Investigating the Gender Gap in Introductory Physics Courses Using Self Reported Metrics

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Theory

A gender gap in physics concept inventories is often observed, with males performing better than females in this type of physics testing (Madsen et al, 2013).

The cause of this gender gap is undetermined, and it is believed that more than one factor contributes to this testing gap. Examples of such factors are test anxiety (Agra et al, 2017), student belief in their ability to succeed (Day et al, 2016), and differences in self-efficacy (Marshman et al, 2018).

This project takes a look at whether this gender gap also exists in student's self reported metrics, such as Interest and Preparedness, in an attempt to gauge the differences between male and female identifying student experience.

It is important to note that this experience may be different for those who identify with other genders. Analysis for non-binary or other gender identifying students is not included due to the very small sample size of replies received from those students.

Methods

A survey was distributed to introductory physics students with roughly 500 responses Winter 2020 and Fall 2021 Semesters. The surveyed course list is as follows:

Engineering Cohort:
- 1D03 (Mechanics)
- 1E03 (Waves, Electricity and Magnetic Fields)

Physical Sciences:
- 1C03 (Mechanics)
- 1CC3 (Mech. II, E&M, Waves, Modern Physics)

Life Sciences:
- 1A03 (Introductory Physics)
  - 11- (Grade 11 or Lower Physics Education)
  - 12+ (Grade 12 or Higher Physics Education)

Changes in Metrics After Course Completion

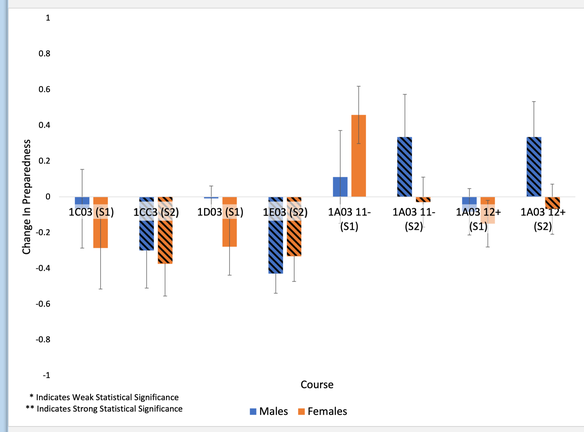

Figure 3:
The average change in perceived Preparedness across the introductory physics courses. -1 indicates a student who is feels less prepared at the end of the semester than at the start of the semester, 0 a student who experienced no change, and 1 a student who feels more prepared. No statistically significant gender gap was observed across any of the courses.

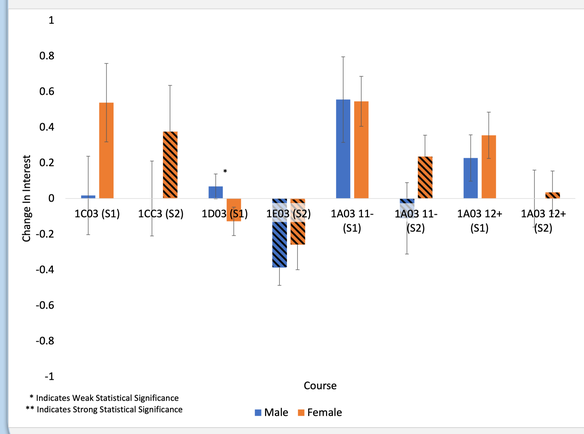

Figure 4:
The average change in interest across the introductory physics courses. 1 indicated a student who gained interest throughout the semester, 0 indicates no change, and -1 indicates a loss of interest. When correcting for sample size and course impact, only 1D03, the mechanics for engineers course, has weak statistical impact of gender.

Gender Gap in Initial Interest

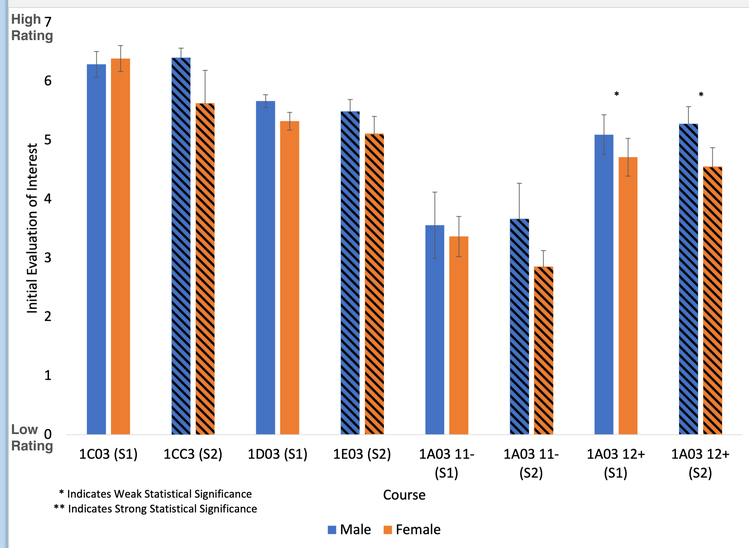

Figure 1: Average student response when asked to rate their initial interest in physics at the beginning of their physics course.

- Once statistically corrected for Course and Sample size, gender only weakly impacts the interest difference in the Life Sciences stream (1A03) for students that have previously taken grade 12 or higher physics.
- Thus, initial interest in a course is not significantly impacted by the gender gap.

Gender Gap in Initial Preparedness

- A statistically significant gender gap is observed in the second semester physics for engineers course (1E03), even though a gender gap did not appear in the first semester course (1D03). This implies that a gender gap may be dependant on specific topics, or forms in-between the semesters.
- A significant gender gap is observed for the life sciences stream (1A03) for students with previous experience in grade 12 physics or higher. This gap does not appear in students with previous experience of 11 or lower physics, due to lower sample sizes and higher variance.

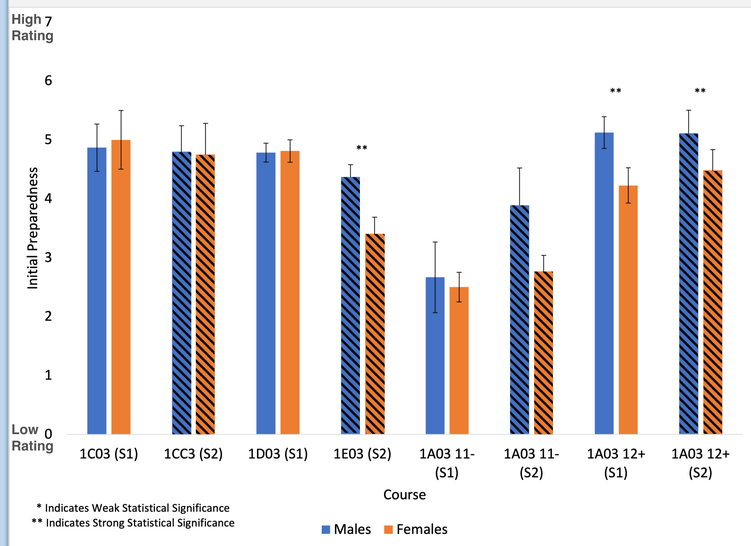

Figure 2: Average student response when asked to rate their initial preparedness for the physics course they are taking.

Correlation Between Metrics

Correlation Metric	Correlation Males	Correlation Females
Interest and Preparedness	0.308	0.380
Mathematical Comfort and Preparedness	0.444	0.261
Mathematical Comfort and Interest	-0.022	0.142

Table 1: The correlation coefficients between different metrics gathered from the survey. A gender gap exists in the correlation of Mathematics Comfort and Preparedness

Conclusions

- There exists a statistically significant gender gap in initial preparedness in 3 of the 6 Intro Physics Classes Offered at McMaster (1E03, 1A03 12+ for both semesters), and raw data gaps can be seen in 2 of the remaining courses (1A03 11-), but variability is too high for any statistical conclusions. This preparedness gap is related more strongly to mathematical comfort for males than for females, hinting that both genders may evaluate preparedness using different internal metrics. This gap does not exist in the delta preparedness metric, implying that students experience similar learning relative to their preparedness throughout the semester.
- There exists only a weak statistical gender gap in Initial Interest and Delta Interest, but it is too weak and specified to courses to state that gender has an impact on a student's interest in physics.

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Sources and References:

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