Does Gender Define Course Selection?

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Abstract

The purpose of this project is to find correlations between the courses students take and their gender. Using these results, Earl Haig Secondary School (EHSS), along with other high schools, might get a more concrete idea of the trends in the academic interests of its students.

It is commonly assumed that girls take more social ("soft") sciences, and boys take more natural ("hard") sciences. However, does this assumption hold up in the context of a modern high school located in a first world country, specifically, at EHSS? Our project will analyze data from individual students, using their gender and courses to find out which courses are male-dominated (more than 60% male), female-dominated (more than 60% female) or relatively gender-neutral.

The results found that the stereotypes of males being interested in physical sciences and education, and females being interested in social sciences and arts are valid. However, the trends are slowly changing as some departments' classes have started evening out the ratio between males and females.

Introduction

It is still assumed that factors such as gender correlate to certain subject areas: girls prefer social, or "soft" sciences (such as Religion Studies, Psychology or History), and, boys prefer natural, or "hard",sciences (such as Chemistry, Physics or Astronomy). Other areas of interest regarding gender include comparing male and female students' likelihood of taking an enriched stream for a particular course, pursuing university courses, or having an interest in art.

Our motivation for pursuing this research is to determine whether gender stereotypes are still true for the 21st century.. It is an archaic assumption that males are more suitable for hard sciences because they show the most interest. Conversely, females are considered to be more interested in the arts and soft sciences. These conjectures are the basis of many sexist claims that discourage either gender from pursuing a career in an industry not assigned to their gender role. Our research hopes to prove that either gender is as likely to go into any area of study, and will be equally successful in any field.

This research project was conducted with the guidance of Dr. Sacha Noukhovitch (oral and written communication, Queens University, September 2014 to May 2015), Dr. Erik Spence (oral and written communication, Applications Analyst, University of Toronto, September 2014 to February 2015) and Dr. Marcelo Ponce (oral and written communication, Applications Analyst, University of Toronto, March to May 2015).

Note that there are approximately 200 more females than males in a given year, so it is reasonable to expect more female-dominated classes in an otherwise gender-neutral department (such as English, which is required throughout all 4 years of high school). For example, in the case of the Social Science Department: of 171 classes throughout both years, 20 were male-dominated, 71 were female-dominated and 80 were gender-neutral. However, the fact that there are 51 more female- than male-dominated classes should not result in a hasty assumption that the the social sciences are female-dominated: taking into consideration the greater female student population at EHSS in general and the remaining 80 classes were gender-neutral, the Social Science department is actually relatively gender-neutral.

Methods

Data from EHSS students of 2013-14, and 2014-15 included student number, gender, birthday, homeroom, and courses taken. The student number was used as the individual identifier where needed. To determine gender-related correlations, student gender and courses taken by the student were compared against the school backdrop to find general patterns. A list of courses is sorted into different departments, as listed on the EHSS website (1). This data has been analyzed through a set of routines written in Python v.3.3.

First, the data was formatted, so that each individual student's information is compiled in a list with the following information in the specified order: gender, student number, homeroom, date of birth, and the complete set of courses taken.

Second, the function findAllCourses is created to return a list of all of the courses (called allCourses) in the school. It gives a complete list of every single individual class, separated by course, department, grade, and class.

Third, the function findCondition (Figure 3.1) is created to search through all of the student information lists and (take out any student that match the condition given, and append it to a new list.)this is unclear

Notice that we are only displaying the code for the most impor-

tant functions. As such, the functions findAllCourses and GenderNumber are not shown.

```
def findCondition(data, condition):
    listOfStudents = list()
    for student in data:
        for info in student:
            if condition in info:
                listOfStudents.append(student)
                break
    return listOfStudents
```

Figure 3.1: Code showing the findCondition function, which returns a list of students found with a particular class.

Similarly, the function findGender is created to count the number of students who are male and female in a given list.

Fourth, the function GenderNumber is created to return the number of male and female students of a particular list of students.

Fifth, the functions findGenderNumber and findNumberPercentDominate (Figure 3.2) are created to go through every single course in the list allCourses and to find the number of male and female students in each course, the percent of male and female students of each course, and whether or not it is a male-dominated (more than 60% male) or more female-dominated (more than 60% female) course. It returns three dictionaries, one with the course as key and a list of the number of male and female students as a value, one with the course as key and a list of the percent of male and female students as a value, and the last one with the department being the key and the number of male/female/neutral classes in that department.

```
def findGenderNumber(data, allCourses):
    allNumbers = dict()
    for course in allCourses:
        listOfStudents = findCondition(data, course)
        number = genderNumber(listOfStudents)
        allNumbers[course] = number
    return allNumbers

def findNumberPercentDominate(allNumbers,departments):
    allDepClassNumber = dict()
    allDepClassPercent = dict()
    allDepClassDominates = dict()
    for course,number in allNumbers.items():
        for dep,cors in departments.items():
            allDepClassNumber.setdefault(dep,[])
            allDepClassPercent.setdefault(dep,[])
            allDepClassDominates.setdefault(dep,[0, 0, 0])
            for cor in cors:
                if cor in course:
                    a = number[0] + number[1]
                    pM, pF = int(number[0]/a*100),int(number[1]/a*100)
                    allDepClassNumber[dep].append([course,[number[0],number[1]]])
                    allDepClassPercent[dep].append([course,[pM, pF]])
                    if pM >= 60:
                        allDepClassDominates[dep][0] += 1
                    elif pM <= 40:
                        allDepClassDominates[dep][1] += 1
                    else:
                        allDepClassDominates[dep][2] += 1
    return allDepClassNumber, allDepClassPercent, allDepClassDominates
```

Figure 3.2: Python code showing findGenderNumber function, which returns a dictionary with the course as the key and the number of male and female students as the value, and findNumberPercentDominate function, which returns three dictionaries, showing the departments as key, and the courses and the number of male and female students, the courses and the percent of male and female students, and the number of male, female, and gender neutral classes as values.

Results

The following results show the highlights of our findings after applying the methods in Section 3. For the complete table of data, refer to Section 8 Appendix.

2014 Classes Overview

It is important to note that there were 974 male and 1150 female students at EHSS in 2014. Although the statistics are analyzed through percentages, any imbalance, especially of a smaller nature, may be a result of the initial disproportionality.

Department	# of male-dominated classes (i.e. more than 60% male)	# of female-dominated classes (i.e. more than 60% female)	# of gender-neutral classes
Modern Language	1	21	9
Dance	0	22	0
Phys Ed	24	15	2
Drama	2	14	6
Com. Sci	8	0	0
Visual Art	0	23	3
Music	14	28	16

Table 4.1: 2014 Department with Number of Male/Female/Neutral Classes

Table 4.1 shows the number of classes in each department in 2014 that are male-dominated (more than 60% male), female-dominated (more than 60% female), or neutral. Only the most extreme cases are documented. See Section 8 Appendix for further details.

2015 Classes Overview

Similarly, there were 933 male and 1153 female students in 2015.

Table 4.2: 2015 Department with Number of Male/Female/Neutral Classes

Table 4.2 shows the number of classes in each department in 2015 that are male-dominated (more than 60% male), female-dominated (more than 60% female) or neutral. Only the most extreme cases are documented here. See Section 8 Appendix for further data.

Department	# of male-dominated classes (i.e. more 60% male)	# of female-dominated classes (i.e. more than 60% female)	# of gender-neutral classes
Modern Language	3	17	12
Dance	0	23	0
Phys Ed	23	15	2
Drama	1	10	7
Com. Sci	11	1	0
Visual Art	0	21	5
Music	10	33	14

University-Level Physical Science Classes Overview

In particular, the enrollment of students in the science department is examined in Table 4.3. Its data presents the trend for male and female students participating in the four physical sciences at a university level, which can serve as an indicator for future enrollment.

Class	# of male-dominated classes (i.e. more than 60% male)	# of female-dominated classes (i.e. more than 60% female)	# of gender-neutral classes
SBI3U/SBI4U (University Biology)	1	25	4
SCH3U/SCH4U (University Chemistry)	15	12	13
SES4U1 (University Earth and Space Science)	6	0	0
SPH3U/SPH4U (University Physics)	21	2	10

Table 4.3: Science Class with Number of Male/Female/Neutral Classes

Enriched English Classes Overview

Table 4.4 shows the trend of student enrollment in enriched English classes, as sorted by gender. The trend can be extrapolated to predict that females generally enroll in enriched English at higher rates than males.

Class	Number of Male Students	Number of Female Students
ENG1D3 (Enriched English Grade 9)	18	86
ENG2D3 (Enriched English Grade 10)	17	71
ENG3U3 (Enriched English Grade 11)	23	66

Table 4.4: 2014 and 2015 English Classes with Number of Male and Female Students

Discussion

Our findings concluded that a majority of the departments at EHSS are gender-neutral, with a few that are more female-dominated (possibly because of the greater female population). However, there are some extreme cases in which a department is completed dominated by male or female students.

Modern Languages, Dance, Drama, Visual Arts and Music are heavily populated by females. This correlates with the stereotype that females rather than males are more likely to pursue and dominate the arts. An extreme case can be found in the Dance department, which does not contain any remotely gender-neutral or male-dominated classes. Each of the 45 classes (combined total from 2014 and 2015) has a significant majority of girls in attendance. Likewise, Drama's 40 classes break down to 24 female-dominated classes, whereas there are 3 male-dominated classes.

The males have a larger presence in special education (only marginally, as there are 13 male-dominated classes and 10 female-dominated ones), physical education, and computer science. An extreme case is in computer science, which in 2014 has mostly male classes, and in 2015 has only one mostly female class, compared to 11 male-dominated classes. The gender trend is that male students enjoy tech and physical based courses.

The courses that have the most neutral student enrollment are also the ones with most classes. Departments such as Co-op, Business, Science and Tech have relatively equal numbers of male- and female-dominated classes, as well as mostly gender-neutral classes. On the other hand, departments such as Social Science, Math and English have a majority of classes as neutral, but also a large number of female-dominated classes. This is likely because of the larger female population in the school.

Film is the only department that has the most gender-neutral classes, but also has a more male-dominated class. These departments share the characteristic of being very broadly described — for example, students in science can be enrolled in biology or physics, and the two subjects are drastically different; however, students in the drama department have more of a defined area of study for all its classes. This could be why the students in these departments are a good mix of male and female, as the classes in these departments are general and appeal to both genders.

Conclusion

The gender stereotypes explored here remain true overall, but they are slowly changing (Figure 6.1). Girls are taking more science and math courses, to the point that those classes are coming close to being gender-neutral. However, the idea that girls are more suitable for arts (drama, English, visual, dance) is supported by this data. Boys take more physical science courses, as the data also showed. This report can inform the public of the present interests of both genders. The next step is to find the cause of gender-specific course paths and to determine whether it is a problem to be addressed by encouraging students to try out new courses, or simply the natural order for a society.

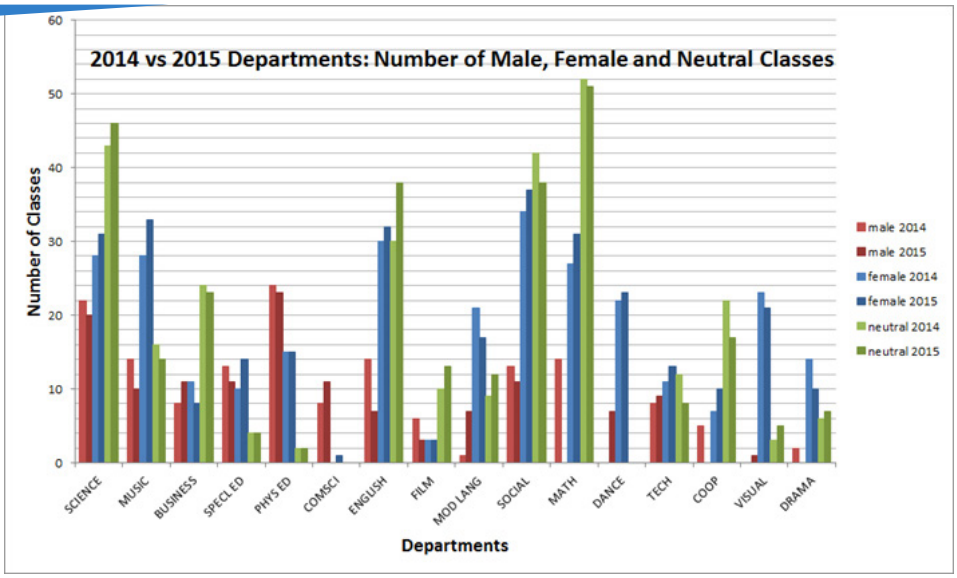

Figure 6.1: Graph comparing trends in 2014 departments to trends in 2015 departments. Red represents male-dominated classes, blue represents female-dominated classes, and green represents gender-neutral classes; a light shade is used for 2014 school year and a dark shade is used for 2015 school year.

Note that SPECL ED is special education, COMSCI is computer science, MOD LANG is modern languages, SOCIAL is social sciences, and VISUAL is visual arts.

References

1. Earl Haig Secondary School. Earl Haig [Internet]. 2005 [updated 2015; cited 2015 May 12]. Available from: http://www.earlhaig.ca/main.php

REVIEW

by Dr. James Charbonneau,
Department of Physics and Astronomy, University of British Columbia

In this paper the authors run a statistical analysis on course enrolment data to determine whether or not certain courses are biased by having more female students or more male students. The paper is generally well written, the overall analysis is sound and the conclusions appear to be correct. The authors have done something genuinely interesting with the data. However, there are some places that the paper could be improved. The following list is approximately in order of occurrence, rather than order of importance.

1. In the abstract it's stated that it's an assumption that certain courses favour certain sexes, however this idea has been very thoroughly explored. Verifying the imbalance is not a new idea, however, the interesting thing that the authors do it see if their particular school has the same gender imbalance. They should present it as such. They are scientically verifying some that is factually seen elsewhere. The authors should be frame their paper in this way. It makes a much stronger scientic statement.

2. The 60% threshold is never really justied. How was it arrived at? Choosing where to make your data cuts can drastically aect the results of your analysis. For instance, if I made the threshold 99% i would likely nd no gender imbalance in the courses taken at the school. The authors should attempt to justify this.

3. The paragraph discussing under who's supervision the work took place seems out of place. This is perhaps a paragraph more appropriate at the end of the paper in the acknowledgements.

4. The note at the end of the introduction is not merely a note, but a key element to the paper. I will discuss later.

5. The gure captions should not be centred.

6. The caption in table 4.1 mentions that only the most extreme cases are documented and all is explained in appendix 8. There is no appendix 8. What is meant by the most extreme cases? Has the data been pruned in some way? Why?

7. The conclusion that things are slowly changing and that math is more gender neutral seems to be incorrect. In fact, math doesn't seem gender neutral at all, but seems to be female dominated. I think the authors have to be careful about these conclusions.

8. In the conclusion the authors mention that the next step in the study is to nd whether this gender imbalance is one of encouragement or is an societal fact. This is noble, but much research has been done on this. I think the authors should review some of the literature on gender issues. It would strengthen their paper and provide them richer material and insight

for their conclusions.

I would like to come back to something that's very important. The note in the introduction discussing the overall gender imbalance shouldn't just be a note. In fact, this initial gender imbalance provides a problem for the authors that they should address. In this paragraph the authors rightly caution interpretation of the data in light of this imbalance. The paper would be made much stronger if the authors managed to address this in a concrete way.

For instance, could you run a Monte Carlo simulation in which you have the student population with the initial gender imbalance choose courses at random? If you run that simulation 1000 times, or a million times, how often does the observed gender dominance occur in the simulation. This would give the authors a likelihood of their data to occur by chance. A low likelihood would mean that their is another factor, beyond statistics, societal or otherwise, that is at work.

With this analysis you would be able to answer a question like \is the fact there are 13 male dominated classes vs 10 female dominated in special education unexpected?" The authors would be able to make statements about their data that are genuine scientic statements rather than humans seeing patterns in data. Generating statements that exist separately from opinion or interpretation is the point of scientic inquiry.