

An analysis of the students' evaluation of professors' competencies in the light of professors' gender

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Abstract—Students' evaluation of professors is commonly performed at all academic levels whereby a number of skill sets are evaluated and the opinion of the students is recorded as a means for professors' assessment. How the students view professors for their teaching competencies is an essential indicator for optimizing the teaching and learning setup. However, the reports of the literature suggest that students can be partially biased in their judgement based upon the gender of the professor. In this study, we have analyzed the results of the Student Evaluation of Teaching (SET) from 103,833 responses which were collected as a result of evaluating 5,083 professors of higher education. With a target to take a close look at the influence of professors' gender on their evaluation results we broke down the study into schools and analyzed the assessment based on 7 teaching competencies. In addition, the responses provided to an open-ended question underwent textual and sentiment analysis to further understand the students' view of their professors. Against a solid body of the literature that suggest female professor can be assessed in a harsher manner than their male colleagues, we have not detected traces of gender bias across schools. While Engineering students have rated their male professors slightly higher for the intellectual challenge they incorporated in the classroom, in the rest of the competencies and across the schools, female professors were rated slightly but systematically higher than their male counterparts. The sentiment analysis shows the exact same set of keywords associated to both sexes of professors even though the order and the frequency of use for each sex were different.

Keywords— *Educational innovation, Gender bias, Students' evaluation of professors, Sustainable development goal 5, Higher education*

I. INTRODUCTION

Student Evaluation of Teaching (SET) is one of the main components in evaluating the quality of the provided

content within an education setup. While, depending on the questionnaires, the evaluation parameters can be different, such assessments provide insight on the competencies of professors ranging from knowledge assessment to communication skills, usefulness of materials, relevance of the assignments, and the difficulty of quizzes. The SETs, however, can shed light on a broader range of topics including possible biases in the perception of the students in their evaluation of their professors [1], [2]. The literature suggests that SETs are not immune to prejudices and tend to manifest different forms of bias [3]–[9]. For instance, how the students view their professors and evaluate their competencies have been analyzed in the light of the professors' genders and those of the students themselves [10].

Certain attributes and behaviors are believed to be of females or males. Perceived attractiveness, for example, was found to be positively correlated with the SET evaluation outcomes [11]. Literature also demonstrates that students may rate their professors negatively if they do not fulfill the expected attributes they may perceive for each sex [12], [13], [14]. A number of studies provide evidence that students described their worst male professors as boring and self-centered. This is while their worst female professors were more often considered as rigid, mean, and unfair [12]. These biases in SET's have been shown to have the potential to be subdued by appropriate inflections in language in the design and communication of the questionnaires [15]. The research on SETs has also shed light on the opposite instances in which the female professors were overall rated higher than their male counterparts. Particularly, in certain areas such as natural sciences, female professors were rated higher than male by both male and female students [16]. In any case, SETs are fundamental tools in assessing the teaching effectiveness [17].

In this article, we analyze the results of the SET generated by over 100,000 students assessing more than 5,000 professors in over 1,000 courses across six different schools: 1) Engineering and Sciences; 2) Humanities and Education; 3) Architecture and Design; 4) Social Sciences and Government; 5) Medicine and Health; 6) Business. We have analyzed the results based upon the schools to find the differences in perceived competencies across disciplines. Moreover, the results were analyzed in full and in the context of how students evaluated the professors based upon their genders and regardless of the discipline. Additionally, we conducted a sentiment analysis to assess the comments of the students via a comprehensive text sentiment analysis. This work was developed to answer the research question: is there a gender bias in students' evaluation of their professors? We seek to provide insight on the perception of students of their professors in the context of their genders in a higher education setup. We further describe our findings in relation to the cultural considerations and the roles each sex is traditionally expected to accept within the society.

II. METHODOLOGY

A. Participants

The participants of this study were students (at different academic stages of higher education) who evaluated the faculty members within a private university in Mexico, Tecnológico de Monterrey. The data hereby are collected from the northern region of the country (campuses of Chihuahua, Ciudad Juárez, Laguna, Monterrey, Saltillo, and Tamaulipas). The information was collected from an institutional Student Opinion Survey (known as ECOA for its acronym in Spanish Encuesta de Opinión del Alumno) with a total of 103,833 answers. These surveys were distributed at the end of each of semesters (January-May 2017; August-December 2017; January-May 2018) and were concluded prior to the final exams. In total, 5,083 professors from 6 schools (Engineering and Science, Medicine and Health Sciences, Humanities and Education, Social Science and Government, Architecture and Design, and Business) were evaluated through ECOA for their teaching competencies in delivering 1,082 different courses within 78 departments.

B. ECOA Evaluation

The ECOA, which has been previously assessed and validated [18]–[20], contains 8 questions used to evaluate various aspects of the professors' performance. The first 6 questions offer an eleven-point Likert-like scale (with 10 being exceptional and 0 perceived as dreadful) to rate: (1) methodology and learning activities used by the professor during the course; (2) applied concepts taught in terms of their application in the real world; (3) the advising role of the professors; (4) the assessment and grading system; (5) the applied intellectual challenge in teaching; and (6) the learning guidance offered by the professor. The response to the seventh question ("Would you recommend this professor to other students as the best professor?") was a binary "Yes or No". The eighth item was an open-ended question whereby the students

were asked to explain why (or why not) they may recommend this professor. In our data analysis, we included the gender of the professor, but the name and gender of the student answering the ECOA, along with any demographic data are concealed from access due to the institutional privacy policies.

C. Analysis

Quantitatively, the professors' average scores for the first 7 questions of the ECOA were obtained upon segmentation of the sample by gender, ECOA question, and school. The responses to the eighth open-ended question "Why would you recommend or not recommend the professor?" were analyzed using an Educational Process and Data Mining (EPDM) model previously validated [21] to obtain the following parameters: the frequency of gender-related words and the correlations between the most frequently used terms by the students in their description of the professors extracted from the comments. This step was a text sentiment analysis, which is based on the extraction of keywords or phrases from a text and assigning an emotional valence to these words in order to determine the overall sentiment of the text [22]. The keywords or phrases were extracted based on the emotional valence, after cleaning the comments and removing other words such as articles and conjunctions. From these emotional weights assigned, an overall emotional valence can be drawn for a given comment, and the statistics regarding the words and their emotional valence can be generated.

III. RESULTS AND DISCUSSION

A. Evaluation of teaching competencies

The results obtained from the analyses of the first 7 questions of the ECOA show that professors of different sexes, on average, are rated differently depending on the discipline they teach. Table 1 to 6 represent the results of the ECOA evaluation per school. Table I summarizes the results of the evaluation of the students at the School of Engineering and sciences classified based on professors' gender. As can be observed, the female professors are rated slightly higher than male professors even though the difference is rather negligible. In response to question 5, male professors were rated slightly higher than their female counterpart as Engineering students found the intellectual challenge the male professors have incorporated in the class rather more interesting than that of female professors. The reports of the literature suggest female professors to be rated lower than male colleagues when assessed for their teaching in the area of Engineering [23] which is a trend that cannot be observed in our assessment.

TABLE I. Engineering and Science School average answers segmented by professors' gender

# item	Engineering and Science	Gender	
		Female	Male
1	Methodology and learning activities	8.88 ± 0.88	8.82 ± 0.93

2	Concepts and application in real world	9.02 ± 0.79	8.95 ± 0.84
3	Advisory role	9.22 ± 0.73	9.15 ± 0.79
4	Evaluation System	9.07 ± 0.79	9.00 ± 0.81
5	Intellectual Challenge	9.02 ± 0.78	9.06 ± 0.74
6	Learning guide	9.05 ± 0.87	9.00 ± 0.91
7	Recommended professor	8.76 ± 1.14	8.73 ± 1.19

In agreement with the School of Engineering and Sciences, the students at the School of Humanities and Education rated their female professors slightly higher than male counterparts in almost all competencies (Table II). Noteworthy, the gap in average grades per competency is larger favoring female professors than those seen in the School of Engineering and Sciences (Table II).

TABLE II. Humanities and Education School average answers segmented by professors' gender

# item	Humanities and Education	Gender	
		Female	Male
1	Methodology and learning activities	8.87 ± 0.87	8.77 ± 1.02
2	Concepts and application in real world	9.00 ± 0.76	8.90 ± 0.91
3	Advisory role	9.24 ± 0.68	9.10 ± 0.90
4	Evaluation System	9.07 ± 0.76	8.96 ± 0.93
5	Intellectual Challenge	9.02 ± 0.77	8.99 ± 0.88
6	Learning guide	9.06 ± 0.82	8.95 ± 0.95
7	Recommended professor	8.75 ± 1.17	8.69 ± 1.24

The same trends as that of Table 1 and Table 2 can be observed when analyzing the results obtained from the School of Architecture and Design (Table III) and the School of Social Sciences and Government (Table IV). Female professors were consistently rated higher than their male counterparts even though the gap is not significant.

TABLE III. Architecture and Design School average answers segmented by professors' gender.

# item	Architecture and Design	Gender	
		Female	Male
1	Methodology and learning activities	8.90 ± 0.8	8.82 ± 0.88
2	Concepts and application in real world	9.05 ± 0.70	8.96 ± 0.79
3	Advisory role	9.29 ± 0.61	9.15 ± 0.76
4	Evaluation System	9.10 ± 0.72	9.01 ± 0.79
5	Intellectual Challenge	9.07 ± 0.66	9.03 ± 0.73
6	Learning guide	9.08 ± 0.76	9.00 ± 0.81
7	Recommended professor	8.77 ± 1.08	8.72 ± 1.13

TABLE IV. Social Sciences and Government School average answers segmented by professors' gender.

# item	Social Sciences and Government	Gender	
		Female	Male
1	Methodology and learning activities	8.95 ± 0.88	8.72 ± 1.05
2	Concepts and application in real world	9.06 ± 0.74	8.86 ± 0.96
3	Advisory role	9.26 ± 0.66	9.08 ± 0.92
4	Evaluation System	9.12 ± 0.71	8.93 ± 0.93
5	Intellectual Challenge	9.09 ± 0.66	8.98 ± 0.88
6	Learning guide	9.10 ± 0.82	8.89 ± 1.09
7	Recommended professor	8.82 ± 1.21	8.64 ± 1.19

School of Medicine and Health Sciences marked an interesting milestone when compared to the rest of the schools (Table V). The students have rated the male and female professors very closely and comparably in all competencies as they seem to identify almost no difference between the performance of the professors from both sexes.

TABLE V. Medicine and Health Sciences School average answers segmented by professors' gender.

# item	Medicine and Health Sciences	Gender	
		Female	Male
1	Methodology and learning activities	8.90 ± 0.89	8.81 ± 0.92
2	Concepts and application in real world	9.05 ± 0.77	8.93 ± 0.83
3	Advisory role	9.21 ± 0.76	9.13 ± 0.84
4	Evaluation System	9.08 ± 0.84	9.01 ± 0.82
5	Intellectual Challenge	9.05 ± 0.76	9.03 ± 0.80
6	Learning guide	9.04 ± 0.88	9.00 ± 0.90
7	Recommended professor	8.73 ± 1.23	8.72 ± 1.21

School of Business fits the previous pattern observed in other 4 schools where female professors are slightly favored over male professors (Table VI). A very interesting observation is that alike School of Engineering and Sciences, the higher recorded grades for female professors within the School of Business seem to be opposing the reports of the literature where female faculty were found to be typically ranked lower than their male counterparts when teaching business-related contents [24], [25]. In contrast to the School of Engineering and Sciences, the students at the School of Business found the intellectual challenge the same whether it was incorporated by a female professor or by a male professor.

TABLE VI. Business School average answers segmented by professors' gender

# item	Business	Gender	
		Female	Male
1	Methodology and learning activities	8.88 ± 0.91	8.74 ± 1.05
2	Concepts and application in real world	9.03 ± 0.76	8.89 ± 0.97
3	Advisory role	9.23 ± 0.76	9.10 ± 0.89

4	Evaluation System	9.11 ± 0.77	8.94 ± 0.95
5	Intellectual Challenge	9.01 ± 0.81	9.00 ± 0.85
6	Learning guide	9.07 ± 0.86	8.94 ± 0.99
7	Recommended professor	8.78 ± 1.18	8.65 ± 1.29

When comparing the results intra-schools, it can be concluded that School of Medicine and Health Sciences, and School of Humanities and Education have rated the female professors lower than the rest while the school that rated the female faculty the highest was School of Social Sciences and Government. School of Engineering and Sciences rated male professors higher than the rest while these members of the faculty were ranked the lowest by the school of Social Sciences and Government. Such recorded differences between the schools can be attributed to the different expectation and roles each gender is anticipated to fulfill [26], [27].

The gender inequality index updated by the United Nations on an annual basis differs dramatically from one country to another, let alone a cross-continental analysis [25]. Nonetheless, our observations suggest that among the population of the study there is no gender bias when assessing the professors for their teaching competencies and no significant gap between the faculty of different sexes. It is indeed true that the Mexican society has struggled with certain levels of sexism in the past decades and the male dominance might have generated biases towards female in different areas of life [29]–[31]. However, this is promising to see that the new generations rise above such prejudices [32] and have a fair judgement regardless of the sex. Moreover, socio-economic, geo-demographic status are known to be negatively correlated with biased gender expectations [33]. This, in turn, is a call for Reduced Inequality (Sustainable Development Goal 10 of United Nations) which will undoubtedly lead to Gender Equality (Sustainable Development Goal 5 of United Nations) across all nations [34]

B. Sentiment analysis

The five most significant sentiments extracted from the comments of the students were the same for both male and female professors, although they represented different percentages of the total frequency of use of these 5 terms (Fig. 1). Male professors were mostly referred to as “confident” while female professors were found to be rather “anxious” (identified as the second most repeated sentiment for male professors). The sentiment analysis also revealed “Uncertain” as the third, “Resentful” as the fourth, and “Dissatisfied” as the fifth attributes for the male professors. For the female professors the comments suggest “Uncertain” as the second most relevant sentiment followed by “Resentful” as the third, “Confident” as the fourth, and “Dissatisfied” as the fifth. What requires a great deal of attention is the fact that 4 out of the 5 most prevalent sentiment-related keywords obtained from the analysis are negative. This observation requires further investigation of the causes.

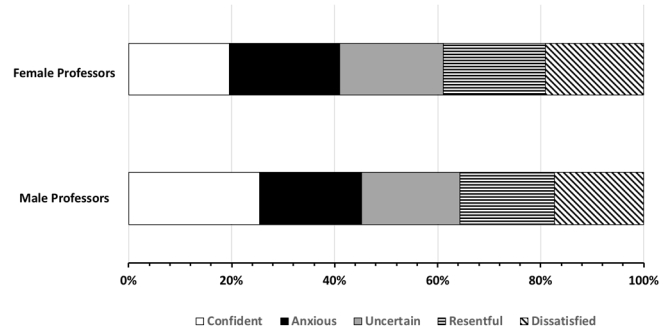


Fig. 1. The main sentiments of the students towards professors based upon the professors’ gender extracted from the comments in response to question #8.

C. Frequently repeated words in the comments

The result of the textual analysis demonstrates the most repeated words per gender which are shown in Fig. 2. The first two frequently repeated words, “explain” and “knowledge”, are the same for both genders although in reverse orders for male (“knowledge” comes first) than female (“explain” comes first). Although the 6 most used words to describe both genders are the same, the recurrence of these descriptors vary according to the gender of the professor. The students have seemingly characterized male professors as knowledgeable while female professor as better explainers who have communicated the content more effectively. Our results are in line with other reports whereby female professors are found as better communicators that their male colleagues [21]. While the left sides of both graphs presented as Figure 2-A and 2-B have shown no significant difference, the right side brings the word, “doubts”, to attention. This is important to note that in Spanish, the word ‘doubt’ is commonly used as an equivalent of the word ‘question’. The frequency of the use of this word is 2,991 occurrences in the case of female as opposed to 2018 times for

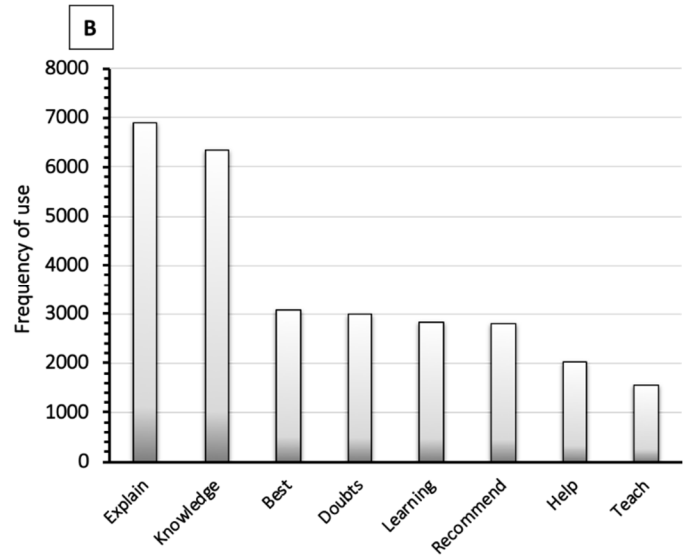
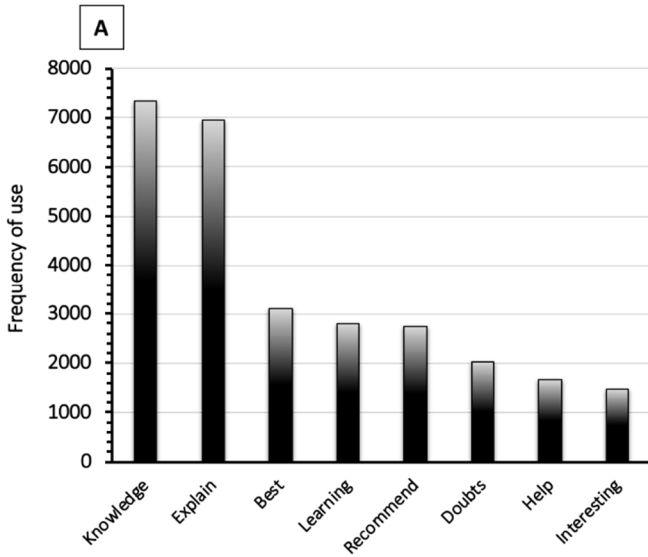


Fig. 2. The most repeated words extracted from the comments on male (A) and female (B) professors in response to question #8.

male professors. This refers to the stronger role female professors play in clarifying the doubts and addressing the questions than their male counterparts. It is known that students, to a certain degree, form emotional bonds with their teachers at K-12 level [35]. Female professors, in general, present a different teaching style than male professors [36], hence the association of female educators with a more affectionate patient manner of conducting the class makes students more comfortable to raise questions and clarify their doubts more frequently. As a result, the students largely consider the female professors' ability to answer questions greater than that of the opposite sex which is also in line with the previous works describing the association of the genders with roles and expectations [10].

Literature suggests that female professors are commonly rated more severely than their male counterparts when they fail to meet the gender expectations of the students [12], [13]. Multiple studies, [10], [37] provide evidence that students do in fact have different expectations of professors based on their gender. Sprague and Massoni [12] reported that students described their worst male professors as boring and self-centered, whereas their worst female professors were more often labeled as rigid, mean, and unfair. Students, from the early stages of their knowledge acquisition (primary through secondary school) may develop an unconscious association between female professors and being great communicators and clear explainers who can keep their temper under control [37]. Such expectations may lead the students to inadvertently looking for different qualities in their professors based on their gender. This is in line with the findings of gender biases in SETs identified in previous works [8], [38], [39]. In fact, different studies demonstrate that male professors only need to show competence to achieve the gender expectations, as opposed to female professors who must need to demonstrate warm, caring, supportive and nurturing behaviors in order to fulfill their gender expectations [36, 16]. This study provides insight on the perception of students of their professors in the context of their genders. This is also an invitation to find meaning for such

findings in the context of social and cultural advancements of the society in order to find manners of raising awareness and promoting gender equality across generations.

While the database used for this analysis was rather vast, multiple factors including the anonymity of the survey, and lack of access to students' gender have limited us to using descriptive data analysis as the sole means to interpret the data. A future window of opportunity is to look into the gender biases across disciplines in the context of students' gender, their socio-economic background and other relevant features that may influence their judgment and evaluation of their professors.

IV. CONCLUSIONS

Recent decades have seen the rise of SETs as one of the most used tools for evaluating the performance of professors. The information gathered through these instruments is a means for decision-making that directly impact the lives of professors in the context of assigning raises, promotions, and tenure positions, amongst others. However, the biases of students when rating their professors may skew the grades each sex obtains based on characteristics that might be entirely unrelated to their teaching skills. The present analysis shows that over 100,00 students studying in 6 distinctly different disciplines have not presented gender biases when grading their professors even though students of each school have a different view of their professors. The two schools that rated the female professors lower than the rest were School of Medicine and Health Sciences, and School of Humanities and Education. The lowest rated school for male professors was Social Sciences and Government. School of Engineering and Sciences rated male professors higher than the rest, while their female counterparts were rated highly by the School of Social Sciences and Government. Such recorded alterations among the schools can be attributed to the roles each gender is expected to play within the social context. Gender-based expectations and early age normalization of gender roles are identified as contributing factors to this particular blind spot of current SETs within higher education. The results, surprisingly, have shown that female professors were systematically rated higher when compared with male

professors. Although the difference in this assessment was rather nuanced and in certain cases even negligible, almost across all disciplines/schools, female professors were favored over their male peers. The textual analysis has shown that the students considered male professors primarily as ‘knowledgeable’, while the female peers were recognized as ‘better in explanation’. Our analysis also provides a detailed comparison of the sentiment analysis whereby the five most significant sentiment-related keywords were identified for both male and female professors, although in different orders. These keywords were confident, anxious, uncertain, resentful, and dissatisfied.

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