

# Directed Crib Sheet Development as a Test Preparation and Review Tool: Identifying the Effectiveness of Incentives on Student Learning Outcomes in Principles of Economics

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## Crib Sheets as a Teaching Strategy

- The strategy of allowing students to bring a resource aid into the classroom during exams is a widely-used learning technique which often takes the form of crib sheets whereby students create their own hand-written notes on a specified-sized piece of paper.
- Crib sheets may encourage a student to plan, prioritize and organize the course content in a logical manner which helps best prepare the student for the exam<sup>1</sup>.
- However, there can be unintended consequences if the method leads to reduced preparation prior to the exam. For instance, a student may choose to simply copy another student's crib sheet, bypassing the process through which learning takes place.
- Research in other fields is inconclusive with regards to whether cheat sheets improve student performance on tests<sup>2</sup>. Research on the effectiveness of all three methods on student's performance is absent in economics, a field in which logical and organized thought is paramount in successful learning.

## Experimental Method

- Students in six sections total of Principles of Microeconomics and Principles of Macroeconomics were allowed to use a crib sheet on two out of three mid-semester exams according to the following schedule:

	Section 1	Section 2	Section 3
Test 1	Directed Crib Sheet	Non-Directed Crib Sheet	No Test Aid
Test 2	Non-Directed Crib Sheet	No Test Aid	Directed Crib Sheet
Test 3	No Test Aid	Directed Crib Sheet	Non-Directed Crib Sheet

### Directed Crib Sheet

- Shortly after students began work on the section of material to be covered in the exam, they were put into groups of 5 and assigned to work together to prepare a one-page summary of each chapter. Students were instructed that this was the first part of a process which would result in their having a crib sheet for use on the upcoming exam.
- One class day prior to the exam, students submitted the summary pages so that the instructor could briefly review them.
- Students were instructed to use the summary pages to create a one-page crib sheet for use on the exam.

### Non-directed Crib Sheet

- Shortly after students began work on the section of material to be covered on the exam, they were told that they would be allowed to use a one-page crib sheet on the exam. No further instructions or guidance were given, although they were reminded prior to the exam that a crib sheet would be allowed.
- In addition to test scores, students completed an online Qualtrics survey at the start of the semester regarding their overall GPA, academic classification, study habits, etc.
- After the final mid-semester exam, students responded to a brief survey which elicited their subjective observations regarding the value of crib sheets as a study and test aid.

## Do students perform better on exams when using crib sheets?

### Motivation

- Students tend to believe that they will perform better on tests when allowed to use crib sheets (also called cheat sheets) on exams. We test whether this is the case in Principles of Microeconomics and Principles of Macroeconomics using two processes for creating the test aid.

### Method

- Students in each of the course sections created crib sheets, directed or non-directed, for two mid-semester exams according to an established schedule.
- We test whether student test performance is improved when using a crib sheet and whether the self-made or process-directed crib sheet is more helpful.
- We test the differential impact of using crib sheets as a learning aid by categories such as different academic classifications, GPAs, etc.

### Results

- Controlling for the specific test taken, course, section, same individuals across tests as well as other observables, the results indicate that using directed crib sheets (relative to no crib sheet) has a positive and statistically significant impact on test scores.
- By taking a test aided with a directed crib sheet, test scores increase by about 9 percent.

### Selected Summary Statistics

Variables	All		
	Mean (std. dev.)	Min	Max
	(1)	(2)	(3)
<b>Dependent variable(s)</b>			
Test scores (Quality points)	2.188 (1.233)	0.000	4.000
<b>Control variables</b>			
No crib sheet	0.381	0.000	1.000
Non-directed (self) crib sheet	0.304	0.000	1.000
Directed (group) crib sheet	0.315	0.000	1.000
Female	0.515	0.000	1.000
White	0.861	0.000	1.000
Other race	0.139	0.000	1.000
Hispanic (any race)	0.045	0.000	1.000
Age	19.297 (1.153)	17.000	25.000
GPA (overall)	3.352 (0.543)	0.000	4.000
Microeconomics	0.500	0.000	1.000
Music Business major	0.574	0.000	1.000
Freshmen	0.500	0.000	1.000
Sophomore	0.193	0.000	1.000
Junior	0.228	0.000	1.000
Senior	0.040	0.000	1.000
Number of observations	606		

- Weimer, Maryellen. "Crib Sheets Help Students Prioritize and Organize Course Content." *Faculty Focus: Focused on Today's Higher Education Professional*. Magna Publications, 27 February 2013. Web. 28 March 2013.
- See, for instance, de Raadt, Michael. "Student Created Cheat-Sheets in Examinations: Impact on Student Outcomes." *Proceedings of the Fourteenth Australian Computing Education Conference*, Melbourne, Australia, 12 January (<http://crpit.com/confpapers/CRPITV123Raadt.pdf>) OR Dickson, K.L. and M.D. Miller "Authorized Crib Cards Do Not Improve Exam Performance." *Teaching of Psychology* 32.4 (2005): 230-233. Print



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## Results

### Difference in Mean Test Scores (Quality Points) by Selected Categories

Selected categories	Difference in mean (non-directed crib sheet minus no crib sheet)	Difference in mean (directed crib sheet minus no crib sheet)	Difference in mean (directed crib sheet minus non-directed crib sheet)
	p-value (1)	p-value (2)	p-value (3)
All	0.264	0.153	0.735
Female	0.215	0.112	0.692
Male	0.695	0.658	0.952
White	0.161	0.1178	0.837
Other race	0.574	0.854	0.716
Music Business major	<b>0.059</b>	0.116	0.812
Non-Music Business major	0.643	0.692	0.428
Freshmen	0.845	0.502	0.644
Sophomore	0.189	0.109	0.749
Junior	0.980	0.826	0.816

### Estimates of the Differential Impact of Crib sheets as Learning Aid on Student test scores as measured by quality points

Variables	(1)	(2)	(3)
Non-directed (self) crib sheet	0.160* (0.097)	0.178* (0.098)	0.165 (0.112)
Directed (group) crib sheet	0.175* (0.091)	0.195** (0.091)	0.203* (0.106)
Female	-0.294** (0.124)	-0.249** (0.124)	-0.062*** (0.010)
White	-0.072 (0.184)	0.064 (0.185)	0.194*** (0.013)
Hispanic (any race)	-0.122 (0.352)	-0.001 (0.355)	-1.049*** (0.013)
Age	-0.101* (0.053)	-0.092* (0.049)	-0.384*** (0.004)
Overall GPA	0.841*** (0.224)	0.810*** (0.212)	0.733*** (0.006)
Music Business major	-0.004 (0.124)	0.002 (0.122)	0.384*** (0.011)
Test fixed-effects	Yes	Yes	Yes
Section fixed-effects	Yes	Yes	Yes
Class fixed-effects	No	No	Yes
Individual fixed-effects	No	No	Yes
Number of observations	598	598	598
R-square	0.223	0.263	0.696

Notes: Robust standard errors clustered by individual. Statistical levels of significance are: \* indicates p<0.1, \*\* indicates p<0.05, \*\*\* indicates p<0.01. The dependent variable is the equivalent quality points based on student test scores. The models also control for whether students indicated they copied notes, read notes, read the text, practice homework questions or discussed with the material with others while studying for tests. Also, various types of study distraction indicators (TV, unrelated stuff and telephone) were included as controls in the model. The last two columns (that is, Columns 2 and 3) include controls for student learning styles derived using Kolb's (1984)<sup>^</sup> Learning inventory, namely accommodative, divergent, assimilative and convergent.

<sup>^</sup>Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall

## Selected Student Comments

"I felt like when I made my crib sheet that once I wrote everything down I memorized it, so I barely looked at it during the test. It was more reassurance than anything else."

"It depended on the test. On the first test, the sheet was helpful because there were lots of definitions and equations to remember, but on the 2<sup>nd</sup> test it did not help much because the test was much more involved."

"Crib Sheets offer an incentive to study. After making my crib sheet I knew the material MUCH better because I was forced to pick out the important topics from each chapter and organize my thoughts in a way that helped me...fully understand."

"I didn't necessarily use the crib sheet once it was time to take the test, but preparing it to use on the test was a great study tool as was it nice to have a crutch I could fall back on if needed."

"Didn't force you to remember formulas which helped a lot. Made me, or allowed me, to focus on the important parts of each chapter."

"Group sheets were just too complicated to meet up [and] make sure each person had the info they needed on the sheet."