Student Polling: It’s the Taking Part That Counts
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I was given a $3,000 grant by Echo360 to become a ‘2019 Echo Champion’. This has paid for my attendance at SwanDELTA 2019.

Echo360 has not place any conditions on receiving or using the funding.

They haven’t asked to approve my slides and they haven’t been involved in my project aside from releasing the Echo360 logo and screenshots for publication.

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Introduction and Literature

Active Learning

There are established links between active learning in tertiary STEM classes and course performance (Freeman et al., 2014)

- around 6% improvement in active learning sections
- odds ratio for failing a course was 1.95 in classes with ‘traditional’ lecturing compared with active learning sections
- holds across all disciplines, class sizes, course types, levels

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Introduction and Literature

Electronic Voting Systems
Student Polling & Clickers

Electronic Voting Systems
Student Polling & Clickers

EVS, Student Polling & Clickers

Electronic Voting Systems
Student Polling & Clickers

Electronic Voting Systems
Student Polling & Clickers

Student polling clearly meets Freeman et al.’s (2014) definition of active learning.

They are listed as a specific example:

[where clickers are used], 10–15% of class time [is] devoted to clicker questions.

We were not able to evaluate the relationship between type of active learning event and student performance (Freeman et al. 2014, p4)

In tertiary mathematics...

There is an established positive association between student polling and student satisfaction (Strasser, 2010).

What about the ‘active learning’ effect?

- Simelane and Skhosana (2012) found a grade improvement at the aggregate level
- King and Robinson (2009) could find no clear link between individual clicker use and attainment
- Castillo-Manzano et al.’s (2016a) meta-analysis on links between clicker use and attainment only found a tiny effect size for “hard-science” classes (Hedges’ $g = 0.0522$, $SE = 0.0157$, $p < 0.01$)
- In another paper, Castillo-Manzano et al. (2016b) remark:

There is no empirical evidence at all that [clickers] are an aid to solving mathematical problems [in future assessments]

This study

Aim

To explore whether student engagement with in-class polling is associated with better performance in associated assessments.

- Can we control for the effect of ‘student engagement’?
- Is the association consistent across different levels of student ability?

Participants

First-year mathematics course for non-mathematics majors ($N = 110$).

- Echo360 synchronous polling activities were used throughout (105 total activities)
- Secondary data made available for research via a National Statement §2.3.10. consent waiver

Poll examples: Multiple Choice

[slide 9, bottom] What is $d$?

Which of the expressions represent vectors?

A $a+b+c$  A  
B $a+b$  B  
C $a-b+c$  C  
D $a-b+c$  D  
E $a-b+c$  E  
F $a+b+c$  F  

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Poll examples: Heat Maps

Where is 1-2j

The median datapoint will be located at which position?

n=46  leaf=unit=0.1
6  2|124999
15 3|00000011133344
(14) 3|6666777777889
11  4|14455777889

Poll examples: Numerical Answer

A bank pays 5.60% p.a., compounded daily, on a 9-month certificate of deposit. If you deposit $20,000, how much interest will you earn (to the nearest whole dollar)?

What degree polynomial would be a reasonable choice?

Data & Variables

Data from Semester 1, 2019 (March-June)
- Responses to in-class polling activities
- Final exam score (unmoderated)

Indicators of engagement
- Online assessment engagement**
- Canvas activity*
- Non-polling Echo360 activity**
- Physics attendance

Indicators of prior performance
- ATAR**
- Exam score in most recent Physics exam** (unmoderated)

* significant correlation with exam score at the 0.05 level (two-tailed)
** significant correlation with exam score at the 0.01 level (two-tailed)

Effect of Clicker Use

Students who responded to in-class polls scored higher their exams
- Students who responded to at least one clicker question did better on their exam ($N=88$, mean $z$-score= 0.147) compared to their peers who did not answer any polling prompts ($N=22$, mean $z$-score= −0.599), $t(108) = −3.218$, $p = .002$.
- There was a positive correlation between the number of responses and exam score $r_s = .422$, $p < .001$.

Only considering those who responded to at least one poll,
- There was still positive correlation between number of responses and exam score $r_s = .325$, $p = .020$. 
The students who responded with correct poll choices usually did better in their exams:

- Across the entire cohort (including those who did not engage with polls), there was a positive correlation between number of correct responses and exam score, \( r_s = .272, p = 0.05 \).
- Only considering those who completed at least one clicker question there is no statistical significance in the correlation between number of correct responses and exam score, \( r_s = .138, p = .208 \).

Controlling for engagement:

- Online assessment engagement
- Canvas activity
- Non-polling Echo360 activity

After removing missing cases, \( N = 107 \)

Controlling for these variables, there was a significant partial correlation \((p < 0.001)\) between polling participation and exam score:

- Across the entire cohort \( r = .452, \text{BCa CI } [.270, .608] \)
- Considering only those students who responded to at least one polling question \( r = .393, \text{BCa CI } [.176, .574] \)
Effect of prior performance?

Prior performance variables which are correlated with exam score

- Australian Tertiary Admission Rank (ATAR)
- Exam score in most recent Physics exam

After removing missing cases, $N = 72$

Controlling for these variables, there was a significant partial correlation ($p < 0.001$) between polling participation and exam score

- across the whole cohort $r = .280$, BCa CI [.051, .472]
- considering only those students who responded to at least one polling question $r = .276$, BCa CI [.016, .512]

Summary & Discussion

There is strong evidence of a relationship between student engagement with in-class polling and increased exam performance.

- This relationship appears to be robust with relation to [available] metrics for student engagement and student ability

It feels unlikely that engagement with in-class polling should be different to other forms of active learning in class

- Then why haven’t other studies have found such strong evidence in tertiary mathematics or “hard science”? (Castillo-Manzano et al., 2016a)

- Castillo-Manzano et al. (2016b) suggested that polling activities may not be helpful in preparing students for solving future mathematical problems. Could the variation of polling types available in Echo360 be a driver of this effect?

References


