HOW DO QUIZ AND HOMEWORK SUBMISSION TIMES AFFECT STUDENTS' PERFORMANCE IN A FLIPPED CS1 CLASS?
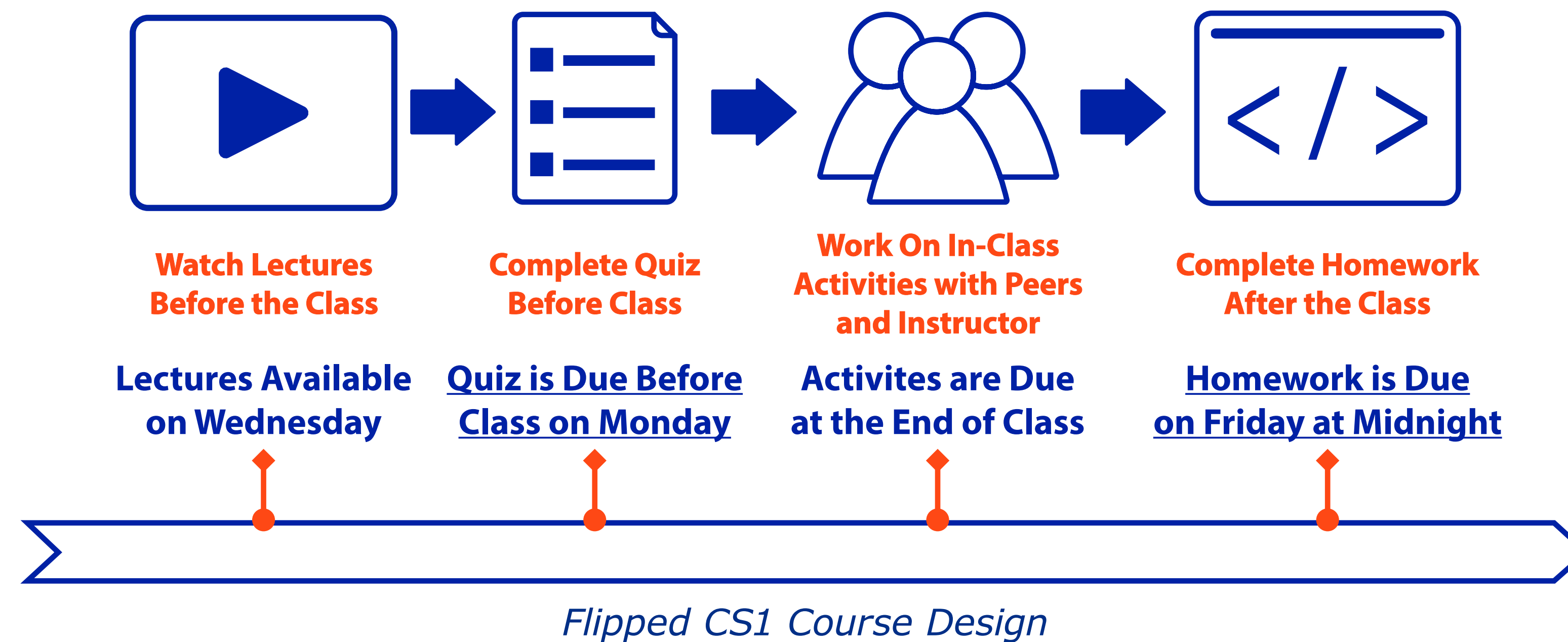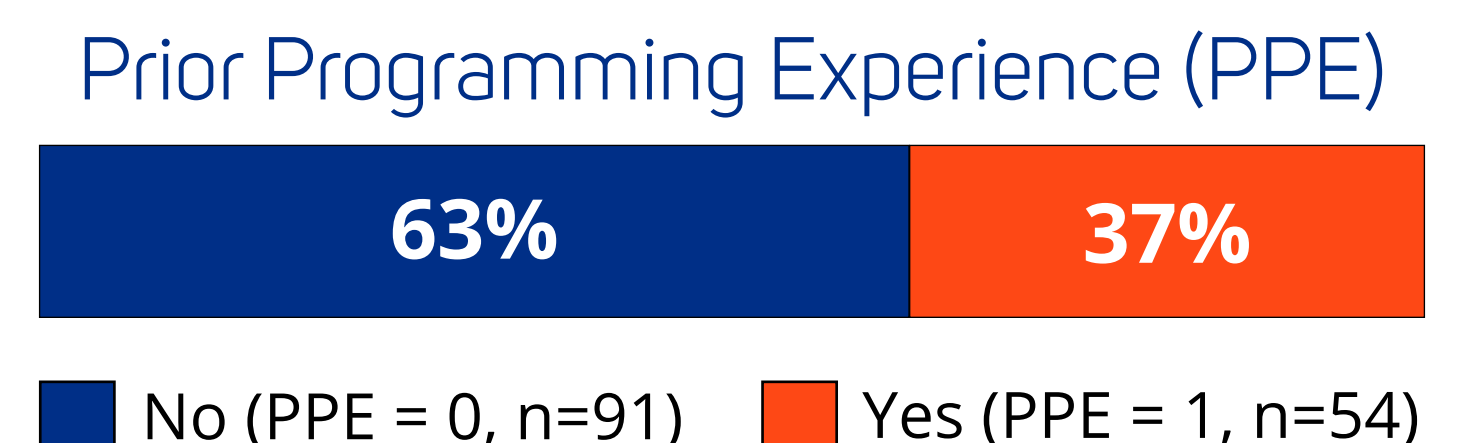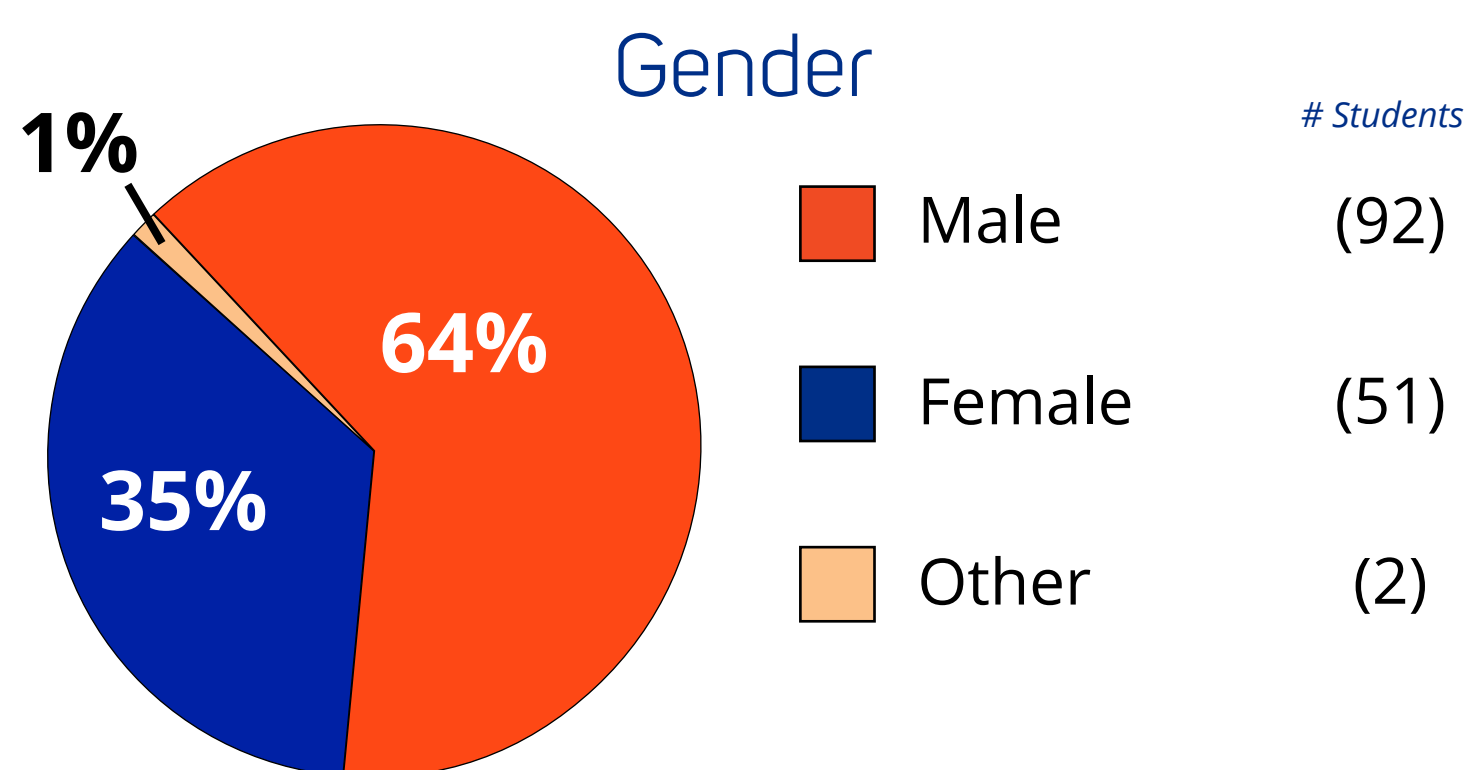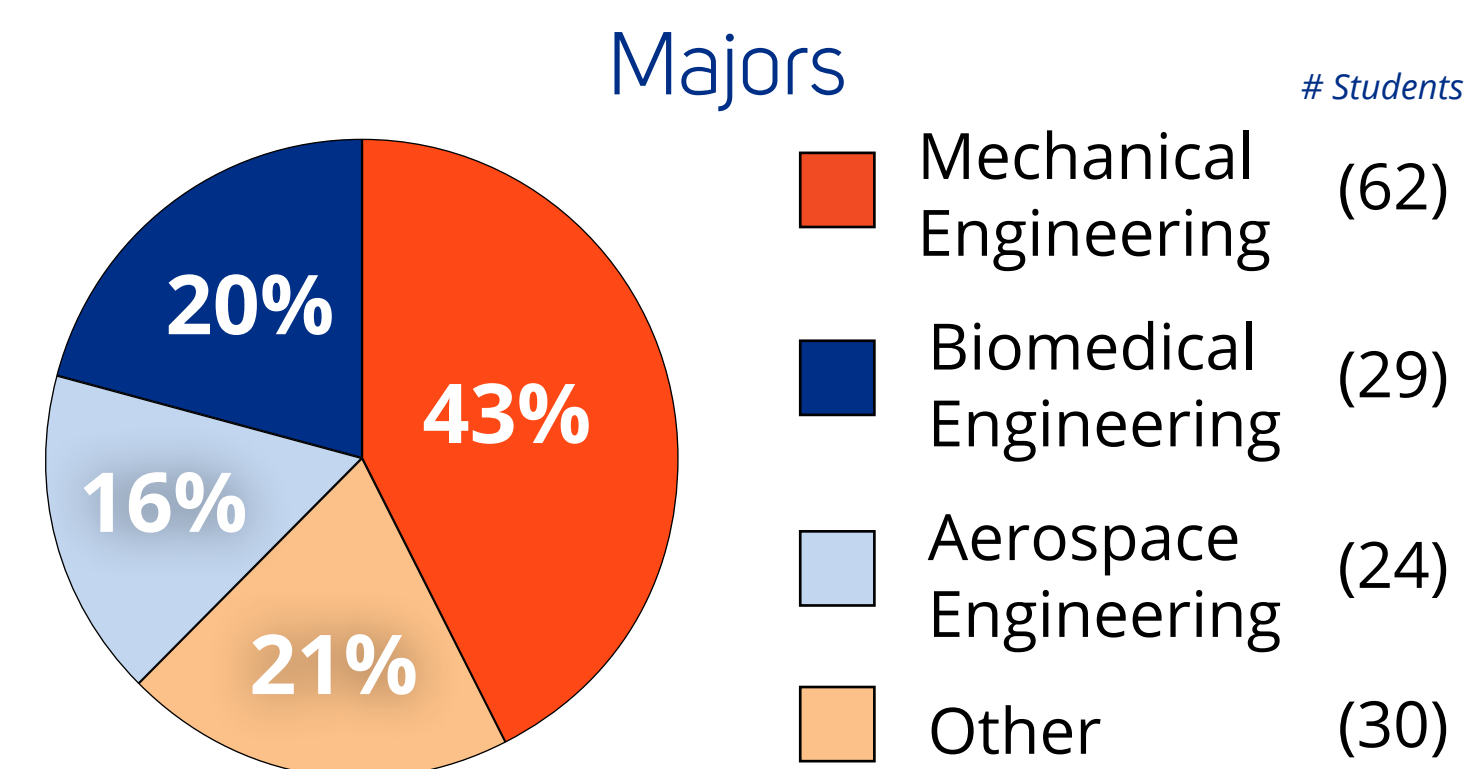
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RESEARCH QUESTIONS

> How do quiz and homework submission times affect students' performance in a CS1 course?

> What role does prior programming experience have in influencing students' performance with respect to their quiz and homework submission times?
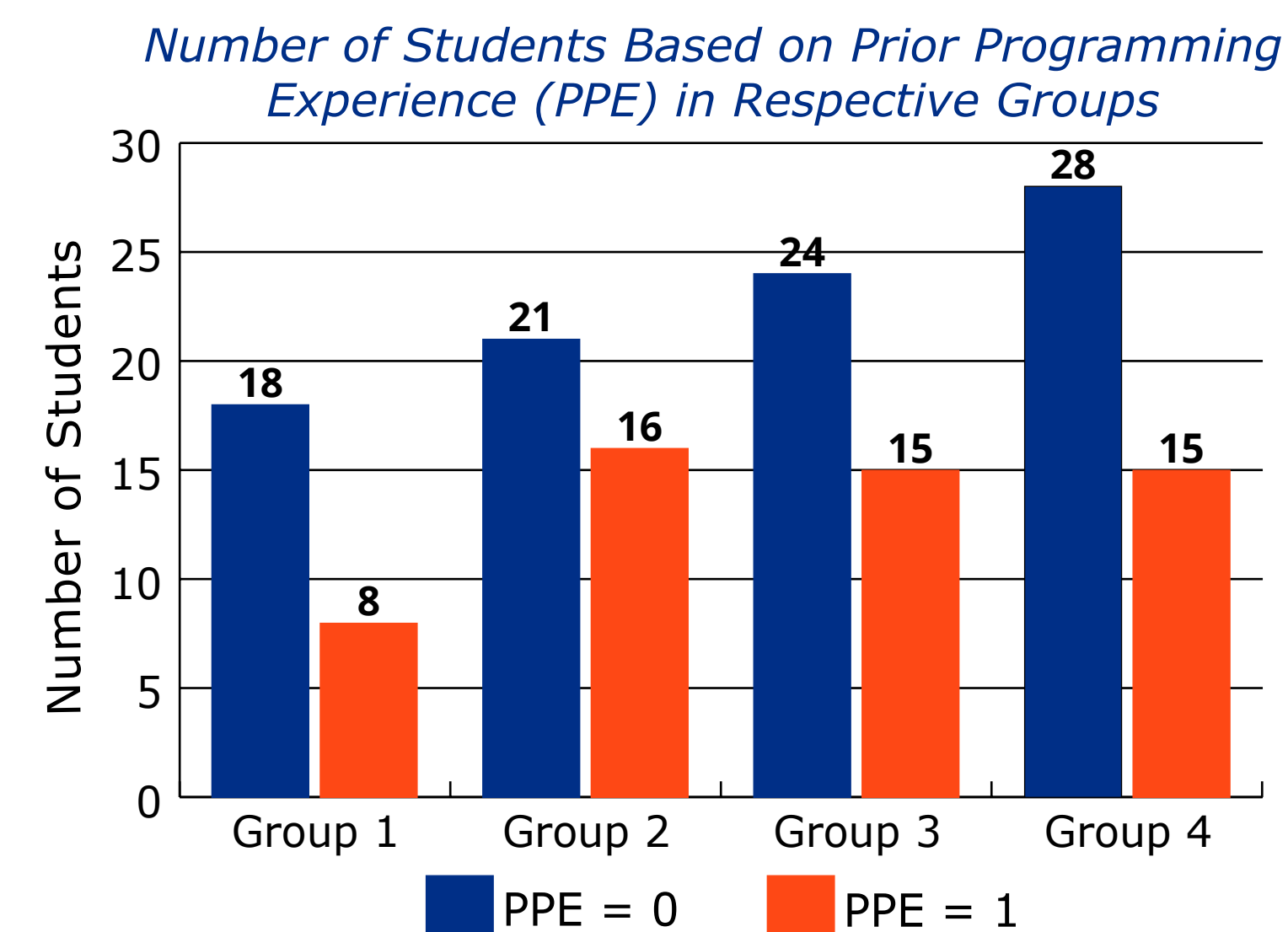
CLASS DEMOGRAPHICS

 # Students = 145 | Non Majors | MATLAB

Majors

	# Students
Mechanical Engineering	(62)
Biomedical Engineering	(29)
Aerospace Engineering	(24)
Other	(30)

20%, 43%, 16%, 21%

Gender

	# Students
Male	(92)
Female	(51)
Other	(2)

64%, 35%, 1%

Prior Programming Experience (PPE)

| 63% | 37% |

■ No (PPE = 0, n=91)   ■ Yes (PPE = 1, n=54)

Watch Lectures Before the Class → **Complete Quiz Before Class** → **Work On In-Class Activities with Peers and Instructor** → **Complete Homework After the Class**

Lectures Available on Wednesday   **Quiz is Due Before Class on Monday**   **Activites are Due at the End of Class**   **Homework is Due on Friday at Midnight**

Flipped CS1 Course Design

METHODS

Students were divided into 3 sections

Total Number of Quizzes: 11
Total Number of Homeworks: 10

Time Remaining (Quiz/Homework) =
(Deadline - Student's Latest Submission Time)

$$\text{Aggregate Time Remaining} = \frac{\text{Median}(\sum \text{Quiz}) + \text{Median}(\sum \text{HW})}{2}$$
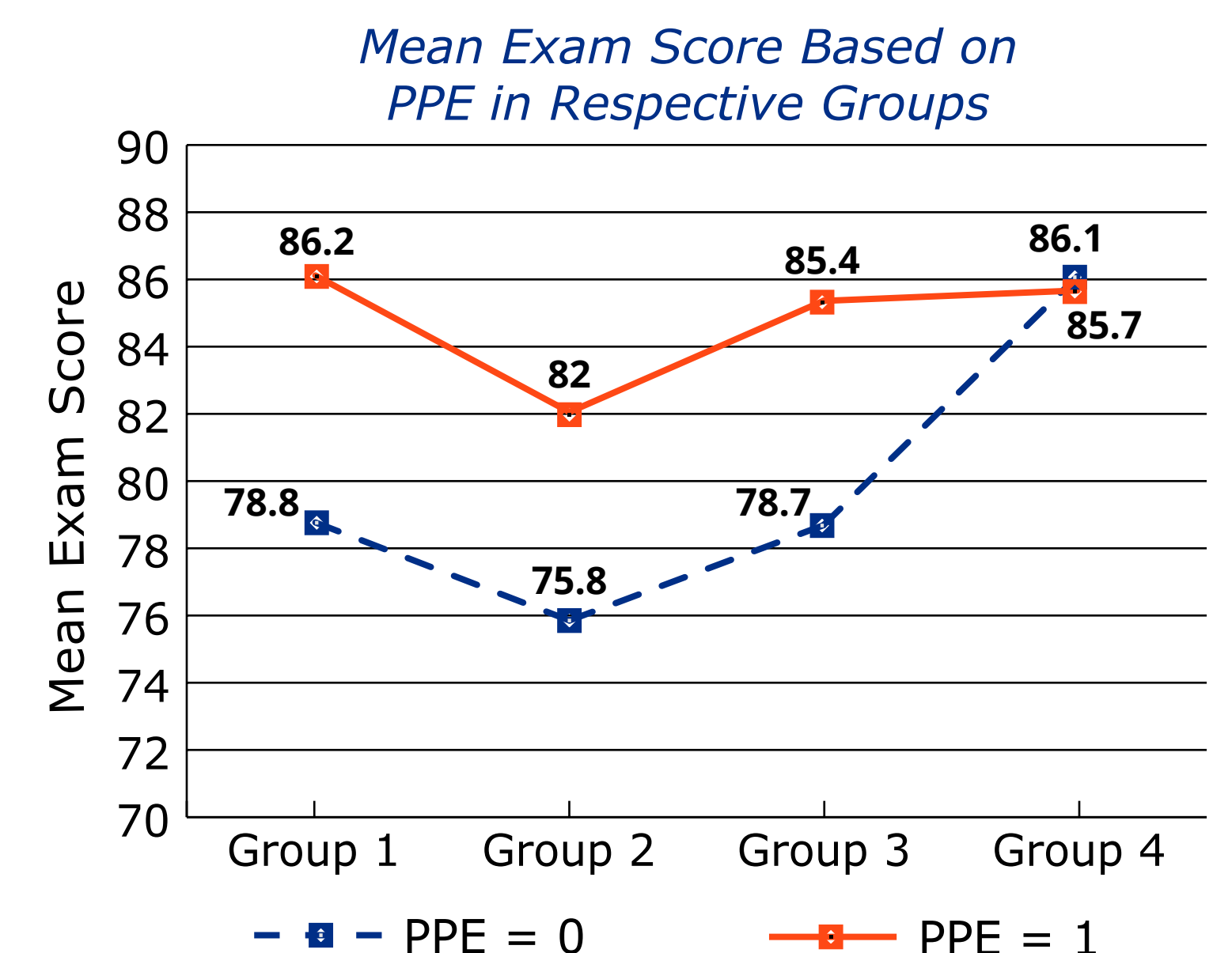
One-Way ANOVA ($\alpha = 0.05$)

Number of Students Based on Prior Programming Experience (PPE) in Respective Groups

■ PPE = 0   ■ PPE = 1

Group 1: 18, 8; Group 2: 21, 16; Group 3: 24, 15; Group 4: 28, 15

Group Classifications

Group	Aggregate Time Remaining	# Students	Mean Exam Score	Standard Dev.
1	≤ 6 hours	26	81.03	10.21
2	> 6 hours and ≤ 12 hours	37	78.49	12.30
3	> 12 hours and ≤ 24 hours	39	81.25	11.21
4	> 24 hours	43	85.98	9.92

RESULTS

> One-Way ANOVA $(F(3,141) = 3.28, p=0.023)$ **statistically significant**

> Based on Prior Programming Experience:

• **Case PPE = 1;** $(F(3,50) = 0.52, p=0.585)$ **not statistically significant**

• **Case PPE = 0;** $(F(3,87) = 0.36, p=0.017)$ **statistically significant**

Mean Exam Score Based on PPE in Respective Groups

- - PPE = 0   — PPE = 1

PPE = 1: Group 1: 86.2, Group 2: 82, Group 3: 85.4, Group 4: 86.1
PPE = 0: Group 1: 78.8, Group 2: 75.8, Group 3: 78.7, Group 4: 85.7

TAKEAWAYS

> Students who do not have prior programming experience can improve their course performance by completing the assignments earlier.

> Instructors can encourage certain types of behavioral engagement with certain student populations in flipped CS1 courses either through instructional design or through explicit recommendation. This could especially be helpful as a growing number of students with mixed abilities enroll in CS1 courses.