Analyzing Individual and Cooperative Electronic Response Systems in Astronomy

Patrick M. Len
Cuesta College
San Luis Obispo, CA
(pLen@cuesta.edu)

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Background/Goals
“Clickers” used to engage and challenge students (Classroom Performance System, eInstruction.com)
What motivates “collaborative” clicker use?
What motivates “self-tester” clicker use?

Clicker Reward Structures
Introduction questions versus review questions
- Introduce new material
- Confront common misconceptions
- Participation credit awarded, regardless of response

Clicker Reward Structures
Introduction questions versus review questions
- Test comprehensive understanding
- Are based on sample exam questions
- Participation credit doubled if success rate ≥ 80%

Response/Success Rates
(Fall semester 2005, N = 36)
111 Intro. questions (participation only)
Clickthroughs
Success
80% ± 13%
45% ± 7%

100 Review questions (participation + success bonus)
Clickthroughs
Success
80% ± 14%
82% ± 17%

Review questions have same response rate (p < 0.993), but higher correct rate (p < 0.000) than intro. questions

Student Response Modes
(Self-reported, Fall semester 2005, N = 36)

<table>
<thead>
<tr>
<th></th>
<th>Self-testers (Answer independently)</th>
<th>Collaborators (Interact before answering)</th>
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<tbody>
<tr>
<td>Intro. questions</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>Review questions</td>
<td>1</td>
<td>35</td>
</tr>
</tbody>
</table>

Intro. questions (participation only) divided class into two response types (p < 0.001 significance)
Review questions (participation + success bonus) motivated near-unanimous cooperation (p < 0.001)
**Student Attitudes**
(Attitudes Towards Astronomy, Fall semester 2005)

<table>
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<th>Self-testers (Answer independently)</th>
<th>Collaborators (Interact before answering)</th>
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<tbody>
<tr>
<td>Cognitive competence (low = 1, high = 5)</td>
<td><img src="chart" alt="" /></td>
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<tr>
<td>pre</td>
<td>3.6 ± 0.8</td>
<td>3.5 ± 0.5</td>
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<tr>
<td>post</td>
<td>3.8 ± 1.0</td>
<td>3.1 ± 0.6</td>
</tr>
</tbody>
</table>

- Negative pre- to post- shift for collaborators (p < 0.001)
- Lower post-test scores for collaborators versus self-testers (p < 0.05)

**Summary/Conclusions**
“It was the best of times, it was the worst of times...”

Review questions (participation + success bonus) motivate near-unanimous cooperation, interaction, and higher success rates.

Collaborators (interact for participation-only credit) have lower and negative shifts in attitudes towards science.

**Future Research Questions**
What is the difference in science backgrounds (if any) between self-testers and collaborators?

Can cooperative clicker behavior be constructively used to improve attitudes towards science?

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