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ORIGINAL ARTICLE

Impact of the COVID-19 pandemic on the business management Engineering Program at ITSP: a case study

Impacto de la pandemia de COVID-19 en Ingeniería en Gestión Empresarial del ITSP: estudio de caso

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Abstract

This study assessed the impact of COVID-19 on the professional training of eighth-semester students enrolled in the Business Management Engineering program at the Instituto Tecnológico Superior de (ITSP). A quantitative, cross-sectional design was employed, using an online questionnaire comprising 21 Likert-scale items, which demonstrated high reliability (Cronbach's $\alpha = 0.916$). The findings revealed mean scores of 3.59 for technological adaptation and digital competencies, 3.58 for satisfaction with academic training, 3.54 for experiences with online learning modalities, and 3.38 for perceived impact on professional development. Key strengths identified included faculty proficiency in virtual platforms, the quality of feedback provided, enhancement of digital skills, and the development of student resilience. Conversely, several areas for improvement were observed, including a decline in academic performance, limited effectiveness of collaborative work, insufficient institutional technological support, and reduced opportunities for professional internships. Overall, distance education mitigated academic disruption and contributed to the strengthening of digital and self-regulation competencies; however, it did not fully replace the practical training required for professional practice.

Keywords: COVID-19; higher education; professional training; Business Management Engineering; digital competencies; online learning

Resumen

El presente estudio analiza el impacto del COVID-19 en la formación profesional de estudiantes de octavo semestre de Ingeniería en Gestión Empresarial del ITSP. Se utilizó un enfoque cuantitativo de corte transversal, mediante la aplicación de un cuestionario en línea de 21 ítems con escala Likert, el cual presentó alta fiabilidad ($\alpha = 0.916$). Los resultados evidencian promedios de 3.59 en adaptación tecnológica y competencias digitales, 3.58 en satisfacción con la formación, 3.54 en experiencias con la modalidad en línea y 3.38 en impacto en el desarrollo profesional. Se identifican como principales fortalezas el dominio docente de plataformas virtuales, la calidad de la retroalimentación, el fortalecimiento de competencias digitales y el desarrollo de la resiliencia estudiantil. En contraste, se observan áreas de oportunidad relacionadas con la disminución del rendimiento académico, la limitada eficiencia del trabajo colaborativo, el escaso apoyo tecnológico institucional y la reducción de oportunidades para prácticas profesionales. Se concluye que la educación a distancia permitió mitigar la interrupción académica y fortalecer competencias digitales y de autorregulación; sin embargo, no sustituyó plenamente la formación práctica requerida en el ámbito profesional.

Palabras clave: COVID-19; educación superior; formación profesional; Ingeniería en Gestión Empresarial; competencias digitales; aprendizaje en línea

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INTRODUCTION

The COVID-19 pandemic has caused an unprecedented disruption to educational systems worldwide, affecting more than 1.6 billion students across over 190 countries and leading to the widespread closure of educational institutions (UNESCO, 2021). This contingency forced a rapid shift in teaching–learning processes toward digital environments, giving rise to what has been termed emergency remote teaching, characterized by its rapid implementation and limited pedagogical planning (Hodges et al., 2020; Bond et al., 2021). In this context, most countries adopted multimodal approaches that combined digital platforms, printed materials, and traditional communication media, thereby highlighting both institutional adaptability and existing inequalities in access to education (UNESCO, 2022; Norman et al., 2022).

In Mexico, distance education already had antecedents in open and virtual modalities; however, its development had progressed gradually prior to the pandemic (García-Peñalvo, 2021). The health crisis significantly accelerated digital transformation in higher education, compelling institutions to reconfigure their educational models, requiring faculty to develop new technological competencies, and prompting students to adopt a more autonomous role in their learning processes (Ordorika, 2020; Sánchez-Mendiola et al., 2021). This shift entailed not only technological challenges but also pedagogical, organizational, and socio-emotional ones.

Recent studies consistently indicate that the transition to online education exposed significant digital divides, limitations in access to technological resources, and difficulties in adapting to new learning dynamics (OECD, 2021; Egger & Huber, 2022). Moreover, confinement has been associated with adverse effects on students' emotional well-being, including heightened levels of stress, anxiety, and demotivation, which in turn have negatively impacted academic performance and engagement (Son et al., 2020; Aristovnik et al., 2020; UNESCO, 2021).

Within the domain of professional training, the effects of the pandemic have been particularly significant due to the need to integrate practical experiences, collaborative work, and engagement with real-world contexts. In this regard, recent research suggests that while online education has fostered the development of digital competencies and self-regulated learning, it has also constrained the acquisition of practical and socio-emotional skills that are essential for labor market integration (Bond et al., 2021; Rapanta et al., 2020; Skrbinjek et al., 2024). Furthermore, the reduction in opportunities for internships and enterprise-based projects has generated uncertainty regarding students' professional development (ILO, 2021; OECD, 2021).

Industrial Engineering in Business Management, as a discipline focused on organizational processes, strategic decision-making, and innovation, requires comprehensive training that integrates theoretical knowledge with practical and collaborative

experiences. In this sense, the transition to virtual environments posed a substantial challenge, as it hindered direct interaction, teamwork, and the application of knowledge in real-world settings—elements that are critical for the development of professional competencies (García-Peñalvo, 2021).

Within the institutional context of the Instituto Tecnológico Superior de Pánuco (ITSP), part of the Tecnológico Nacional de México, these challenges were particularly evident among students enrolled in Industrial Engineering in Business Management, especially those in their final semesters. These students were at a critical stage of their professional training, where the limited opportunities for in-person practice and the need to adapt to new educational conditions influenced their perceptions regarding the quality of their academic preparation and their future employability.

Against this backdrop, the present study aims to analyze the impact of the COVID-19 pandemic on the professional training of eighth-semester students in Industrial Engineering in Business Management at ITSP, identifying both the limitations and opportunities arising from the implementation of distance education. This analysis seeks to provide empirical evidence to better understand the effects of pandemic-driven educational transformation and to inform institutional strategies aimed at strengthening the quality of professional training in contexts of uncertainty.

METHODS, TECHNIQUES, AND INSTRUMENTS

This study followed a quantitative approach employing a non-experimental, descriptive, cross-sectional design. Data collection was conducted through a combination of documentary review of specialized literature and fieldwork using a structured questionnaire. Given that the study focused on a single academic program—Industrial Engineering in Business Management—and a specific population of eighth-semester students (n = 17), it was methodologically framed as an institutional case study. This approach enabled an in-depth analysis of the effects of the pandemic within a particular educational context, without aiming for statistical generalization to other populations or institutions.

The data collection instrument consisted of an online questionnaire developed using Google Forms, the access link of which was distributed to all students enrolled in the eighth semester of the formal education system. A total of 17 out of 18 students participated, corresponding to a 94% response rate of the target population. The questionnaire comprised 21 items organized into four analytical dimensions: (I) experiences with online learning, (II) level of satisfaction with training, (III) technological adaptation and digital competencies, and (IV) impact on professional development and future perspectives.

Variables were measured using a five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree),

allowing for the standardized quantification of participants' perceptions. Instrument reliability was assessed using Cronbach's alpha coefficient, yielding a value of $\alpha = 0.916$, indicating a high level of internal consistency.

Dimension I, Experiences with Online Learning, consisted of six items designed to examine students' perceptions of the transition to virtual education, including aspects such as motivation, academic performance, instructional adaptation, proficiency in digital tools, academic communication, and the balance of personal responsibilities.

Dimension II, Level of Satisfaction with Training, included five items assessing perceived quality of the educational process during the pandemic, considering factors such as overall satisfaction with teaching, development of competencies, appropriateness of assessment methods, quality of feedback, and effectiveness of collaborative work.

Dimension III, Technological Adaptation and Digital Competencies, comprised four items aimed at evaluating the development of students' technological skills, including the use of virtual platforms, familiarity with digital tools, access to institutional technological support, and the facilitation of collaborative work through digital resources.

Finally, Dimension IV, Impact on Professional Development and Future Perspectives, consisted of six items intended to assess the influence of the pandemic on professional training, particularly in relation to internship opportunities, acquisition of professional competencies, development of resilience, preparedness for the labor market, limitations in experiential learning, and the impact on soft skills development.

RESULTS AND DISCUSSION

Figure 1, entitled "Mean Scores by Section," indicates that the highest average score was observed in Section III, Technological Adaptation and Digital Competencies ($M = 3.59$), followed closely by Section II, Level of Satisfaction with Training ($M = 3.58$), and Section I, Experiences with Online Learning ($M = 3.54$). In contrast, the lowest mean corresponded to Section IV, Impact on Professional Development and Future Perspectives ($M = 3.38$).

Overall, the findings revealed a relatively homogeneous distribution of student perceptions, with a maximum variation of 0.21 points across dimensions, suggesting a moderate and consistent evaluation of the educational process during the study period. However, within this apparent uniformity, distinct patterns emerged. On the one hand, technological adaptation processes and the development of digital competencies were identified as key strengths. On the other hand, a relative lag was observed in components associated with professional development, particularly those related to the practical application of knowledge. From the students' perspective, this limitation may have implications for their preparedness for labor market

entry and their expectations regarding future professional performance..

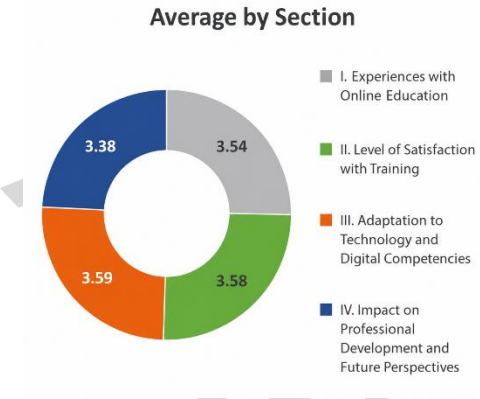

Figure 1. *Survey results by section*

Figure 2 provides a more detailed examination of item-level performance, allowing for the identification of both the highest- and lowest-rated indicators within each dimension. Regarding the most highly rated items, within Section I, the statement related to instructors' proficiency in virtual platforms and digital tools (Item 4; M = 4.06) stood out, suggesting a favorable perception of faculty technological competencies. In Section II, the highest score was observed for Item 10 (M = 3.82), associated with the timeliness and usefulness of instructor feedback, highlighting the importance of pedagogical interaction in virtual learning environments. In Section III, Item 12 (M = 3.94) confirmed the strengthening of digital skills during the pandemic period, while in Section IV, Item 18 (M = 3.94) emphasized the development of resilience and adaptability as positive outcomes derived from the contingency context.

In contrast, the lowest-rated items revealed critical areas within the educational process. In Section I, Item 2 (M = 3.24) reflected a perceived negative impact on academic performance; in Section II, Item 11 (M = 3.18) pointed to limitations in the effectiveness of collaborative work; in Section III, Item 14 (M = 3.31) suggested a moderate level of satisfaction with institutional technological support; and most notably, in Section IV, Item 16 (M = 2.76) highlighted a pronounced perception of reduced opportunities for internships and project-based learning, constituting the primary factor of impact within the professional development dimension.

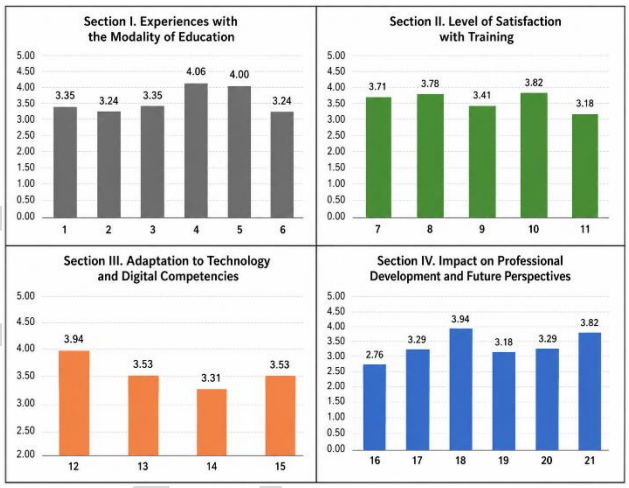

Figure 2. *Survey results by section and item*

The findings should be interpreted in light of certain methodological limitations. First, the study was restricted to a small sample (n = 17), drawn from a single academic program and one institution, which constrains external validity and limits the generalizability of the results to other educational contexts. Second, the cross-sectional design precluded the analysis of temporal changes in the variables examined, particularly with regard to the

development of competencies and the labor market integration of graduates.

Despite these limitations, the high response rate (94% of the target population) and the strong internal consistency of the instrument (Cronbach's $\alpha = 0.916$) reinforce the study's internal validity, enabling the generation of robust and contextually relevant empirical evidence for understanding the phenomenon under investigation and informing institutional decision-making.

The empirical findings support the notion that the transition to virtual learning modalities during the COVID-19 pandemic not only ensured continuity of the educational process but also significantly strengthened students' digital competencies. This is reflected in the highest mean score obtained by the dimension of technological adaptation and digital competencies ($M = 3.59$), as well as in the elevated rating of the item related to the development of digital skills ($M = 3.94$). These results are consistent with recent literature recognizing emergency remote teaching as a catalyst for the accelerated acquisition of technological skills among both students and higher education faculty (Bond et al., 2021). Similarly, it has been argued that this process contributed to advancing the digital transformation of universities, reshaping patterns of academic interaction and learning environments (García-Peñalvo, 2021).

However, these advancements in the technological domain coexist with substantial limitations in the sphere of professional training. In particular, the lower mean observed in the dimension impact on professional development and future perspectives ($M = 3.38$), together with the notably low score for the item referring to reduced opportunities for internships and project-based learning ($M = 2.76$), indicates that virtual instruction was unable to fully substitute the practical experiences required in students' professional formation.

This finding aligns with recent studies documenting how lockdown measures significantly restricted access to professional and workplace experiences, thereby generating uncertainty regarding students' future career development (Egger & Huber, 2022). Likewise, the reduction of hands-on learning opportunities and the limited ability to apply theoretical knowledge in real-world contexts have been identified as major concerns among university students during the pandemic (Aristovnik et al., 2020).

Regarding the perceived quality of the educational process, the results indicate a moderately positive evaluation ($M = 3.58$), particularly in aspects related to instructor feedback and proficiency in digital tools. The high score obtained for the item on timely feedback ($M = 3.82$) suggests that pedagogical interaction remained a central element even within virtual learning environments. This observation is consistent with prior research emphasizing the importance of faculty adaptability and effective use of technological resources as key factors in sustaining educational continuity during crisis situations (Pokhrel & Chhetri, 2021).

Moreover, the quality of teacher–student interaction has been identified as a critical determinant of student motivation and academic engagement in non-face-to-face learning settings (Rapanta et al., 2020).

Nevertheless, alongside these positive aspects, several areas for improvement emerge, reflecting underlying structural challenges within the educational process. These include the perceived decline in academic performance, limitations in the effectiveness of collaborative work, and only moderate satisfaction with institutional technological support. These findings are situated within a broader context marked by persistent digital divides and unequal access to technological resources, which have been widely recognized as significant barriers to ensuring equitable educational experiences during the pandemic (Norman et al., 2022). Additionally, the reduction in face-to-face interaction has been associated with adverse effects on the development of socio-emotional and collaborative skills, which are essential components of comprehensive higher education training (UNESCO, 2021).

Finally, one of the most noteworthy findings is the strengthening of students' resilience and adaptive capacity, as reflected in the high rating of the corresponding item (M = 3.94). This suggests that, beyond the structural constraints imposed by the pandemic, the context of uncertainty fostered the development of transversal competencies related to self-regulation and the management of complex situations.

This premise aligns with recent studies highlighting the role of the pandemic as a catalyst for the development of adaptive capacities among students, with potentially positive implications for their future professional performance (Skrbinjek et al., 2024).

CONCLUSIONS

The evidence analyzed indicates that the health emergency constituted a turning point in the configuration of educational processes in technological higher education, revealing both the adaptive capacity of the educational system and its structural limitations. In this context, the need to reconceptualize pedagogical models toward more flexible, resilient, and technologically integrated frameworks becomes evident—approaches that move beyond the merely emergency-driven character of virtual instruction.

From a formative perspective, the study confirms the relevance of strategically incorporating digital technologies not only as supportive tools but as structural components of the educational process. However, such integration must be aligned with mechanisms that ensure meaningful engagement with real-world practice environments, thereby preventing fragmentation between theoretical knowledge and its professional application.

At the institutional level, the findings underscore the importance of strengthening technological infrastructure, as well as systems for academic and socio-emotional support, in order to reduce disparities in access, retention, and student

performance. Additionally, the consolidation of pedagogical strategies oriented toward collaborative work in digital environments is highlighted as a key element for comprehensive education.

From a prospective standpoint, the design of hybrid models that effectively balance face-to-face and virtual modalities is identified as a priority. In this regard, the implementation of simulation environments, virtual laboratories, and project-based learning schemes emerges as a viable approach to reinforce the practical dimension of professional training.

Finally, given the contextual nature of the study, there is a recognized need to expand future research toward comparative and longitudinal designs that allow for the assessment of the evolution of professional competencies in post-pandemic scenarios. Such efforts will contribute to the development of more robust empirical foundations for decision-making in educational policy and for the consolidation of training models suited to contexts characterized by high levels of uncertainty.

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