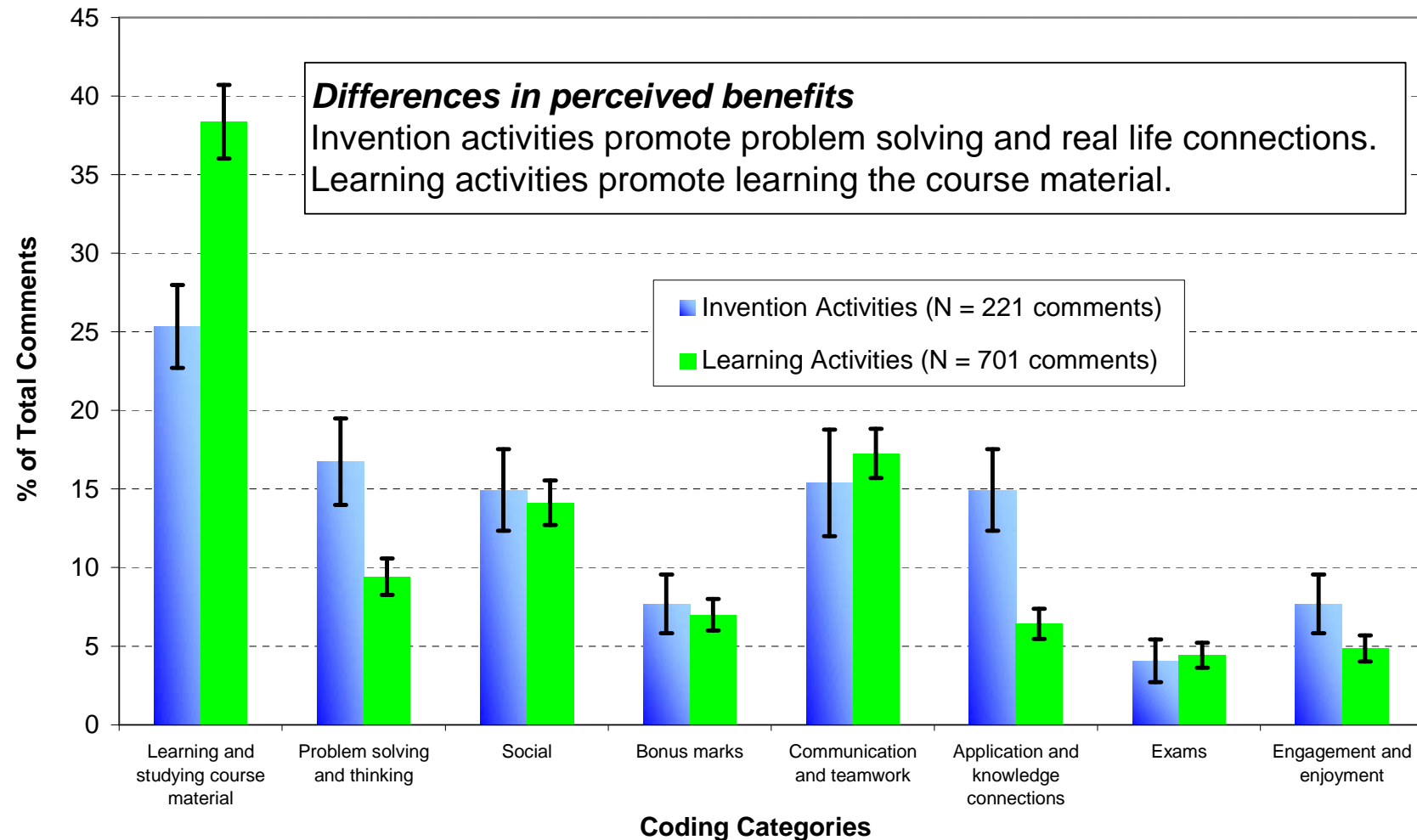
- Four types of assessments were used to evaluate various performance aspects of the learning and invention activities:
 - Self-reporting surveys.
 - Engagement monitoring.
 - One-on-one problem solving interviews.
 - Exam performance (analysis currently in progress).
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Results: Self-Reporting Surveys



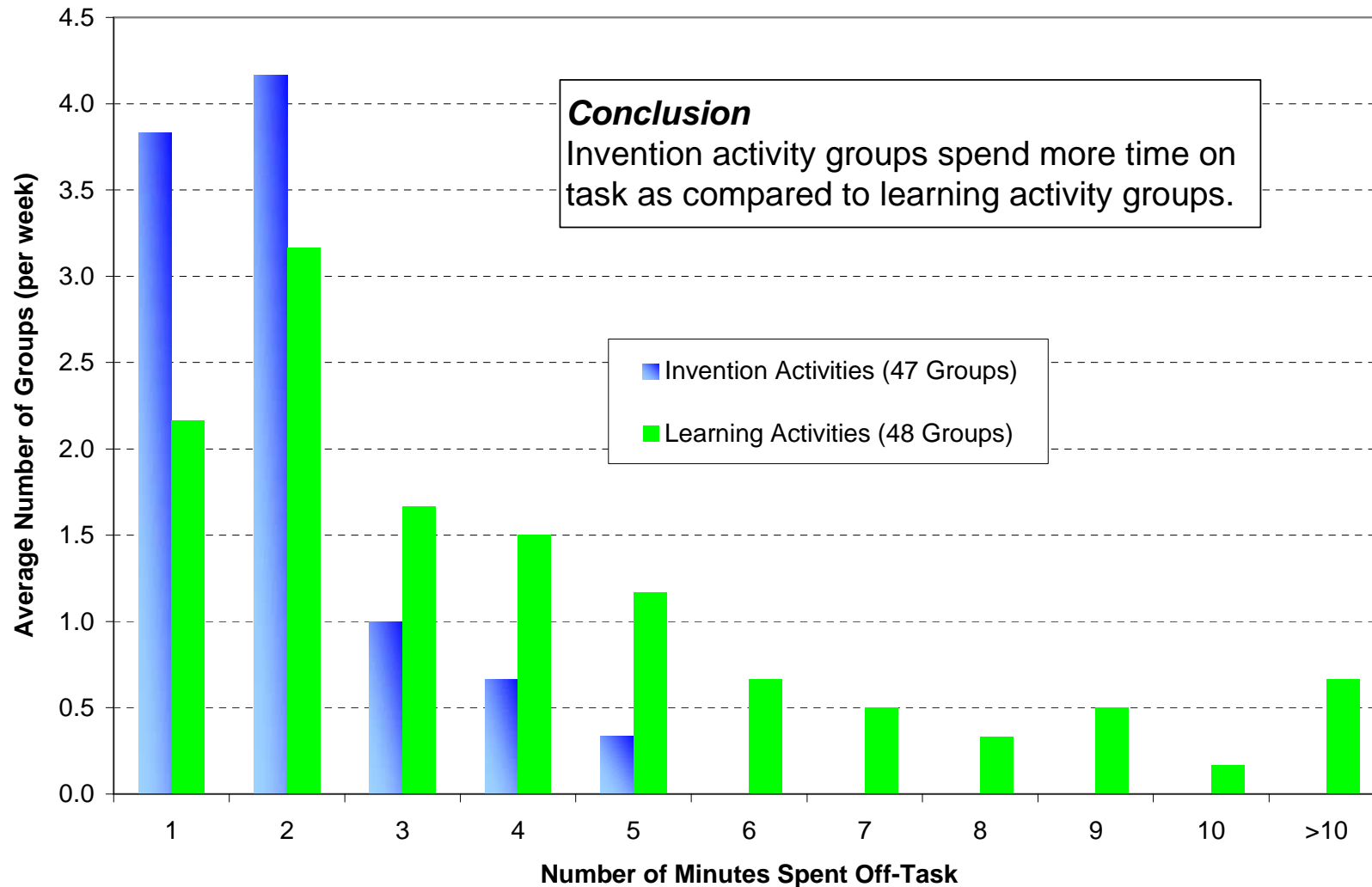
Results: Self-Reporting Surveys

"What were the top three benefits of participating in the invention or learning groups?"



Results: Engagement

Number of Disengaged Groups Per Week

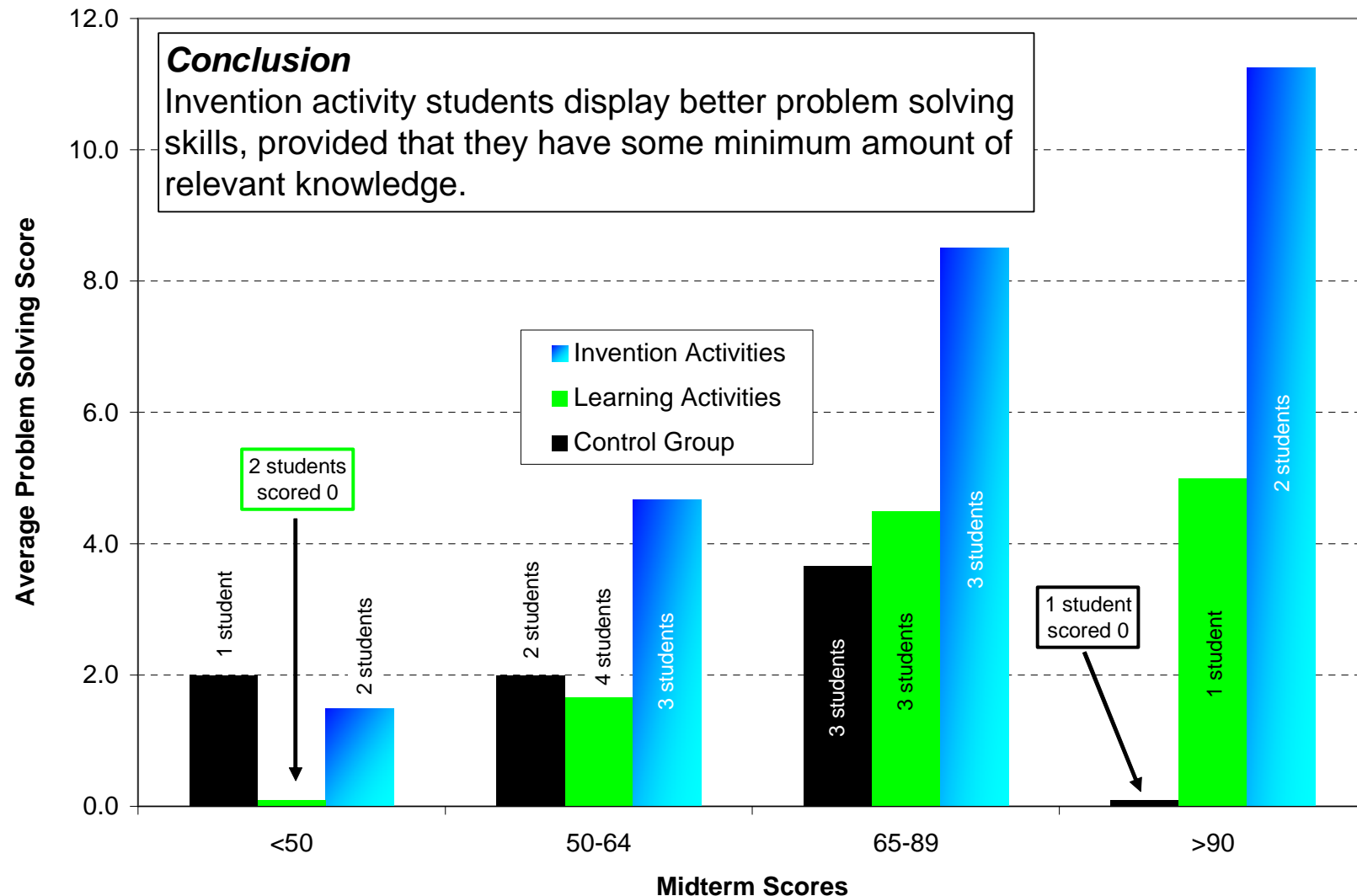


Results: Interviews

- Students from the invention activity group, learning activity group, and control group (students who volunteered but could not be placed into an activity) were interviewed to test their problem solving skills.
 - During the interview, student were asked to suggest a solution to biological problem based on a system they had not seen in class.
 - Each student received an “problem solving score” based on the number of solutions and the quality of each solution.
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Results: Interviews

Interview Problem Solving Scores



Acknowledgements

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