*International Journal of Instruction*
*e-ISSN: 1308-1470 ● www.e-iji.net*

*July 2026 ● Vol.19, No.3*
*p-ISSN: 1694-609X*
*pp. 17-36*

Article submission code: 20250915145802

Received: 15/09/2025
Revision: 04/12/2025

Accepted: 17/12/2025
OnlineFirst: 01/04/2026

# Factors Influencing the Professional Competencies of Engineering Students: A Prospective Continuous Improvement Approach

**Karina Vega García**
Prof., Facultad de Ingeniería Mecánica y Eléctrica, Universidad Autónoma de Nuevo León, Mexico, *karina.vegagrc@uanl.edu.mx*

**Martha Elia García Rebolloso**
Prof., Facultad de Ingeniería Mecánica y Eléctrica, Universidad Autónoma de Nuevo León, Mexico, *martha.garciab@uanl.edu.mx*

**Juan Diego Guerrero Villegas**
Prof., Facultad de Ingeniería Mecánica y Eléctrica, Universidad Autónoma de Nuevo León, Mexico, *jguerrerov@uanl.edu.mx*

This research aimed to predict the level of professional competencies using key elements of the educational process, such as teacher performance, the school climate, and evaluation methods. The study was developed from the perspective of students enrolled in the Facultad de Ingeniería Mecánica y Eléctrica of the Universidad Autónoma de Nuevo León, recognizing that their perceptions offer valuable insight into how academic practices influence competency development. To conduct the analysis, a quantitative approach with a correlational predictive design was applied, and multiple regression techniques were used on a sample of 332 students from different semesters and academic programs. The results showed that the educational elements examined were statistically significant predictors of the level of professional competencies, collectively explaining 73% of the variance. These findings underscore the critical role that instructional quality, institutional environment, and assessment practices play in shaping the professional readiness of engineering students. Furthermore, the study emphasizes the need for continuous improvement strategies in higher education, particularly those aimed at strengthening teaching methodologies, promoting a positive and collaborative school climate, and implementing fair and meaningful evaluation processes. Overall, the evidence suggests that enhancing these components can contribute substantially to the formation of highly competent engineering professionals prepared to meet current and emerging demands in the field.

Keywords: professional competencies, educational process, multiple regression, teacher performance, school climate, engineering students

**Citation:** García, K. V., Rebolloso, M. E. G., & Villegas, J. D. G. (2026). Factors influencing the professional competencies of engineering students: A prospective continuous improvement approach. *International Journal of Instruction*, *19*(3), 17-36.

## INTRODUCTION

Within the context of higher education, especially in engineering programs, multiple organizations are responsible for carrying out evaluation and accreditation processes at both the national and international levels. These include the Council for the Accreditation of Engineering Education (CACEI), the Accreditation Board for Engineering and Technology (ABET), and the EUR-ACE (European Accredited Engineers) label. These organizations clearly define the professional competencies that an engineer must develop to be considered competitive.

This study aims to determine which elements influence the strengthening of these competencies from the perspective of engineering students. For the analysis of the predictive factors in this research, a search was conducted for state-of-the-art studies on solutions proposed by various authors such as Shuman, Besterfield-Sacre, and McGourty (2005) and Winberg et al. (2020) . Although there is no unanimous agreement on the precise set of skills within the term "professional competencies" (also called "soft," "transferable," "transversal," or even "21st-century" skills), Kolmos and Holgaard (2019) and Winberg et al. (2020) highlight competencies related to social responsibility, ethics, collaborative work, communication, and project management. These are crucial for current engineering positions. In response to growing concerns about job automation, increased outsourcing, and globalization, analyses have sought to anticipate how these needs will evolve. Frey and Osborne (2017) examined the vulnerability of jobs to automation and found that those demanding skills in interpersonal and interprofessional areas—such as perception, negotiation, and persuasion—showed a lower probability of being impacted. The research will focus on examining the relationship between various factors within the specific context of the Facultad de Ingeniería Mecánica y Eléctrica at the Universidad Autónoma de Nuevo León

Evaluating the professional competencies of aspiring engineers is a key element within the education system, as its implications extend not only to the student body but also to the faculty, the academic institution, the university environment, and the community as a whole. Therefore, it is relevant to strengthen evaluation mechanisms based on a competency-based approach and to analyze the degree of progress that students achieve in their professional competencies. Based on the above, the objective is to identify to what extent students perceive significant performance from their teachers, the school environment, and evaluation tools in relation to the level of professional competencies they believe they have developed at the Facultad de Ingeniería Mecánica y Eléctrica de la Universidad Autónoma de Nuevo León.

### *Teacher Performance*

The performance of teaching staff is considered a key pillar in educational quality, as pointed out by Pareja (2019), due to their role in the strategic direction and integral functioning of institutions, which allows them to address both their goals and needs. From this renewed perspective, teachers play a key role in structuring educational processes, providing students with resources, strategies, and learning experiences that help them develop the ability to learn independently (Pegalajar Palomino, Montes, &

Valdivia, 2025). Preparation to teach effectively begins in the early stages, through adequate conditions for their professional training, including postgraduate studies as part of their future development. Within the sphere of educational organizations in Latin America, and following the guidelines established by international bodies such as the OECD and UNESCO (2018), teacher performance is highlighted as a crucial component for achieving high-quality standards in educational systems. Consequently, the demand for appropriate teaching practices that comply with the legal regulations in force in each nation is increasing (Decorpiso, 2023).

According to Ramos and Rueda (2020), the teaching profession is understood as a dynamic process that encompasses both academic planning and the application of pedagogical strategies. From this perspective, a teacher's effectiveness is closely related to their creative ability to implement practical methodologies. These strategies not only facilitate their disciplinary performance but also promote student attention and interest. In agreement, Carlucci et al. (2019) state that the quality of higher education largely depends on teacher performance. Similarly, Escobar (2021) emphasizes the need for constant renewal in teaching practices, giving students an active role in the educational process. As a social activity, teaching must recognize students' previous experiences and focus on identifying and developing their skills and competencies.

***School Environment***

According to Medina and Villareal (2020), the active participation of teachers, along with the conditions of the classroom environment, contributes significantly to strengthening interaction and harmony in the school environment. The improvement of school coexistence is favored by the attention provided by teachers, the encouragement of participation among students, and the implementation of disciplinary measures. These elements, together, contribute to the development of civic education in students. Gómez Arce et al. (2023) show that the classroom environment facilitates learning, and that factors such as responsibility, institutional structure, incentives, and problem-solving. Likewise, Acosta et al. (2025) point out that there is a positive relationship between the emotional development and academic achievements of students.

Rosiles Villalobos et al. (2020) argue that the organizational environment is a behavior influenced by administrators and contextual circumstances; they state that there is a significant relationship between the perception of the organizational environment and various factors, such as the internal structure, hierarchical levels, economic compensation, staff attitudes, their level of satisfaction, and the way institutional members perceive and interpret that context. According to Aleksandrovna et al. (2020), the motivational aspect covers a series of motives that arise in response to needs recognized by an individual; these include cognitive and social aspects, the desire for professional growth and career advancement, as well as pragmatic motivations linked to material rewards derived from the performance of their work duties.

***Evaluation Strategies***

Padial et al. (2025) write that evaluation and feedback with a formative approach serve as key tools for students to strengthen cognitive skills, including the understanding of

concepts, the reduction of anxiety, and the improvement of academic performance. Evaluation provides flexible approaches that favor the achievement of formative objectives and encourage students to acquire knowledge and competencies applicable in their daily lives, thus promoting constant lifelong learning (Gaete-Rengifo & Parra-Díaz, 2024).

Considering the teacher's approach, assessment is carried out not only to provide academic staff with information that supports program improvement and guides their development, but also to collect data on the student's progress throughout their educational trajectory (González, Melgoza, Cabeza, & Okoye, 2024). This practice is concretized by offering feedback that helps students evaluate their development and adjust their study methods, especially in the context of academic tutoring (Alonso, V 2019). From the student's perspective, it is essential to understand the criteria by which their learning will be evaluated, as it allows for self-regulation of learning, which refers to a way of learning autonomously and participatively, guided by personal goals and objectives that guide the educational process (Rodríguez & Sánchez, 2022). Feedback constitutes a key element within formative evaluation, so it is essential to use strategies and instruments consistent with the objectives established in a competency-based pedagogical model. Likewise, students should be encouraged to develop critical and reflective self-evaluation processes (Valdez et al., 2023). This ensures quality learning and, at the same time, improves the teacher's pedagogical intervention (Barrientos, López, & Pérez, 2019).

***Professional Competencies***

The theoretical basis of this research is structured around three fundamental axes: the instructional, the formative, and the growth-oriented, in accordance with the conception of professional competence from a perspective centered on human and social development. Similarly, methodologies such as the educational approach aimed at solving problematic situations, proposed by Bertome and Olivares (2019), and the formative projects strategy described by Tobón (2015), which are manifested in specific educational practices, are recognized. The operational aspect of the model includes the active participation of teachers, tutors, and students, promoting the strengthening of professional competencies through a structured organization of theoretical knowledge. On the other hand, educational institutions have the purpose of training students with key skills that allow them to face the challenges of the current environment, as pointed out by the CEPAL (2021). Likewise, it is essential to incorporate evaluation mechanisms such as surveys and interviews, which allow for the analysis of individual contributions to the process of continuous improvement in education. According to Joya Bonilla, B. Y. (2024), competency-based evaluation has been established as a key component to guarantee educational quality in the contemporary context. This evaluation modality allows for the assessment of theoretical knowledge as well as practical skills and personal qualities necessary for a complete education.

### *Relationships Between Variables*

*Teacher Performance and Competencies*

The role of the teacher has a favorable impact on the formation and acquisition of competencies by the students. In this line, Salguero et al. (2024) conducted a study focused on digital skills, understood as technological capacities that directly influence the educational environment. To analyze the connection between these capacities and the academic performance of university students, a quantitative approach was used with a non-experimental correlational design. The sample, intentionally selected, consisted of 100 students out of a total of 300. The information was collected through surveys that included a questionnaire to evaluate digital skills, while academic grades were used as an indicator of performance. The findings indicated a favorable correlation between the two variables, which implies that an adequate mastery of digital competencies is associated with higher academic performance.

Pedro and Ysaías (2025) investigated the influence of teachers' technological skills on the quality of education. In their study, they highlighted the importance of the appropriate use of digital tools as a fundamental element to optimize teaching processes. The instruments used were validated by three experts and applied using a Likert scale, whose reliability was confirmed with the Cronbach's Alpha coefficient. The findings revealed a positive and significant correlation between the variables, with a Spearman coefficient of 0.391 and a p-value of 0.005.

On the other hand, Núñez Jiménez (2022) examined the link between competencies and performance in the workplace in the public sector, using a quantitative approach with a transversal, non-experimental, and correlational design. The sample consisted of 120 administrative employees of a district municipality. The results indicated a strong and significant correlation between the level of competence of the workers and their work performance ($p = 0.0000$, $Rho = 0$).

*School Environment and Competencies*

According to Ponce et al. (2023), the school environment has a crucial impact on the educational development of students. An enriching and positive educational environment within the institution favors the comprehensive development of students. Additionally, Cobos Márquez (2025) suggests that school spaces should focus on strengthening competencies, and likewise, contribute to the acquisition of skills and values that favor superior academic performance. On the other hand, a harmonious school climate, in which constructive relationships between teachers and students prevail, fosters both commitment to studies and the capacity for autonomous learning. As demonstrated by Mardones (s.f.), this type of environment is fundamental to promoting the acquisition and strengthening of skills in high school and higher education students. The role of the educator in educational environments is fundamental, as it directly influences student academic performance. It fosters comprehensive learning, encompassing academic, personal, and social aspects, preparing active and autonomous students (Mardones, s.f.).

*Evaluation Strategies and Competencies*

Tobón (2015) argues that planning evaluation in advance constitutes a key indicator for achieving a specific skill. This is achieved through the implementation of performance-based evaluations and different levels of execution, thus facilitating a more precise orientation and better control during the evaluation. Menzala-Peralta and Ortega-Menzala (2023) argue that competency-based evaluation allows for measuring student performance based on quality criteria, determining how much a student masters a competency through specific criteria. Camacho-Navarro and Salinas-García (2022) pointed out that the acquisition of digital skills during the teacher training process is key to responding to current demands. Their curricular proposal, based on an evaluative research, applied the authentic evaluation approach in the design of subjects. Students developed competencies in areas such as digital information management, effective communication, the creation of digital materials, data protection, and the ability to solve technological problems. In addition, they perceived their digital skills at an intermediate to advanced level and recognized their usefulness for professional practice.

Taking into account the aforementioned, this research formulated the following main question: To what extent do teacher performance, the educational environment, and evaluation methods influence as predictive factors on the level of professional competencies perceived by students in advanced semesters at the Facultad de Ingeniería Mecánica y Eléctrica?.

## METHOD

The research was conducted using a non-experimental design with a quantitative, cross-sectional, and predictive approach. The information obtained was systematized using Excel spreadsheets to facilitate subsequent analysis with specialized statistical software. To test the proposed hypothesis, structural equation modeling was used, supported by corresponding statistical tests.

### *Population and Sample*

A non-probabilistic convenience sampling method was used. This sampling strategy was selected due to the accessibility and availability of students enrolled in the final semesters, which facilitated the efficient administration of the instruments during scheduled academic periods. Although convenience sampling offers practical advantages, it may introduce sampling bias because the participants may not fully represent the entire student population of the program or institution. Consequently, the results should be interpreted with caution, acknowledging that generalizability may be limited.

The population consisted of 400 students in the final semesters of the Facultad de Ingeniería Mecánica y Eléctrica de la Universidad Autónoma de Nuevo León. From this group, a sample of 332 students participated in the research.

### *Variables and Instruments*

In this study, the first independent variable was Teacher Performance (TP), which was measured using an instrument developed by Quispe Malaver (2020), composed of 20

items with a five-level Likert scale ranging from "never" to "always". The second independent variable, School Environment (SE), was evaluated using a 20-item questionnaire, also on a five-point scale, ranging from "strongly disagree" to "strongly agree". As for the third independent variable, Evaluation Strategies (ES), a 13-item instrument was applied using the same Likert scale format. Finally, the dependent variable, Professional Competencies (PC), was measured with an instrument specifically designed for this research, consisting of 31 items and using a five-level response scale.

The reliability coefficients (Cronbach's Alpha) obtained for each instrument were as follows:

- Teacher Performance (TP): .976
- School Environment (SE): .960
- Evaluation Strategies (ES): .960
- Professional Competencies (PC): .981

***Construct Validation of the Instruments***

For the teacher performance variable, a KMO or sample size of 0.973 was obtained, which is sufficient for a factorial analysis. A chi-square value of 11254.152 and an explained variance of 66.848 were also obtained, resulting in three factors or dimensions.

For the school environment variable, a KMO or sample size of 0.965 was obtained, which is sufficient to conduct a factorial analysis. A chi-square value of 1454.418 and an explained variance of 71.025 were obtained, resulting in four factors or dimensions.

For the evaluation strategies variable, a KMO or sample size of 0.927 was obtained, which is sufficient to conduct a factorial analysis. A chi-square value of 4850.738 and an explained variance of 78.164 were obtained, resulting in three factors or dimensions.

Finally, for the professional competencies variable, a KMO or sample size of 0.975 was obtained, which is sufficient to conduct a factorial analysis. A chi-square value of 10948.854 and an explained variance of 72.95% were obtained, resulting in five factors or dimensions.

The professional competencies acquired can be explained by 73% by the combined influence of teacher performance, school environment, and evaluation strategies.

Table 1
Sample Demographic Data

| Variable | n | % |
|---|---|---|
| Gender | | |
| Male | 236 | 71.1 |
| Female | 96 | 28.9 |
| Semester of study | | |
| Seventh | 49 | 14.8 |
| Eighth | 102 | 30.7 |
| Ninth | 112 | 33.7 |
| Tenth | 69 | 20.8 |
| Shift of study | | |
| Morning | 73 | 22.0 |
| Afternoon | 56 | 16.9 |
| Evening | 203 | 61.1 |
| Place of origin | | |
| Resident | 247 | 74.4 |
| Non-resident | 85 | 25.6 |

## FINDINGS

In Table 2, a general arithmetic mean of 4.18 (SD = 0.650) is reported for teacher performance, which reflects a medium dispersion in the collected data. This value represents 79.5% of the total scale used, suggesting a favorable level of teacher performance. The table presents both the averages and standard deviations of the different criteria that make up this construct.

According to the results, the items with the highest means were: "DEM17 They foster respectful relationships among students" and "DEM16 They prevent conflicts within the classroom," both with a score of 4.40. The findings show a favorable evaluation of the teacher's ability to foster a climate of respect in the classroom and anticipate possible conflicts or problematic situations. In contrast, the items with the lowest averages were: "DCP8 They monitor the activities of student teams" and "DRE29 They provide personalized attention to those with learning difficulties". This could indicate areas for improvement in strengthening differentiated attention and following up on collaborative work.

Table 2
Teacher Performance

| Criteria | M | DE |
|---|---|---|
| DEM17 They foster respectful relationships among students. | 4.40 | .789 |
| DEM16 They prevent conflicts within the classroom. | 4.40 | .769 |
| DCP10 They maintain adequate discipline during class. | 4.39 | .760 |
| DEM13 They guarantee a pleasant atmosphere in the classroom. | 4.33 | .765 |
| DEM15 They know how to regulate their own emotions. | 4.30 | .814 |
| DRE31 They present the key activities of the semester from the first week. | 4.29 | .781 |
| DRE18 They review content seen in the previous session. | 4.27 | .808 |
| DRE27 They demonstrate commitment to their work. | 4.27 | .787 |
| DRE30 They develop the course according to the analytical program. | 4.26 | .785 |
| DRE22 They comply with the established work schedule. | 4.26 | .822 |
| DRE19 They verify the tasks delivered by the students. | 4.25 | .855 |
| DRE26 They clarify students' doubts with precision. | 4.22 | .809 |
| DCP9 They answer students' questions clearly. | 4.20 | .819 |
| DCP7 They use understandable language. | 4.20 | .819 |
| DCP5 They are characterized by their organization. | 4.18 | .805 |
| DRE25 They question the group to confirm what has been learned. | 4.17 | .872 |
| DEM12 They perform teaching with enthusiasm. | 4.17 | .856 |
| DEM11 They show empathy towards their students. | 4.17 | .835 |
| DRE28 They encourage the exchange of ideas among students. | 4.17 | .869 |
| DRE24 They supervise the teamwork of the students. | 4.15 | .908 |
| DCP1 They have extensive knowledge of the content they teach. | 4.15 | .745 |
| DCP2 They effectively use technological tools for teaching. | 4.14 | .840 |
| DEM14 They are tolerant of those who think differently. | 4.13 | .913 |
| DRE21 They encourage student participation through innovative strategies. | 4.12 | .864 |
| DRE20 They explore the previous knowledge of the students. | 4.11 | .947 |
| DCP3 They distribute the contents of the subject appropriately. | 4.09 | .793 |
| DRE23 They individually supervise the work of each student. | 4.04 | .990 |
| DCP4 They adapt teaching activities using diverse strategies. | 4.02 | .901 |
| DCP6 They plan tasks according to the group's learning pace. | 4.02 | .908 |
| DCP8 They monitor the activities of the student teams. | 3.98 | .985 |
| DRE29 They provide personalized attention to those with learning difficulties. | 3.98 | 1.044 |

In Table 3, which corresponds to the school environment construct, a general arithmetic mean of 4.20 (SD = 0.616) is reported. This indicates a moderate dispersion in the responses. This value represents 80% of the total scale used, which places the perceived school environment at a "good" to "very good" level. The table presents the average values and standard deviations for each of the items that make up this construct.

The items with the highest scores were: "ASP18 I identify with this school and consider it my space" (M = 4.36, SD = 0.758) and "ARI1 The bonds among students in this school are cordial and constructive" (M = 4.33, SD = 0.727). This reflects a sense of belonging and positive interpersonal relationships within the student community. In contrast, the items with the lowest averages were: "ARI4 There is fluid communication between students and teachers in this school" (M = 4.08, SD = 0.820) and "ARC17 The restrooms in the school are kept in adequate clean conditions" (M = 4.04, SD = 0.945).

The results indicate potential areas for improvement, particularly regarding the effectiveness of communication between teachers and students, as well as the cleanliness and hygiene of the restrooms.

Table 3
School Environment

| Criteria | M | DE |
|---|---|---|
| ASP18 I identify with this faculty and consider it my space. | 4.36 | .758 |
| ARI1 The bonds among students in this faculty are cordial and constructive. | 4.33 | .727 |
| AAA8 The faculty has resources such as a library and laboratories that support the learning process. | 4.31 | .764 |
| ARI3 In this institution, respect is promoted among all members of the educational community. | 4.28 | .810 |
| ASP20 The organized activities and events strengthen coexistence between students and teachers. | 4.27 | .810 |
| ARI6 The teacher communicates the rules that must be followed in class clearly. | 4.27 | .759 |
| ACA11 Classrooms provide an adequate environment for focusing and learning. | 4.27 | .735 |
| ARC15 The outdoor spaces are well-conditioned for physical and recreational activities. | 4.26 | .811 |
| ACA10 The active participation of the students is encouraged during classes. | 4.23 | .761 |
| ARC13 The facilities such as laboratories and libraries are in good condition. | 4.21 | .851 |
| ACA12 Academic activities foster creativity and curiosity. | 4.20 | .774 |
| ARC14 The faculty provides effective access to technology and digital platforms. | 4.20 | .839 |
| ASP19 Work is done to maintain an inclusive environment within the faculty. | 4.19 | .813 |
| ARI5 There is a good relationship between students and teachers in this institution. | 4.17 | .769 |
| AAA7 The teacher shows a willingness to provide additional support to those who need it. | 4.14 | .817 |
| AAA9 Teachers offer useful comments that contribute to students' academic progress. | 4.09 | .859 |
| ARAC16 The classrooms in this faculty have the necessary equipment. | 4.08 | .879 |
| ARI4 There is fluid communication between students and teachers in this faculty. | 4.08 | .820 |
| ARC17 The restrooms in the faculty are kept in adequate clean conditions. | 4.04 | .945 |

Table 4, which pertains to the evaluation strategies construct, displays the means and standard deviations for its various criteria. The data reveals that the dimension with the lowest mean is related to the evaluation method, whereas the dimensions with the highest scores are associated with the clarity of the criteria used and how the teacher applies them. The items with the highest means were: "EV8 The evaluation criteria are clearly established from the beginning of the course" (M = 4.26, SD = 0.745) and "EV1 Teachers apply evaluations according to the previously defined criteria" (M = 4.23, SD = 0.777), which suggests that, in general, students perceive the evaluation as structured and consistent with established guidelines. Conversely, the items with the lowest means were: "EV5 Grades fairly reflect each student's performance" (M = 4.16, SD = 0.822) and "EV7 During classes, everyone has the opportunity to express their opinions on the evaluation process" (M = 4.13, SD = 0.919). These results could point to areas for improvement, particularly regarding the perception of fairness in grading and the inclusion of student voices in the evaluation process.

Table 4
Evaluation Strategies

| Criteria | M | DE |
|---|---|---|
| EV8 The evaluation criteria are clearly established from the beginning of the course. | 4.26 | .745 |
| EV1 Teachers apply evaluations according to the previously defined criteria. | 4.23 | .777 |
| EV3 The professor clearly details the procedure that will be followed for evaluation. | 4.23 | .816 |
| EV11 The evaluations allow me to effectively measure my understanding of the content. | 4.23 | .770 |
| EV9 The evaluation system is easy to understand and well-structured. | 4.22 | .788 |
| EV4 The teacher communicates the results of the evaluations to students in a timely manner. | 4.22 | .771 |
| EV6 The way in which evaluation is carried out is fair and treats everyone equally. | 4.22 | .783 |
| EV10 The evaluations are aligned with the content taught during the semester. | 4.20 | .780 |
| EV2 The evaluation is carried out according to what was previously explained in class. | 4.20 | .782 |
| EV12 The evaluation method encourages both study and active participation. | 4.19 | .803 |
| EV13 The evaluations include useful feedback to improve my learning. | 4.18 | .813 |
| EV5 Grades fairly reflect each student's performance. | 4.16 | .822 |
| EV7 During classes, everyone has the opportunity to express their opinions on the evaluation process. | 4.13 | .919 |

Table 5, which deals with the professional competencies construct, shows a general mean of 4.29 and a standard deviation of 0.595, indicating moderate dispersion in the responses. This average is equivalent to 82.25% of the maximum value of the scale used, placing the level of acquired professional competencies in a range from "good" to "very good".

The dimension that received the highest score was professional ethics, which indicates solid training in ethical principles and a strong sense of moral responsibility. Conversely, the dimension with the lowest average was related to professional knowledge, suggesting opportunities for improvement in aspects related to updating and applying specialized technical knowledge.

Among the items with the highest scores were: "I take responsibility for my actions and consider my mistakes an opportunity to learn" (M = 4.45, SD = 0.691), "I recognize the importance of acting ethically in the professional practice of engineering" (M = 4.38, SD = 0.718), and "I easily adapt and collaborate with people from different contexts and perspectives" (M = 4.38, SD = 0.704). These results reflect a high level of personal commitment, ethical awareness, and skills for collaborative work in diverse environments.

In contrast, the items with the lowest averages were: "I know how to formulate and solve complex technical problems within the engineering field" (M = 4.18, SD = 0.806) and "I stay informed about current advances and trends in my professional area" (M = 4.17, SD = 0.825). These responses point to areas of opportunity focused on continuous updating and strengthening skills to face complex technical challenges in the field of engineering.

Table 5
Professional Competencies

| Criteria | M | DE |
|---|---|---|
| CER31 I take responsibility for my actions and consider my mistakes an opportunity to learn. | 4.45 | .691 |
| CER27 I recognize the importance of acting ethically in the professional practice of engineering. | 4.38 | .718 |
| CTE23 I easily adapt and collaborate with people from different contexts and perspectives. | 4.38 | .704 |
| CER30 I maintain principles of honesty and transparency in all my professional activities. | 4.37 | .740 |
| CER29 I am actively involved in protecting the environment and safety in the projects I develop. | 4.37 | .756 |
| CER28 I always evaluate the social and ethical consequences before acting or making decisions. | 4.37 | .706 |
| CPA17 I have the ability to identify key trends and useful patterns when analyzing data. | 4.34 | .701 |
| CTE22 I have skills to mediate conflicts and foster collaborative work within a team. | 4.33 | .712 |
| CTE21 I contribute effectively to collaborative work with professionals from different disciplines. | 4.33 | .728 |
| CTE26 I know how to work in a team, defining goals, planning activities, meeting deadlines, and considering risks. | 4.33 | .736 |
| CTE24 I participate with constructive ideas and actively listen to the contributions of my colleagues. | 4.33 | .743 |
| CPA19 My data analysis allows me to make informed and strategic decisions. | 4.32 | .743 |
| CTE25 I enjoy working with other people and appreciate the variety of skills within the team. | 4.31 | .743 |
| CPA18 I can generate innovative and creative ideas to solve professional problems. | 4.30 | .730 |
| CHC15 I have the ability to communicate engineering concepts to facilitate interdisciplinary collaboration. | 4.30 | .711 |
| CHC14 I use visual tools such as graphs and diagrams to transmit technical information clearly. | 4.29 | .731 |
| CCO7 I apply essential principles of basic sciences and engineering in problem-solving. | 4.29 | .775 |
| CCO3 Thanks to my professional training, I am prepared to face and solve complex situations. | 4.28 | .743 |
| CHC11 I express engineering concepts clearly, both orally and in writing. | 4.27 | .758 |
| CPA20 I am prepared to face new situations and generate practical solutions effectively. | 4.27 | .749 |
| CCO5 My technical preparation gives me the confidence to face professional challenges with assurance. | 4.27 | .752 |
| CCO8 I have skills to design and execute appropriate experiments in the engineering context. | 4.26 | .762 |
| CHC12 I communicate technical information effectively to people outside the field of engineering. | 4.26 | .764 |
| CCO9 I consider myself capable of designing engineering solutions within my specialized field. | 4.26 | .780 |
| CCO1 I possess a solid understanding of the principles that govern my area of engineering. | 4.26 | .772 |
| CHC13 My technical reports are clear, organized, and have an appropriate structure. | 4.25 | .773 |
| CPA16 I can analyze complex problems by breaking them down into simpler parts for their solution. | 4.23 | .719 |
| CCO2 I use theoretical knowledge to provide answers to practical problems in my specialty. | 4.21 | .782 |
| CCO6 I know how to formulate and solve complex technical problems within the engineering field. | 4.18 | .806 |
| CCO4 I stay informed about current advances and trends in my professional area. | 4.17 | .825 |

***Null Hypothesis Test***

In this study, the null hypothesis (H0) was formulated as follows: teacher performance, the educational environment, and evaluation methods do not show a significant influence as predictive factors on the level of professional competencies perceived by students at the Facultad de Ingeniería Mecánica y Eléctrica de la Universidad Autónoma de Nuevo León. To test this hypothesis, a structural equation model was used, with a significance level of 0.05 established as the criterion for its possible rejection.

***Results of the Hypothesis Test***

The hypothesis was evaluated using a sample of 332 students from the School of Mechanical and Electrical Engineering at the Autonomous University of Nuevo León in Mexico. The research proposed that teacher performance, the academic environment, and evaluation strategies function as relevant predictive factors for the level of professional competencies perceived by the students of this school.

During the analysis, 15 outliers were identified and removed from the study using the Mahalanobis distance calculation. To verify the multivariate normality of the data, Mardia's multivariate kurtosis coefficient was applied, yielding a critical ratio (C.R.) of 4.34. According to criteria established by Bentler (2005), a value below 5 indicates that the assumption of normality has not been severely violated.

The statistical processing was carried out using a structural equation model, which showed a good fit according to most of the suggested indicators. The model's findings revealed that the three independent variables—teacher performance ($\gamma = 0.33$, $p = .019$), school environment ($\gamma = 0.34$, $p = .003$), and evaluation strategies ($\gamma = 0.33$, $p = .001$)—have a significant effect on predicting the level of professional competencies perceived by students. This is because all p-values were below the significance level of 0.05. Therefore, the results allow for the rejection of the null hypothesis and support the alternative hypothesis based on the evidence obtained. Collectively, these three variables explain 73% of the variability in the level of professional competencies reported by the students.

The model also identified the factors with the greatest and least contribution within each variable.

- Teacher Performance: The factor with the most weight was job responsibility ($\lambda = 0.95$), while emotionality had the least contribution ($\lambda = 0.92$).
- School Environment: Academic support and the learning climate were the most influential factors ($\lambda = 0.93$), with sense of belonging having the least impact ($\lambda = 0.83$).
- Evaluation Strategies: The evaluation method was the most relevant factor ($\lambda = 0.96$), and teaching work was the least significant ($\lambda = 0.91$).
- Professional Competencies: Professional knowledge showed the highest factor loading ($\lambda = 0.96$), while professional ethics had the lowest ($\lambda = 0.87$).

## DISCUSSION AND CONCLUSION

This research aimed to analyze whether variables such as teacher performance, the academic environment, and evaluation strategies have a direct influence on the professional competencies that students at the School of Mechanical and Electrical Engineering at UANL perceive they have developed. The results show that the teacher's role is a fundamental component with a significant impact on students' professional training. This finding underscores the strategic importance of the teacher in developing the competencies and knowledge that enable students to face the challenges of the professional world.

### *Teacher Performance and Competencies*

Numerous studies have demonstrated the direct influence of teaching on the acquisition of professional competencies. A prime example is the research by Ramos López (2018), who, using a correlational method, found a close link between teacher performance and the skills students acquire. This highlights the importance of fostering continuous training for teaching staff to improve both educational quality and the career opportunities of graduates. In line with these findings, Espino Wuffarden (2018) reported a significant connection between teachers' skills and students' academic performance. This perspective is also supported by Núñez Jiménez (2022), who, using a cross-sectional design, confirmed that the level of competencies achieved by students is considerably influenced by the performance of teachers during the training process. Similarly, a recent study, "Is Education-Job Transferability?" (Lee & Jung, 2023), found that when competencies acquired during education (knowledge, skills, and attitudes) are applicable to the job ("education-job transferability"), there is a strong positive association with job satisfaction and a lower intention to leave employment in the ICT sector. However, another investigation—"Teacher Professional Development and Student Mathematics Achievement: A Meta-Analysis" (2025)—reported a moderate positive effect of teacher professional development programs on student performance in mathematics. It also observed that several moderators (educational level, professional development format, number of days, inclusion of students with disabilities) significantly influence the magnitude of this effect. Lastly, the conclusions drawn in this study are consistent with Hervis (2018), who established that the quality of academic and professional performance is highly influenced by the level of skills developed. This reinforces the importance of promoting educational processes aimed at strengthening these competencies in both students and teachers as a way to improve educational and career outcomes.

### *School Environment and Competencies*

The environment in which the educational process takes place for students at the School of Mechanical and Electrical Engineering at the Autonomous University of Nuevo León has been identified as a key component in the development of skills essential for professional practice. This observation aligns with previous research, such as that by Ponce et al. (2023), who note that the school environment has a significant influence on both the academic and personal growth of students. An enriching educational environment that fosters enthusiasm for learning and provides favorable conditions

enhances student performance and promotes their overall well-being. This type of context not only facilitates the transmission of knowledge but also stimulates formative spaces aimed at comprehensive education, with an impact that extends beyond the classroom, as argued by Ley-Leyva (2022). When a positive school climate is combined with the committed involvement of teachers, it creates conditions conducive for students to develop fundamental competencies for their professional careers.

*Evaluation Strategies and Competencies*

On the other hand, the findings of the present study confirm that the methods used to evaluate the teaching-learning process directly affect the acquisition of professional skills. In this regard, Tobón (2015) suggests that a well-structured evaluation, aligned with learning objectives, allows for the precise measurement of certain skills. These evaluations can be carried out using instruments such as performance tests or progressive levels of execution, which allow for better guidance of the formative process. Similarly, Rodríguez et al. (2019) emphasize the importance of designing evaluation strategies that are coherent, comprehensive, and organized. To be effective, evaluative practices must follow a solid methodological approach that contributes directly to the strengthening of the competencies necessary for the professional field. From a complementary perspective, Hincapié Parejo and De Araujo (2021) argue that the evaluation of the educational process is not limited to a diagnostic analysis but also enhances the educational process itself. This is achieved through strategies that clearly articulate the content taught with the knowledge acquired, providing greater understanding for both the teacher and the students.

*Theoretical Implications of the 73% Explained Variance*

The model's ability to explain 73% of the variance in professional competencies represents a substantial contribution to the theoretical understanding of competency development in engineering education. This percentage suggests that teacher performance, school environment, and evaluation strategies collectively function as a robust predictive framework. Theoretically, this reinforces models that conceptualize competency development as an integrative process shaped by pedagogical effectiveness, contextual atmosphere, and formative assessment. Furthermore, such a high level of explained variance provides empirical support for competency-based education approaches, which emphasize the alignment between teaching practice, institutional support, and assessment methods. This may also indicate that engineering programs with strong instructional design and supportive learning environments are well-positioned to advance holistic student development.

*Limitations*

Despite the strengths of this study, several limitations must be acknowledged. First, the use of convenience sampling restricts the generalizability of the findings to the broader population of engineering students. Second, the cross-sectional design limits the ability to infer causality, as it captures perceptions at a single point in time. Third, all variables were measured through self-report instruments, which may introduce response bias and inflate associations due to common method variance. Additionally, the model, while

explaining 73% of the variance, leaves 27% unaccounted for, suggesting the presence of other influential factors not included in the analysis, such as motivation, prior academic preparation, or external socioeconomic conditions. Future research could address these limitations by incorporating longitudinal designs, diversified samples, and mixed-method approaches.

*Conclusions and Recommendations*

In conclusion, the study demonstrates that teacher performance, school environment, and evaluation strategies significantly predict the level of professional competencies among engineering students. These factors jointly explain 73% of the variance, highlighting the importance of strengthening teaching practices, fostering a positive academic environment, and applying effective evaluation methods. This evidence reinforces the need to align institutional strategies with continuous improvement and professional training in higher education.

The research carried out at the Facultad de Ingeniería Mecánica y Eléctrica at the Universidad Autónoma de Nuevo León (Mexico) demonstrated that three factors—teacher performance, the institutional environment, and evaluative practices—significantly influence the level of professional competencies that students perceive they have developed. The data obtained highlights the importance of ensuring effective teaching practices, generating positive educational contexts, and applying appropriate evaluation systems as key elements for a solid and complete professional education.

Moreover, although the study is limited to a single institution, its findings have the potential to be applicable to other engineering faculties or universities with similar academic profiles. Future research should examine whether these predictive relationships hold across diverse institutional contexts, enabling broader generalization. Likewise, the results offer valuable insights for engineering education policy, emphasizing the need to invest in teacher development, strengthen institutional environments, and implement coherent assessment frameworks that promote continuous improvement and support competency-based training at a systemic level.

**RECOMMENDATIONS**

- Based on the results, the following measures for improvement are suggested for the management team of the School of Mechanical and Electrical Engineering:
- Develop continuous training programs for teachers, including workshops, seminars, and training sessions aimed at strengthening their pedagogical and didactic competencies.
- Promote a greater bond between teachers and students, as well as the implementation of learning spaces that are stimulating, collaborative, and motivating.
- Implement diverse evaluation strategies, such as projects, practical activities, and formative evaluations, to holistically assess the development of students' skills and knowledge.
- It is recognized that a greater level of strategic management by administrative leaders will contribute to more effective and well-founded decision-making.

## FUTURE WORK

- Analyze which evaluation strategies—exams, projects, continuous assessments, among others—show a greater correlation with the development of professional competencies.
- Examine which specific components of the school environment (such as the teacher-student relationship, resource availability, or emotional climate) influence students' perception of professional competencies most significantly.
- Investigate which teaching behaviors and methods are closely related to the formation of essential skills for professional practice, considering factors such as teaching experience, teaching style, and the ability to motivate students.
- Replicate the research with a different group of university students to compare results and validate the findings in different educational contexts.

## REFERENCES

ABET. (n. d.). Accreditation. ABET. https://www.abet.org/accreditation/

Acosta, J. L. P., Velásquez, M. E. L., León, O. E. M., Mena, C. P., & Pacheco, A. J. G. (2025). Inteligencia emocional para un buen rendimiento académico en educación superior. Revista Invecom. https://doi.org/10.5281/zenodo.14920622

Aleksandrovna, A. A., Alekseevna, A., & Afanasyevna, A. (2020). Future teachers forming professional expectations in modern educational conditions. Research Articles, 5(1), 1–10. https://doi.org/10.20511/pyr2020.v8nSPE3.720

Alonso, V. (2019). Experiencia "tricantina" de evaluación formativa y compartida en Educación Primaria. Revista de Innovación y Buenas Prácticas Docentes, 8(1), 132–141. https://doi.org/10.21071/ri_bpd.v8i1.11574

Barrientos, E., López-Pastor, V. M., & Pérez-Brunicardi, D. (2019). ¿Por qué hago evaluación formativa y compartida y/o evaluación para el aprendizaje en EF? Retos, 36, 37–43. https://doi.org/10.47197/retos.v36i36.66974

Bentler, P. M. (2005). EQS 6 Structural Equations Program Manual. Encino, CA: Multivariate Software. https://www.scirp.org/reference/referencespapers?referenceid=2504511

Bertome, E. L., & Olivares, Á. L. G. (2019). Metodología didáctica y modelos pedagógicos en la enseñanza preuniversitaria de la Comunidad de Madrid. Comunitania Revista Internacional de Trabajo Social y Ciencias Sociales, 16, 103. https://doi.org/10.5944/comunitania.16.5

Camacho-Navarro, A., & Salinas-García, R. J. (2022). Estrategia basada en la evaluación auténtica para el desarrollo de competencias digitales en la formación inicial docente. RIDE Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 12(24). https://doi.org/10.23913/ride.v12i24.1126

Carlucci, D., Renna, P., Izzo, C., & Schiuma, G. (2019). Assessing teaching performance in higher education: A framework for continuous improvement. Management Decision, 57(2), 461–479. https://doi.org/10.1108/MD-04-2018-0488

Cobos Márquez, J. E. (2025). Gestión de ambientes óptimos de aprendizaje en la modalidad de telesecundaria. Revista Universidad YAAN. https://universidadyaan.mx/revista/2025/enero/especial_2/articulo_2.pdf

Consejo de Acreditación de la Enseñanza de la Ingeniería. (2018). Marco de referencia 2018 del CACEI en el contexto internacional (ingenierías). https://www.uv.mx/cq/files/2013/01/2018-Marco-de-Referencia-para-la-acreditacion-de-los-Programas-de-Ingenieria.pdf

Decorpiso. (2023). El marco legal de la profesión docente en México. https://decorpiso.com.mx/cual-es-el-marco-legal-en-el-que-se-desarrolla-la-profesion-docente-en-mexico

ENAEE. (n. d.). European Network for Accreditation of Engineering Education. https://www.enaee.eu/

Escobar, M. A. H. (2021). La práctica docente y su influencia en la motivación de los estudiantes. Revista Atlante. https://dialnet.unirioja.es/servlet/articulo?codigo=9113590

Espino Wuffarden, J. E. (2018). Competencias digitales de los docentes y desempeño pedagógico en el aula [Tesis de maestría, Universidad San Martín de Porres]. Repositorio USMP. https://repositorio.usmp.edu.pe/handle/20.500.12727/5639

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? Technological Forecasting and Social Change, 114, 254–280. https://doi.org/10.1016/j.techfore.2016.08.019

Gaete-Rengifo, R. M., & Parra-Díaz, J. A. (2024). Evaluación del desarrollo de competencias de un programa de preparación para el ingreso a la educación superior. Revista Electrónica Educare, 29(1), 1–21. https://doi.org/10.15359/ree.29-1.18496

Gómez Arce, R. M., Pongo Mendo, E. G., Nolasco Carbajal, E., Quispe de la Torre, D., Bocanegra Collazos, R., & Gutiérrez Tirado, R. A. (2023). Clima escolar, inteligencia emocional y psicología educativa en los espacios de aprendizaje. Editorial Mar Caribe. https://ciencialatina.org/index.php/cienciala/article/view/11959

González, J., Melgoza, E., Cabeza, L., & Okoye, K. (2024). Assessment of students' learning outcome and competency through a blend of knowledge and practical ability. International Journal of Instruction, 17(2), 561–582. https://doi.org/10.29333/iji.2024.17231a

Hervis, E. E. (2018). El desempeño del docente como factor asociado a la calidad educativa en América Latina. https://www.redalyc.org/journal/440/44055139021/html/

Hincapié Parejo, N. F., & De Araujo, C. C. (2021). Evaluación de los aprendizajes por competencias. Revista Educación y Humanismo, 23(41), 1–17. https://doi.org/10.17081/eduhum.23.41.4469

Joya Bonilla, B. Y. (2024). Evaluación y aprendizaje basado en competencias. Revista Investigación & Praxis en Ciencias Sociales, 3(1), 80–96. https://doi.org/10.24054/ripcs.v3i1.3041

Kolmos, A., & Holgaard, J. E. (2019). Employability in engineering education: Are engineering students ready for work? In S. H. Christensen et al. (Eds.), The engineering-business nexus (pp. 499–520). Springer. https://doi.org/10.1007/978-3-319-99636-3_22

Lee, S.-T., & Jung, S.-M. (2023). Is Your Degree Worth It? Education-Job Transferability and Job Satisfaction of ICT Workers. SAGE Open. https://doi.org/10.1177/21582440231210068

Ley-Leyva, N. V. (2022). El papel del docente de educación básica en el contexto actual. Portal de la Ciencia, 3(1), 27–37. https://doi.org/10.51247/pdlc.v3i1.308

Mardones, G. (n. d.). The influence of school climate on learning. Revista Realidad Educativa. https://revistas.uft.cl/index.php/rre/article/view/300/359

Menzala-Peralta, C. C., & Ortega-Menzala, E. (2023). Evaluación basada en competencias en educación superior. Horizontes Revista de Investigación En Ciencias de la Educación, 7(28), 836–851. https://doi.org/10.33996/revistahorizontes.v7i28.558

Padial, M. J. A., Fuentes, A. R., Ballesta-Claver, J., & Torres, J. M. T. (2025). Competencia docente universitaria en Neuroeducación y Diseño Universal de Aprendizaje. Dialnet. https://dialnet.unirioja.es/servlet/articulo?codigo=10298486

Pareja, J. A., Fernández, M., & Fuentes, J. (2019). Innovación metodológica en posgrado: Aprendizaje basado en proyectos. Profesorado, 23(3), 113–128. https://doi.org/10.30827/profesorado.v23i3.9497

Park, S., Lee, Y. R., Nelson, G., Cook, M. A., & Doabler, C. T. (2025). Teacher Professional Development and Student Mathematics Achievement: A Meta-Analysis of the Effects and Moderators. Education Sciences, 15(9), 1177. https://doi.org/10.3390/educsci15091177

Pegalajar Palomino, M. C., Montes, D. A., & Valdivia, E. M. (2025). Evaluation of dialogical learning in higher education: Psychometric validation of a questionnaire. International Journal of Instruction, 18(1), 619–634. https://doi.org/10.29333/iji.2025.18134a

Ponce, S. R. T., Sevilla, G. J. B., Aguirre, T. V. G., Arcos, F. N. C., Toral, C. K. H., Quiñonez, B. K. C., & Quiñonez, A. Á. A. (2023). Creación de ambientes de aprendizaje en los contextos educativos (1st ed.). Portal SOAR Sapienza Open Access Repository, 4(EBOA04). https://doi.org/10.56183/soar.v4ieboa04.14

Ramos Martínez, L., & Rueda Beltrán, M. (2020). Rasgos distintivos de las evaluaciones formativas para el desempeño docente. Perfiles Educativos, 42(169). https://doi.org/10.22201/iisue.24486167e.2020.169.59287

Rodríguez Flores, E. A., & Sánchez Trujillo, M. de los Ángeles. (2022). Bienestar psicológico en estudiantes de primeros ciclos. Propósitos y Representaciones, 10(3), e1705. https://doi.org/10.20511/pyr2022.v10n3.1705

Rosiles-Villalobos, A., González-Montejo, C., & Clara-Zafra, M. Á. (2020). Relación del clima y satisfacción laboral en una dependencia gubernamental. Vinculatégica EFAN, 6(1), 515–531. https://doi.org/10.29105/vtga6.1-600

Shuman, L. J., Besterfield-Sacre, M., & McGourty, J. (2005). The ABET "professional skills". Journal of Engineering Education, 94(1), 41–55. https://doi.org/10.1002/j.2168-9830.2005.tb00828.x

Silva-Ramos, M. F., López-Cocotle, J. J., & Columba Meza-Zamora, M. E. (2020). Academic stress in university students. Investigación y Ciencia, 28(79), 75–83.

Tobón, S. (2015). Evaluación de competencias en la educación superior. ECOE Ediciones. https://www.ecoeediciones.com/wp-content/uploads/2015/08/Formacion-integral-y-competencias.pdf

Valdez, L. S. V., Uscamayta, J. O. S., & López, G. S. L. (2023). Evaluación formativa: retroalimentación, estrategias e instrumentos. Revista Educación. https://doi.org/10.15517/revedu.v47i2.53987

Winberg, C. et al. (2020). Building Knowledge in Higher Education: Enhancing Teaching and Learning with Legitimation Code Theory. Routledge. https://www.routledge.com/Building-Knowledge-in-Higher-Education-Enhancing-Teaching-and-Learning-with-Legitimation-Code-Theory/Winberg-McKenna-Wilmot/p/book/9780367463335