CRLT-ENGIN
UNIVERSITY OF MICHIGAN

Long Term Effects of Partner Programming in an Introductory Computer Science Sequence

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Problem

- Pair programming is a software development technique where two programmers work together at one workstation on the same problem
- Concern that students may divide the work instead of working together, missing portions of material
- Concern that students may become dependent on partnerships, leading to future difficulty working independently

Research Questions

- Are student partnerships during a past semester associated with changes in student performance during a future semester while working alone?
- Do observations about student partnerships vary with different demographic groups?

Dataset

CS2: Introductory Data Structures (EECS 280)
CS3: Data Structures and Algorithms (EECS 281)

CS1

CS2
- 2,234 students
- 4 total semesters
- Project and exam scores
- **Optional partnerships**

CS3
- 2 total semesters
- Project and exam scores
- **Individual work**

Advanced Courses

Demographic Information
- Gender
- Cumulative GPA

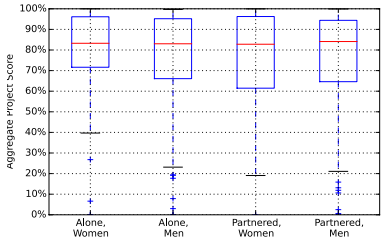
CS3 (EECS 281) Results

Evaluation	Gender	Partnered Mean	Alone Mean	Difference	p Value
Projects	Men	77.2%	72.6%	4.6%	0.023
	Women	76.7%	69.3%	7.3%	0.111
Exams	Men	62.9%	64.6%	-1.7%	0.110
	Women	61.9%	60.9%	1.0%	0.712

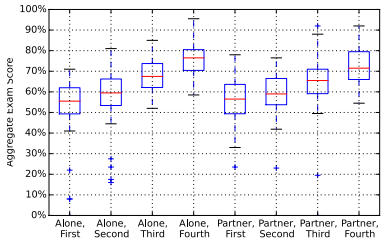
CS3 Performance by Gender

Evaluation	Quartile	Partnered Mean	Alone Mean	Difference	p Value
Projects	**1st**	**60.4%**	**51.2%**	**9.2%**	**0.032**
	2nd	71.0%	66.2%	4.8%	0.149
	3rd	81.7%	77.7%	4.0%	0.168
	4th	90.8%	92.1%	-1.3%	0.469
Exams	1st	55.2%	55.6%	0.04%	0.846
	2nd	57.4%	58.2%	-0.8%	0.669
	3rd	64.4%	66.6%	-2.0%	0.223
	4th	**72.0%**	**75.8%**	**-3.8%**	**0.008**

CS3 Performance by Quartile



CS3 Project Scores by Gender



CS3 Exam Scores by Quartile

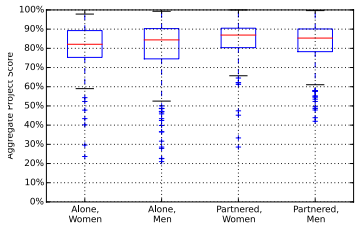
CS2 (EECS 280) Results

Evaluation	Gender	Partnered Mean	Alone Mean	Difference	p Value
Projects	**Men**	**83.0%**	**80.3%**	**2.7%**	**0.005**
	Women	**84.1%**	**79.1%**	**5.0%**	**0.007**
Exams	**Men**	**72.0%**	**75.2%**	**-3.2%**	**0.001**
	Women	**70.9%**	**72.5%**	**-1.6%**	**0.388**

CS2 Performance by Gendre

Evaluation	Quartile	Partnered Mean	Alone Mean	Difference	p Value
Projects	**1st**	**76.6%**	**67.8%**	**8.8%**	**0.000021**
	2nd	**81.4%**	**77.7%**	**3.7%**	**0.033**
	3rd	**85.7%**	**83.6%**	**2.1%**	**0.022**
	4th	**89.5%**	**90.6%**	**-1.2%**	**0.095**
Exams	1st	61.6%	62.9%	-1.3%	0.434
	2nd	66.9%	70.2%	-3.3%	0.031
	3rd	74.4%	78.2%	-3.8%	0.001
	4th	84.5%	86.4%	-1.9%	0.037

CS2 Performance by Quartile



CS2 Project Scores by Gender

Evaluation	Partnered Mean	Alone Mean	Difference	p Value
Projects	**83.3%**	**80.0%**	**3.3%**	**0.0001**
Exams	**71.8%**	**74.6%**	**-2.8%**	**0.001**

Overall CS2 Performance

Discussion

- Students who partnered in CS2 tended to score better on projects in CS2. Students in CS2 working alone were associated with higher CS2 exams scores.
- Women had nearly double the benefit of CS2 partnerships than men. Additionally, negative effect of partnerships on CS2 exam performance for women is half that of men
- Men who partnered in CS2 had a higher average project score in CS3 higher than those who had worked alone
- We see that the associated benefit of partnerships decreases with higher GPA.
- Students in the lowest GPA quartile do better on projects in CS3 after partnering in CS2.
- Students in the fourth quartile tend to do slightly worse on exams in CS3, when they choose to partner in CS2.

Limitations

- Students had the choice to partner on projects in their CS2 course; and furthermore they had their choice of partners.
- We had did not have control over group dynamics

Conclusions

- Partnerships were mostly associated with increased project performance in both CS2 and CS3; especially among those in the lowest GPA quartile
- Working alone was mostly associated with higher exam scores in both CS2 and CS3; especially among those in the highest GPA quartile