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Assessment of Multiple Intelligences in First-Year Engineering Students in Northeast Mexico

Wendy Xiomara Chavarría-Garza [1,2], Ayax Santos-Guevara [1], José Rubén Morones-Ibarra [2] and Osvaldo Aquines-Gutiérrez [1,*]

[1] Department of Physics and Mathematics, Universidad de Monterrey, Av. Morones Prieto 4500, San Pedro Garza García 66238, Nuevo León, Mexico; wendy.chavarria@udem.edu or wendy.chavarriagrz@uanl.edu.mx (W.X.C.-G.); ayax.santos@udem.edu (A.S.-G.)

[2] Faculty of Physical-Mathematical Sciences, Autonomous University of Nuevo León, Av. Universidad S/N, Ciudad Universitaria, San Nicolás de los Garza 66455, Nuevo León, Mexico; rubenmorones@yahoo.com.mx

* Correspondence: osvaldo.aquines@udem.edu; Tel.: +52-81-8215-1211

Abstract: In sustainable education, it is important to analyze student diversity in order to create strategies that allow for the implementation of inclusive education based on the differences observed among students. To achieve this, a sample of 321 first-year engineering students (107 females and 214 males) at a private university in northeast Mexico was analyzed during the 2020 academic year. Students were classified according to their gender, engineering program, and the development of their multiple intelligences according to Howard Gardner theory of multiple intelligences. To verify the effect of gender and program factors on the development of multiple intelligences, Kruskal–Wallis tests were performed with $\alpha = 0.05$. The analysis of the effects of gender identified significant differences in four intelligences: linguistic and interpersonal (for which the female students obtained higher mean scores) and mathematical and visual (for which the male students obtained higher mean scores). The analysis of the effects of the engineering program identified significant differences in five intelligences: mathematical, visual, and musical (for which civil engineering students obtained a higher mean score than the students in the other programs); kinesthetic (for which computer science students obtained a lower mean score than students in the other programs); and naturalistic (for which sustainability engineering students obtained a higher mean score than students in the other programs). These differences allowed us to observe the characteristics of the students and to develop more inclusive courses in order to make the teaching and learning process more optimal and sustainable.

Keywords: engineering education; gender; inclusive education; programs; multiple intelligences; sustainability

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1. Introduction

"UNESCO contributes to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information" [1]. Hence, two of the 17 main SDG's (Sustainable development goals) of the UNESCO's 2030 Agenda for Sustainable Development [1] are: 4-Quality Education and 5-Gender Equality. The agenda gives special attention to "to the fundamental contribution of quality, inclusive education at all levels and to the importance of lifelong learning opportunities for all (SDG 4)". Similarly, it also highlights "Science, technology, engineering and mathematics education (STEM); and education for sustainable development (ESD) as part of quality education" Therefore equity and inclusiveness in engineering education plays an important role in the achievement both of these SDG's.

"A sustainable society goes through sustainability in education" [2]. In higher education, this requires designing instructional practices adapted to the students and striving to guarantee quality education that is responsive to the diversity of the student body [3]. To this end, it is important to design and adapt a curriculum so that it can meet the diverse needs of students, and for instructors to be able to recognize the different needs of students and individually support their students through the curriculum [4].

The exploration of multiple intelligences in students can help us to improve higher education [5] by modifying curriculum delivery to achieve the necessary skills for sustainability in education [6], since knowledge of the different intelligences and implementation of different teaching strategies can optimize learning motivation and can improve memory by accelerating the learning process [7]. Therefore, it is relevant to analyze the abilities of students relative to variables such as gender and academic program, in order to identify the factors necessary to develop instructional strategies that promote citizens who are capable of collaborating, speaking, and acting to promote changes in society [8].

1.1. Aim and Structure of the Study

Different authors [9–12] have analyzed gender and shown that engineering students have different learning profiles; other authors [13–16] have shown differences among the learning profiles of students according to their academic program. Therefore, in this study, we aimed to observe the differences in the learning profiles of engineering students by measuring the development of multiple intelligences of first-year engineering students and observing the differences in the development of multiple intelligences according to their gender or academic program. We aimed to show that there is a need in higher education to create inclusive education that does not benefit one demographic group over another [17].

We present statistics and discussion of the different Howard Gardner multiple intelligence profiles of first-year engineering students from a private university. Comparisons were made between the profiles of female and male, as well as between academic programs. The analysis of the effects of gender identified significant differences in four intelligences and the analysis of the effects of the engineering program identified significant differences in five intelligences, shown below. The rest of the paper is organized as follows: Section 2 materials and methods, Section 3 results, Section 4 discussion, and we conclude in Section 5.

1.2. Multiple Intelligences

Gardner's theory of multiple intelligences provides us with a useful theoretical basis for recognizing the different abilities and talents of students [18]. According to Howard Gardner's theory of multiple intelligences [19], human beings have eight different types of intelligence that reflect different ways of interacting with the world. Each person has a unique combination or profile. Although each of us has all eight types of intelligence, no two individuals have the exact same configuration, similar to the unique nature of our fingerprints; therefore, here, we provide a brief description of the characteristics of multiple intelligences based on the recent literature [20–22].

Linguistic intelligence enables people to communicate. Linguistically intelligent individuals have the ability to speak, read, and write effectively, which enables them to give explanations and descriptions and to express themselves optimally. Standard intelligence tests include vocabulary and reading comprehension. Activities that require divergent thinking include storytelling, persuasive speaking, and creative writing.

Logical/mathematical intelligence enables people to understand abstract situations, such as solving complex problems or performing mathematical calculations mentally. Most intelligence tests evaluate the ability to reason and solve problems, but with respect to logical/mathematical intelligence, it is also important to analyze the ability of people to solve novel problems or generate new questions about a daily situation.

Visual intelligence makes it possible for people to perceive the visual world accurately, allowing people to understand visual or spatial information, transform it, and mentally recreate images. Visual intelligence abilities help individuals to develop in artistic design, to read maps with ease, and to work with objects such as in architecture or visual art.

Body/kinesthetic intelligence enables people to use all or part of their body to express themselves to the world, as well as to use these skills to solve problems. Athletes, surgeons, dancers, choreographers, and artisans have a level of body/kinesthetic intelligence, since precision, control, and body agility are the most outstanding characteristics of people with such intelligence.

Intrapersonal intelligence is aimed at understanding of one's own interests, and self-control that involves constant self-evaluation to achieve established goals. People high in this type of intelligence are in tune with their inner feelings, which helps them to distinguish between their own feelings and to make decisions about their lives. This is a strong factor in the development of self-confidence, which is essential to an individual's sense of satisfaction and success.

Interpersonal intelligence promotes success in managing relationships with other people. This intelligence enables people to recognize emotions and moods, which allows them to be empathetic with the people around them; therefore, they are able to develop in managerial or leadership positions such as teaching, counseling, or psychology.

Musical intelligence enables people to create, communicate, and understand music, as well as to sing or play musical instruments. This intelligence enables people to develop the ability to be a songwriter, instrumentalist, or vocalist, and therefore to develop their creative musical production ability.

Naturalistic intelligence enables individuals to recognize and categorize plants, animals, and other living things by showing empathy and understanding of ecological systems. These characteristics enable people to easily develop skills for activities related to agriculture, veterinary medicine, and biology.

The theory of multiple intelligences can be used to identify the learning capacities of students in a class, or it can provide support for the teacher and students to find better ways of learning, but it cannot be used as a tool for evaluating student performance [23]. Therefore, within the mathematical education literature, there are suggestions that allow us to develop strategies that are adapted to students according to multiple intelligences [24] as follows:

1. Linguistic intelligence involves sensitivity to spoken and written language, and is involved in the ability to learn languages and to use language to achieve certain goals. In mathematics education, a math problem should be effectively communicated to motivate students to repeat the argument on a final exam. In addition, the listening skills of this group should be strengthened;
2. Logical/mathematical intelligence consists of the ability to analyze problems logically, perform mathematical operations, and investigate questions scientifically. In mathematics education, the goal is to solve problems with logical thinking and deductive reasoning;
3. Musical intelligence involves skills for interpreting, composing, and appreciating musical patterns;
4. Body/kinesthetic intelligence involves the potential to use the whole body or parts of the body to solve problems, with reinforcement of mental abilities to coordinate body movements; therefore, with an agile activity such as crawling, both hemispheres of the brain can be activated;
5. Spatial intelligence involves the potential to recognize and use patterns within large spaces and smaller areas. In mathematics education, shapes, image contours, and analysis of different points should be used as teaching strategies;
6. Interpersonal intelligence is concerned with the ability to understand intentions, motivations, and desires of other people. The teacher should encourage students to solve problems in groups to develop these skills;
7. Intrapersonal intelligence implies the ability to understand oneself and to appreciate one's own feelings, fears, and motivations. In mathematics education, students should be provided with opportunities to use a personal idea to solve a problem;
8. Naturalistic intelligence enables people to recognize, categorize, and take advantage of certain characteristics of the environment. Interestingly, the theorists behind most mathematical theories found their main ideas in nature.

The development of multiple intelligences has been identified as differing among engineering students. Therefore, it is important to provide adequate training and workshops for faculty members in engineering departments to effectively improve their teaching skills by adapting strategies that take into consideration the multiple intelligences of the students [14]. The application of Gardner's theory of multiple intelligences helps to promote an inclusive environment by developing an appreciation that all people have strengths in different areas. This promotes teaching in a variety of ways to address individual differences and to ensure that education is accessible to all [25].

Curriculum modifications that consider the model of multiple intelligences are aimed at understanding the various manifestations of intelligence in student profiles and creating environments that foster individual and group potential, which could help people to make a change in the way in that they perceive and treat their environment [26]. Teachers who use Gardner's multiple intelligences theory as the basis for curriculum design enable students to show their strengths and interests, as well as abilities that would not arise in the traditional educational system [27].

2. Materials and Methods

2.1. Research Design

The present observational study has the objective to explore the multiple intelligence profiles of first year engineering students. The research questions were:

RQ.1 Do engineering students from different genders have different multiple intelligence profiles?

RQ.2 Is there a difference of multiple intelligence profiles among engineering students from different majors?

For such purpose, a sample of 321 (107 female and 214 male) first-year engineering students enrolled at a private university in northeast Mexico during the fall 2020 semester was analyzed. The tool used to determine the development of each of the multiple intelligences was a questionnaire based on the theory of multiple intelligences by Howard Gardner and developed by Psicoactiva [27]. The analysis of results according to gender and academic program identified students' learning preferences and provided information that could be used to modify the curriculum to be of greater benefit to the students, with the central idea of generating inclusive and sustainable education.

The research followed a quantitative approach; the study was of an exploratory, descriptive field level and was carried out in three phases as follows:

In Phase 1, the questionnaire was applied in order to obtain the necessary information to identify the level of development of multiple intelligences.

In Phase 2, the results were analyzed and the corresponding statistical tests were performed.

In Phase 3, conclusions were drawn from the comparison analysis of these results answering the research questions (RQ.1) and (RQ.2).

2.2. Participants

Table 1 shows the demographics of the students in terms of gender and academic program. The sample was divided according to seven academic programs taught at the selected university: BioMed, Biomedical Engineering (8.72%); Civil, Civil Engineering (4.67%); CompSc, Computer Science (8.10%); IndMan, Industrial Engineering and Engineering Management (46.11%); MechAuto, Mechanical Engineering and Automotive Engineering (9.03%), MechRob, Mechatronics Engineering and Robotics Engineering (12.77%); and Sust, Sustainable Engineering (10.59%). Among the participants in the sample, 107 (33.33%) were female and 214 (66.66%) were male.

Table 1. Sample by gender and program.

	Female	**Male**	**Total**
BioMed	10	18	28
Civil	3	12	15
CompSc	3	23	26
IndMan	64	84	148
MechAuto	2	27	29
MechRob	5	36	41
Sust	20	14	34
Total	107	214	321

2.3. Questionnaires

Due that this study was conducted in the Spanish speaking Latin American context, the applied tool was the questionnaire based on Howard Gardner's theory of multiple intelligences was developed by Psicoactiva [28] and consisted of 64 questions, divided equally into eight different intelligence types: linguistic intelligence, logical/mathematical intelligence, visual/spatial intelligence, kinesthetic or body kinetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalistic intelligence. The questions could be answered affirmatively or negatively and, depending on the answer, a score was added (or not) to the mental capacity corresponding to that answer. In each intelligence type, a student could obtain a minimum of 0% and a maximum of 100%; these values were used to identify the skills developed by students in each of these intelligences. This questionnaire has been used previously by various authors in similar context [29–31] for the development of similar tools.

2.4. Application Procedure

During the fall of 2020, the questionnaire described above was applied digitally to 321 students at a private university in northeast Mexico who were studying Physics I. This group was selected in order to obtain information from the largest number of students from the different engineering departments on campus.

2.5. Statistical Analysis and Data Processing

The data were analyzed using the R software version 3.6.1 [32]. A multiple Kruskal–Wallis test was performed (given that the assumption of normality and homoscedasticity was violated in the data obtained) to verify the significance of each factor (gender and academic program) for the variables (each of the multiple intelligences), and the effect size was calculated for the Kruskal–Wallis test as an eta squared value based on the H statistic (η_H). It is important to note that interactions between gender and program were not measured.

3. Results

3.1. Statistical Analysis

The mean, standard deviation, and standard error of the mean of the students' scores for the development of multiple intelligences are shown in Table 2. The highest mean score was observed in interpersonal intelligence (82.4 $\pm$ 0.99) and the lowest mean score was observed in naturalistic intelligence (55.9 $\pm$ 1.33).

The results of the Kruskal–Wallis test as well as the effect size are shown in Table 3, in which each intelligence is analyzed according to gender or academic program. In the first case, four intelligence scores showed a significant difference, i.e., linguistic, mathematical, visual, and interpersonal intelligences, which all had a small effect size. Meanwhile, there were five intelligences that had a significant difference according to the academic program, i.e., kinesthetic and musical intelligences with a small effect size and mathematical, visual, and naturalistic intelligences with a moderate effect size.

Table 2. Mean, standard deviation, and standard error of the mean for each multiple intelligences.

	Mean	SD	SE
Linguistic	64.5	18.9	1.05
Mathematical	75.4	20.7	1.16
Visual	62.7	22.1	1.23
Kinesthetic	64.1	21.2	1.18
Musical	62.7	18.8	1.05
Interpersonal	82.4	17.9	0.99
Intrapersonal	79.7	19.2	1.07
Naturalistic	55.9	23.8	1.33

Table 3. Statistical data of each multiple intelligence.

	Gender				Program			
	K	DF	*p*	η_H	K	DF	*p*	η_H
Linguistic	4.86	1	0.027 *	0.012 (small)	4.63	6	0.592	−0.004 (small)
Mathematical	8.68	1	0.003 *	0.024 (small)	27.4	6	<0.001 *	0.068 (moderate)
Visual	4.18	1	0.041 *	0.010 (small)	29.3	6	<0.001 *	0.074 (moderate)
Kinesthetic	2.11	1	0.146	0.003 (small)	16.5	6	0.011 *	0.034 (small)
Musical	2.64	1	0.104	0.005 (small)	17.2	6	0.009 *	0.036 (small)
Interpersonal	4.48	1	0.034 *	0.011 (small)	11.6	6	0.070	0.018 (small)
Intrapersonal	0.173	1	0.677	−0.003 (small)	1.84	6	0.934	−0.013 (small)
Naturalistic	0.0593	1	0.808	−0.003 (small)	28.7	6	<0.001 *	0.072 (moderate)

* *p*-values less than 0.05.

3.2. (RQ.1) Gender Analysis

When analyzing the effect of gender, as shown in Table 3, it was observed that there were significant differences in four of the eight intelligences: linguistics (p = 0.027), mathematical (p = 0.003), visual (p = 0.041), and interpersonal (p = 0.034), which all had a small effect size ($\eta_H \leq 0.241$). Table 4 shows the means, standard deviations, and standard errors of the means, according to each gender.

On one hand, linguistic intelligence showed a small effect (η_H = 0.012) in which the female gender obtained a higher mean score (67.6 ± 1.8) as compared with the male gender (62.9 ± 1.3). Similarly, interpersonal intelligence showed a small effect (η_H = 0.011) in which, again, the female gender reported a higher mean than that of the male gender (85.4 ± 1.6 vs. 80.8 ± 1.3). On the other hand, mathematical intelligence showed a small effect (η_H = 0.024) in which the male gender showed a higher mean score (77.9 ± 1.4) than the female gender (70.6 ± 2.1), as did visual intelligence, in which the male gender showed a higher mean score than the female gender (M, 64.4 ± 1.5 and F, 59.2 ± 2.2).

Consistent with the information mentioned above, Figure 1 shows that, with respect to interpersonal and linguistic intelligences, the female group had higher scores than the male group, while the opposite occurred with respect to mathematical and visual intelligences. It was also observed that with respect to kinesthetic and musical intelligences, the female gender mean scores were greater than the male gender mean scores, but this difference was not significant. These results allowed to partially answer (RQ.1), in terms of evidence supporting that there are significantly different multiple intelligence profiles between genders.

Table 4. Means, standard deviations, and standard deviations of the means for multiple intelligences by gender (F: Female; M: Male).

	Gender	N	Mean	SD	SE
Linguistic	F	107	67.6	18.6	1.8
	M	214	62.9	18.9	1.3
Mathematical	F	107	70.6	21.6	2.1
	M	214	77.9	19.9	1.4
Visual	F	107	59.2	22.3	2.2
	M	214	64.4	21.8	1.5
Kinesthetic	F	107	66.6	20.2	2.0
	M	214	62.9	21.6	1.5
Musical	F	107	65.5	16.5	1.6
	M	214	61.3	19.8	1.4
Interpersonal	F	107	85.4	16.4	1.6
	M	214	80.8	18.4	1.3
Intrapersonal	F	107	79.2	19.2	1.9
	M	214	80.0	19.3	1.3
Naturalistic	F	107	56.7	24.4	2.4
	M	214	55.5	23.6	1.6

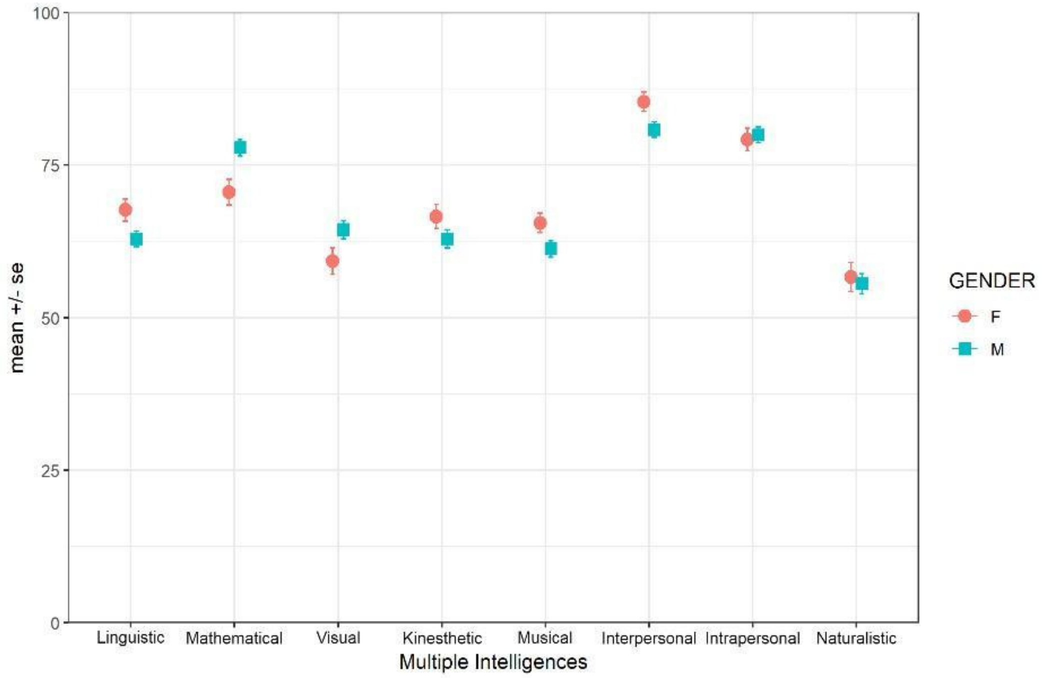

Figure 1. Multiple intelligences by gender (F: Female; M: Male). The red circles show the mean scores for female students and the blue squares show mean scores for male students. The error bars show the standard errors of the means.

3.3. (RQ.2) Analysis by Academic Program

The analysis of the data according to the academic program of the students, as shown in Table 3, showed differences in the mean scores for five of the eight intelligences; the descriptive statistics (mean, standard deviation, and standard error of the mean) are shown in Table 5. The five intelligences are: mathematical, visual, and naturalistic intelligences (all with $p < 0.001$) with a moderate effect ($\eta_H \leq 0.074$), as well as kinesthetic ($p = 0.011$) and musical intelligences ($p = 0.009$) with a small effect ($\eta_H \leq 0.036$).

Table 5. Multiple intelligence scores by program (BioMed: Biomedical Engineering; Civil: Civil Engineering; CompSc: Computer Science; IndMan: Industrial Engineering and Engineering Management; MechAuto: Mechanical Engineering and Automotive Engineering; MechRob: Mechatronics Engineering and Robotics Engineering and Sust: Sustainable Engineering).

	Program	N	Mean	SD	SE
Linguistic	BioMed	28	63.8	21.3	4.0
	Civil	15	65.8	16.0	4.1
	CompSc	26	62.5	17.0	3.3
	IndMan	148	65.4	19.2	1.6
	MechAuto	29	59.1	18.0	3.3
	MechRob	41	64.3	18.4	2.9
	Sust	34	66.9	19.7	3.4
Mathematical	BioMed	28	83.0	16.7	3.2
	Civil	15	88.3	13.7	3.5
	CompSc	26	75.5	18.5	3.6
	IndMan	148	71.1	22.0	1.8
	MechAuto	29	82.8	15.8	2.9
	MechRob	41	82.0	17.7	2.8
	Sust	34	68.0	22.0	3.8
Visual	BioMed	28	60.7	22.0	4.2
	Civil	15	76.7	17.6	4.5
	CompSc	26	64.9	20.9	4.1
	IndMan	148	56.3	23.2	1.9
	MechAuto	29	66.8	21.7	4.0
	MechRob	41	71.0	17.6	2.7
	Sust	34	71.0	15.3	2.6
Kinesthetic	BioMed	28	63.8	19.6	3.7
	Civil	15	68.3	23.1	6.0
	CompSc	26	49.0	21.2	4.2
	IndMan	148	64.7	21.2	1.7
	MechAuto	29	66.8	20.9	3.9
	MechRob	41	63.1	21.1	3.3
	Sust	34	70.6	17.9	3.1
Musical	BioMed	28	65.2	18.4	3.5
	Civil	15	77.5	13.5	3.5
	CompSc	26	58.7	26.2	5.1
	IndMan	148	62.1	17.8	1.5
	MechAuto	29	63.4	18.0	3.3
	MechRob	41	56.1	20.9	3.3
	Sust	34	67.3	12.7	2.2
Interpersonal	BioMed	28	81.3	20.3	3.8
	Civil	15	80.0	17.6	4.5
	CompSc	26	74.5	18.5	3.6
	IndMan	148	85.1	17.4	1.4
	MechAuto	29	81.9	13.6	2.5
	MechRob	41	79.6	19.5	3.0
	Sust	34	82.4	17.7	3.0
Intrapersonal	BioMed	28	80.4	19.1	3.6
	Civil	15	79.2	27.0	7.0
	CompSc	26	77.9	24.8	4.9
	IndMan	148	79.3	18.5	1.5
	MechAuto	29	79.3	18.1	3.4
	MechRob	41	79.6	18.3	2.9
	Sust	34	83.1	16.8	2.9

Table 5. *Cont.*

	Program	N	Mean	SD	SE
Naturalistic	BioMed	28	61.2	25.8	4.9
	Civil	15	64.2	20.5	5.3
	CompSc	26	48.6	20.7	4.1
	IndMan	148	50.8	24.3	2.0
	MechAuto	29	57.3	23.0	4.3
	MechRob	41	57.9	16.9	2.6
	Sust	34	72.4	23.0	3.9

Regarding mathematical intelligence, the students in the civil engineering program (88.3 ± 3.5) obtained a higher mean score than the students in the other programs, especially the sustainability engineering students (68.0 ± 3.8), as shown in Figure 2. Regarding visual intelligence, again, civil engineering students (76.7 ± 4.5), on average, outperformed the students in other programs, and the students in IndMan (56.3 ± 1.9) obtained the lowest mean score in visual intelligence. Finally, at a moderate level of significance, students in the Sust program (72.4 ± 3.9) obtained the highest mean score for naturalistic intelligence as compared with the students in the other programs; the students in the IndMan (50.8 ± 2.0) and CompSc programs (48.6 ± 4.1) obtained the lowest mean scores in this intelligence type.

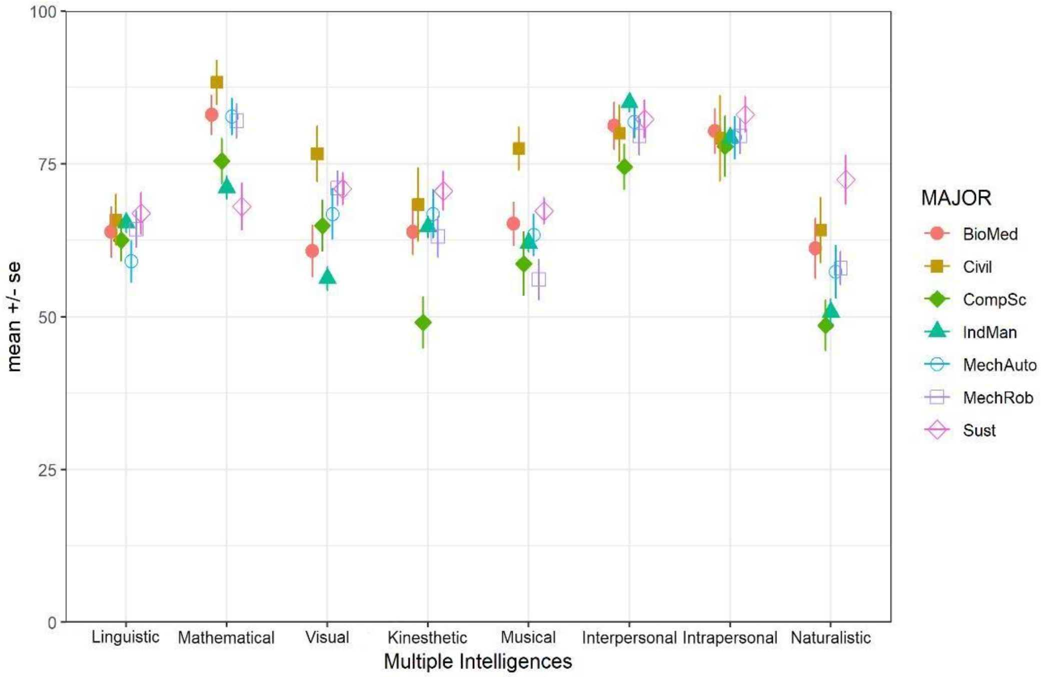

Figure 2. Mean scores of multiple intelligences by program (BioMed: Biomedical Engineering; Civil: Civil Engineering; CompSc: Computer Science; IndMan: Industrial Engineering and Engineering Management; MechAuto: Mechanical Engineering and Automotive Engineering; MechRob: Mechatronics Engineering and Robotics Engineering and Sust: Sustainable Engineering). The solid red circles represent the mean scores of the BioMed program, the solid green squares represent the mean scores of the Civil program, the solid green diamonds represent the mean scores of the CompSc program, the solid green triangles represent the mean scores of the IndMan program, the hollow circles represent the mean scores of the MechAuto program, the hollow squares represent the mean scores of the MechRob program, and the hollow pink diamonds represent the mean scores of the Sust program The error bars show the standard errors of the means.

In Figure 2, kinesthetic intelligence (with a small effect size) stands out, since students in all the programs obtained similar mean scores, except for CompSc students (49.0 ± 4.2) who obtained a lower mean score than the students in the other programs. Finally, with respect to musical intelligence, civil engineering students (77.5 $\pm$ 3.5), again, stood out among all students, since they obtained the highest mean score as compared with students in the other engineering programs.

These results allowed to partially answer RQ.2, in terms of evidence supporting that there are significantly different multiple intelligence profiles between programs.

4. Discussion

The purpose of this study was to analyze the differences among the profiles of first-year engineering students according to gender and academic program. To this end, the development of multiple intelligences was measured and statistical tests were carried out to determine if there were significant differences, in order to create instructional curriculum strategies that allow students to optimally exploit their strengths during their academic courses and throughout their careers.

4.1. General

In global terms, when analyzing engineering students, we would expect that the intelligence with the greatest development would be logical/mathematical intelligence, since the abilities associated with this type of intelligence coincide with the profile of an engineering student [24]. Engineering students have been reported to feel that this intelligence type is their greatest strength [33] and studies have shown that engineering students have a greater development in this intelligence type [14]. However, contrary to expectations, in our analysis, we observed that the students at our university had a greater development in interpersonal intelligence and a lower development in naturalistic intelligence. The same result was obtained by a study of mechanical engineering students at the Yogyakarta State University, Indonesia [34]. Therefore, we agree with other authors who have claimed that logical/mathematical intelligence is not necessarily the most developed intelligence type among engineering students [35]. For example, a study carried out in Africa [36] showed that engineering students did not necessarily enter the career due to their mathematical ability; instead, student had different motivations that varied according to their race, gender, or life goals. Considering studies within the geographic region of this study, we found that in a school also located in northeast Mexico, interpersonal intelligence was shown to be the most developed intelligence type among children [37].

4.2. Gender

We observed that gender and specialty factors did influence students' multiple intelligence profiles. Gender was significant for four of eight intelligence types, with females obtaining the highest mean score in linguistic and interpersonal intelligences, while the mean scores of males were higher in visual and mathematical intelligences.

In the gender analysis, a comparison was made with similar studies. Our results were similar to those of another study that found the females had more developed interpersonal intelligence, while the male sample stood out for its development of mathematical/logical intelligence [38]. The results of another study were in agreement in that the female gender had a higher average score in interpersonal intelligence, but they differed in that the male gender had a higher average score in intrapersonal intelligence [39]. Other authors [40] have agreed with the results of this study and have shown that the female gender has greater development in linguistic intelligence as compared with the male gender, arguing that this difference can be attributed to the social context in which female university students develop. In contrast, Zare-ee et al. [41] only showed a significant difference in naturalistic and existential intelligences, with the female gender obtaining higher scores in both intelligences.

Based on the observed differences between genders, in such courses women may be underserved since they are more developed in the interpersonal and linguistic intelligence. Therefore, a more balanced approach is needed to provide inclusiveness in engineering education. In addition, engineers in their practice are not fully numerical and mathematical. As Achim et al. [42] says: "As a matter of fact, engineering is one of the few professions or occupations that require several distinct thinking processes from both sides of the brain".

4.3. Academic Program

In the analysis by program, five of the eight multiple intelligences were significant: mathematical, visual, naturalistic, kinesthetic, and musical. A comparison with similar studies showed that, in contrast to our results, one study [14] found that civil engineering students had the lowest average score in kinesthetic intelligence, whereas, in our results, civil engineering students had the highest mean score in kinesthetic intelligence; however, our results were in agreement in that CompSc engineering students had the lowest mean score in naturalistic intelligence.

As observed in results engineering students in this context have a more mathematical than visual or linguistic profile. However, as Felder [11] mentions: "most college teaching is verbal—the information presented is predominantly auditory (lecturing) or a visual representation of auditory information". This discrepancy may be an issue. An effective strategy to solve this problem is active learning. According to Felder and Brent [43], active learning is "anything course-related that all student in a class session are called upon to do other than simple watching, listening and taking notes". In this context, they are actively engaged doing more than just listening, they are discussing, analyzing, evaluating, synthesizing, etc. In other words, the students develop other skills and abilities. So, as Ahamad et al. [44] said, the uses of a variety learning methods can stimulate multiple intelligence of students to help them to understand better the concepts.

In addition, there are large differences in some intelligences between programs. For instance, CompSc students show a lower kinesthetic profile than the rest of the programs. This more intuitive non-sensorial trend of Computer science majors has also been spotted in other studies [45,46]. Similarly, the observed musical profile of civil engineers is higher than the other majors. However, since civil engineering curriculum is heavily biased towards the left mode [47] it leaves this creative part of their profile unserved.

Creativity must be part of the engineering curriculum, but its implementation encounters many barriers specially by instructors [48]. Sometimes instructors inadvertently bias lectures towards their own profiles which in most cases is more logical-mathematical. That is why instructors should be aware of their own and their student´s profiles to give a significant instruction [49]. In general, due to the differences in gender and major, engineering education, in addition to active learning needs an adaptive curriculum [4], especially in courses that are taken by all majors.

4.4. Limitations

The limitations of this project include the size of the sample studied, since dividing it into the different programs made the sizes of the subsamples very small. Similarly, given that only one private school in northeast Mexico was observed, generalization of the results may be is limited to similar contexts, since the university has very specific engineering programs and is located in an area with very high industrial development.

5. Conclusions

The observed differences in the development of the multiple intelligences of students according to gender and program allowed us to verify that engineering students have different learning profiles. Regular engineering courses are designed for the more left brained analytical and mathematical student profiles leaving the right brain students underserved. Furthermore, the engineering profession demands distinct thinking processes from both sides of the brain. Therefore, based on these differences, we reaffirm our position of creating favorable environments for students, so that they can be identified and included in their engineering courses. This as a contribution to the UNESCO´s 2030 Agenda for Sustainable

Development, promoting inclusive education, which contributes to the development of a sustainable society.

This leads us to propose the adaptation of inclusive instructional practices and assessment methods that are consistent with the teaching strategies in university education and sensitive to students' differences. Assessment methods that do not agree with individual teaching strategies should be avoided, as they can lead to student academic performance results that do not correspond to the actual learning acquired [3]. Therefore, educational institutions must offer teacher training programs that help teachers to develop the desired competencies in engineering courses [50], and thus help students to achieve better academic performances. Predicting academic performance based on appropriate student profiles can be a valuable tool in guiding instructors to implement timely and relevant teaching strategies to optimally benefit their students [51].

The challenge for higher education in Mexico is to redefine its role and mission to establish strategies to achieve sustainable development, a culture of peace, and global ethics [52]. This analysis confirms the idea that adaptations must be made in instructional design in order to achieve more inclusive and effective education. These changes have an impact at the personal and institutional levels when thinking about sustainability in higher education [53].

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