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Review article

An integrated framework of pedagogical approaches as a foundation for professional practices in the Industrial Engineering program

Un marco integrado de enfoques pedagógicos como fundamento de las prácticas profesionales en la carrera de Ingeniería Industrial

Uma estrutura integrada de abordagens pedagógicas como base para práticas profissionais no programa de Engenharia Industrial

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ABSTRACT

The article analyzed the integration of pedagogical approaches applicable to professional practices in the industrial engineering career. These practices, conceived as a bridge between academia and the working environment, demand educational strategies that enhance vocational skills and improve students' job insertion. The objective is to present a systematic review of the main pedagogical approaches linked to competency development in professional practices in the Industrial Engineering program. A qualitative inductive approach based on content analysis was used. The Atlas.ti-25 software was used to analyze the qualitative data, a tool that helped identify recurrences and relationships, in addition to the theoretical methods of analysis-synthesis and induction-deduction; and documentary analysis as an empirical method. The results highlighted that reflection and mentoring are essential components for the success of professional practices and that the main

competency enhanced by the implementation of these approaches is critical thinking. The approaches are based on theories such as Pragmatism, Cognitive Constructivism, and Sociocultural Constructivism; these demonstrate a high degree of interrelation, favoring their integration into a coherent strategy. Furthermore, challenges that must be addressed were identified, such as the length of the professional practice and the need for competent tutors in the reflective practice process. It was concluded that an eclectic pedagogical strategy is viable, given that the theoretical foundations are congruent and there is a strong connection between its components.

Keywords: professional practice; reflective practice; experiential learning; learning theories; pedagogical approaches; mentoring.

RESUMEN

En el artículo se analizó la integración de enfoques pedagógicos aplicables a las prácticas profesionales en la carrera de Ingeniería Industrial. Estas prácticas, concebidas como un puente entre la academia y el entorno laboral, demandan estrategias educativas que potencien competencias profesionales y mejoren la inserción laboral de los estudiantes. El objetivo es presentar una revisión sistemática de los principales enfoques pedagógicos vinculados con la formación de competencias en las prácticas profesionales de la carrera de Ingeniería Industrial. Se utilizó un enfoque cualitativo inductivo basado en el análisis de contenido. Para la realización del análisis de la información cualitativa se empleó el software Atlas.ti-25, herramienta que ayudó a identificar recurrencias y relaciones, además de los métodos teóricos análisis-síntesis e inducción-deducción; y como método empírico el análisis documental. Los resultados destacaron que la reflexión y la mentoría son componentes esenciales para el éxito de las prácticas profesionales y que la principal competencia que se ve favorecida con la implementación de estos enfoques es el Pensamiento Crítico. Los enfoques se fundamentan en teorías como el Pragmatismo, la teoría Cognitiva Constructivista y el Constructivismo Sociocultural; estos evidencian una alta interrelación, favoreciendo su integración en una estrategia coherente. Asimismo, se identificaron desafíos que deben ser gestionados, como el tiempo de duración de la práctica profesional y el requerimiento de tutores competentes en el proceso de práctica reflexiva. Se concluyó que una estrategia pedagógica ecléctica es viable, dado que los fundamentos teóricos son congruentes y existe sólida recurrencia entre sus componentes.

Palabras clave: práctica profesional; práctica reflexiva; aprendizaje experiencial; teorías de aprendizaje; enfoques pedagógicos; mentoría.

RESUMO

Este artigo analisa a integração de abordagens pedagógicas aplicáveis aos estágios profissionais no curso de Engenharia de Produção. Esses estágios, concebidos como uma ponte entre a academia e o mercado de trabalho, requerem estratégias educacionais que aprimorem as competências profissionais e a inserção profissional dos alunos. O objetivo é apresentar uma revisão sistemática das principais abordagens pedagógicas vinculadas ao desenvolvimento de competências em estágios profissionais no curso de Engenharia de Produção. Utilizou-se uma abordagem qualitativa indutiva baseada na análise de conteúdo. Para a análise dos dados qualitativos, utilizou-se o software Atlas.ti-25, ferramenta que auxiliou na identificação de recorrências e relações, além dos métodos teóricos de análise-síntese e indução-dedução; e a análise documental como método empírico. Os resultados destacaram que a reflexão e a mentoria são componentes essenciais para o sucesso dos estágios profissionais e que a principal competência potencializada pela implementação dessas abordagens é o Pensamento Crítico. As abordagens são baseadas em teorias como Pragmatismo, Construtivismo Cognitivo e Construtivismo Sociocultural; estas demonstram alto grau de inter-relação, favorecendo sua integração em uma estratégia coerente. Além disso, foram identificados desafios que precisam ser enfrentados, como a duração da prática profissional e a necessidade de mentores competentes no processo de prática reflexiva. Concluiu-se que uma estratégia pedagógica eclética é viável, desde que os fundamentos teóricos sejam congruentes e haja forte consistência entre seus componentes.

Palavras-chave: prática profissional; prática reflexiva; aprendizagem experiencial; teorias de aprendizagem; abordagens pedagógicas; mentoria.

INTRODUCTION

The training of professionals in Industrial Engineering in Honduras began in the second semester of 1981, when the program was inaugurated at the National Autonomous University of Honduras (UNAH). Eighteen years later, the offering of this discipline at private universities expanded when, in 1999, the Central American Technological University (UNITEC) launched the Industrial and Systems

Engineering program. Today, four other universities offer this field. At all of these universities, the curricula focus on production and service systems, process analysis, and quality and productivity improvement. Therefore, the profile of these graduates is in demand by all types of companies, both in the manufacturing and service sectors, including banking.

In the two local universities mentioned above, their current educational models have introduced the concept of competency-based learning and, by requirement of article 126 of the Academic Standards of the Directorate of Higher Education of Honduras, "supervised professional practice is established as one of the minimum graduation requirements, delegating to the universities the corresponding specific regulations" (Directorate of Higher Education, 1992, p. 32).

In this sense, supervised professional practices are recognized as a bridge to job placement and as a reinforcement of the learning acquired throughout the curriculum. These practices, located at the end of the academic program, represent an opportunity for students to transcend the theoretical realm and face the real challenges of the labor market. However, the objectives of strengthening competencies and professional integration are not achieved automatically, nor by merely participating in these experiences (Zabalza, 2016). Therefore, it is essential that practices be based on pedagogical and methodological approaches designed to optimize them.

Zabalza (2016) emphasizes that professional practices should be understood as experiences complementary to other training activities. In his words, professional practices not only "act as independent experiences, but also as complementary experiences to other training activities, whose objectives they must share, whose content they must contribute to better understanding, whose competencies they must consolidate in contexts other than academic ones" (p. 9). This perspective reinforces the need to integrate professional practices into a coherent pedagogical strategy that enhances their formative impact.

The literature recognizes the relevance of multiple pedagogical approaches applicable to this context, such as experiential learning (Kolb, 2015), problem-based (Barrows & Tamblyn, 1980) and project-based (Railsback, 2002) learning, situated learning (Lave & Wenger, 2008), and meaningful learning (Ausubel, 2002), among others. However, a detailed analysis of their theoretical foundations and key components reveals a fragmentation in their application. This situation generates a gap in knowledge on how to effectively integrate them to maximize their benefits and overcome the challenges that each approach presents when implemented in isolation.

From a theoretical perspective, professional practices find solid support in the learning theories of John Dewey's Pragmatism, Jean Piaget's Cognitive Constructivism, and Lev Vygotsky's Sociocultural Constructivism. Dewey (1989) highlights the centrality of experience and reflection in learning, postulating that knowledge arises from active interaction with the environment. Piaget (Schunk, 2012), for his part, emphasizes the constructive process of individual learning, where the student builds their knowledge through the assimilation and accommodation of new experiences. Vygotsky (2009) complements this vision by highlighting the influence of the social and cultural context on cognitive development.

Despite this well-established theoretical framework, the implementation of educational strategies in professional practices for Industrial Engineering programs in Honduras lacks a coherent articulation between the different applicable pedagogical approaches and the need to overcome limitations such as insufficient training of academic tutors in reflective methodologies and poor integration between the academic and professional worlds. These gaps hinder the development of professional competencies aligned with the demands of the contemporary labor market, such as critical thinking, complex problem-solving, and collaborative work.

In this context, this research seeks to answer a key question: how can the most relevant pedagogical approaches be integrated into an educational strategy that fosters learning and competency development in supervised professional internships? To this end, this article analyzes ten pedagogical approaches, exploring their theoretical foundations, key components, the competencies they foster, and the challenges associated with their implementation. The purpose is to offer an integrative synthesis that serves as a basis for designing innovative and effective educational strategies in the field of supervised professional practices, with a positive impact on both students and the host organizations.

This effort seeks to contribute to the design of more effective practices that respond to both the demands of the labor market and the educational expectations of students, generating a positive impact on their transition to the professional field.

DEVELOPMENT

Theoretical and empirical methods were used in this review article. Theoretical methods employed were analysis-synthesis and induction-deduction. The former was used to integrate pedagogical approaches and design an eclectic pedagogical strategy. This method allowed pedagogical approaches to be broken down into their essential components (analysis) and then to combine their strengths (synthesis) to overcome the limitations arising from their isolated application. The induction-deduction method was used both in the design of the pedagogical strategy and in the development of conclusions: induction, based on specific observations (results of content analysis and review of pedagogical approaches), allowed general conclusions to be drawn on the viability of an eclectic strategy; while deduction, based on general theories (pragmatism, constructivism, etc.), made it possible to predict or explain specific phenomena related to professional practices.

Regarding empirical methods, a document review and content analysis were conducted. The document review, applied to the selection of works by pioneering authors and relevant recent publications, provided a theoretical basis for the study and allowed for the identification of pedagogical approaches applicable to professional practices. This systematic search process in academic databases demonstrates the use of this technique. A qualitative approach based on content analysis was also followed, processing the qualitative information with Atlas.ti-25 software. This facilitated the identification of patterns, recurrences, and relationships between pedagogical approaches, as well as the extraction of essential components such as reflection, mentoring, and critical thinking.

The unit of analysis for this study was the pedagogical approaches applicable to supervised professional practices in the Industrial Engineering program, identified in the theoretical systematization process. The texts reviewed included both classic documents by the authors who championed these approaches and at least three contemporary articles published in the last five years (Table 1).

These documents were selected using the Google Scholar search engine, prioritizing higher education contexts in the field of engineering.

Table 1. Ten approaches pedagogical applicable to the professional practices

Item	Approach pedagogical	Author precursor	Contemporary documents
1	Learning experiential (AE)	Kolb (2015)	Rossetti (2023), Ali (2023), Niemi (2023)
2	Practicum thoughtful (PR)	Schön (1992)	Escoja *et al.* (2023), Asawo (2022), Kodele and Mesl (2024)
3	Learning significant (ASig)	Ausubel (2002)	Bryce and Blown (2023), Ribeiro *et al.* (2024), Amat *et al.* (2024)
4	Learning based in oroblems (ABP)	Barrows and Tamblyn (1980)	Salvador (2022), Castro-Martin and Silva-Lorente (2022), Sistermans (2020)
5	Learning based in projects (ABPy)	Railsback (2002)	Tsybulski and Muchnik-Rozanov (2021), Marjanah and Pandia (2021), Martinez (2021)
6	Learning collaborative (ACol)	Vygotsky (2009)	Nissim and Danial-Saad (2024), Kelubia (2024), Polly and Byker (2020)
7	Situated Learning (ASit)	Wash and Wenger (2008)	Li *et al.* (2022), Bay (2020), Goel (2020)
8	Learning based in investigation (ABI)	Boyer (1990)	Scallop *et al.* (2021), Figueroa (2020), Ruiz and Road (2021)
9	Learning based in challenges (ABR)	Membrillo-Hernández *et al.* (2019)	Jimarkon *et al.* (2022), Leles *et al.* (2024), Gallagher and Savage (2020)
10	Learning based in competencies (ABC)	Gonzalez and Wagenaar (2003)	Kennel (2021), Campos *et al.* (2020), Villa (2020)

Following inductive reasoning, all selected sources were thoroughly read, making observations and applying labels to identify patterns and recurrences.

Data analysis was conducted on 40 documents (10 by pioneering authors of the reviewed pedagogical approaches, one for each approach, and 30 articles published in the last five years, three for each

approach). For this review, the qualitative analysis software Atlas.ti-25 was used to identify citations in the documents that referenced aspects related to the research questions posed. 264 codes were established to facilitate management of the identified citations, which were grouped into categories, and networks of relationships were developed based on the findings obtained.

Data triangulation was applied to the identified sources for each approach reviewed to clarify and standardize the assigned codes, thereby gaining a better understanding of the characterization of the pedagogical approaches analyzed (Hernández-Sampieri & Mendoza, 2018). Graphs showing word frequencies and creating relationship networks provided a better visualization of the data, allowing for the discovery of connections and interpretation of findings. Finally, the results were discussed, and conclusions were drawn that answered the research questions.

Of the documents reviewed, at least one article from each approach included a historical introduction to the evolution of the learning theories on which it is based, coinciding in referring to one of the following: the learning theory based on Dewey's pragmatism, Piaget's cognitive-constructivist theory and Vygotsky's sociocultural theory, or to one of its derivations, such as Ausubel's meaningful learning.

In this sense, learning from Dewey's (1989) pragmatic perspective focuses on the idea that learning is more effective when it is related to practical and relevant experiences for the student. For Dewey, education should be an active and dynamic experience in which students participate directly and reflect on their experiences. This is the main basis of experiential learning that Kolb (2015) popularized in the 1980s. For their part, experiential learning (Rossetti, 2023) and reflective practice (Escoja *et al.*, 2023) directly and explicitly refer to their foundation in learning from the pragmatism proposed by John Dewey. In turn, these approaches serve as the basis for problem-based learning (PBL), from which four other approaches are derived: inquiry-based learning (IBL), competency-based learning (CBL), challenge-based learning (CBL) and project-based learning (PBLy).

Cognitive constructivist theory maintains that students construct their understanding of the world through experience and reflection on those experiences, with learning being a dynamic process in which students interact with the environment, objects, and other individuals, and in which the social and cultural context plays a crucial role (Sistermans, 2020). This theory constitutes the basis of meaningful learning, problem-based learning, and their derivations (Sistermans, 2020; Ribeiro *et*

al., 2024). In this framework, the role of the student is that of an explorer and researcher, who, based on their experiences and in collaboration with others, constructs knowledge.

Vygotsky (2009) strengthened cognitive theory with the social aspect, in what is known as social cognitivism or sociocultural theory of learning, introducing the concepts of zone of proximal development and scaffolding, through which colleagues or tutors provide support to students to complete tasks that they cannot do on their own. Of the ten approaches reviewed, eight refer directly to Vygotsky's theory or collaborative learning. Only experiential learning and reflective practicum do not do so explicitly; however, Kolb himself (2015) highlights the importance of the sociocultural context in the experience to promote learning. He points this out in the preface to the first edition of his book *Experiential Learning. Experience as a source of learning and development*: "… learning is a social process based on a carefully cultivated experience that challenges all the precepts and concepts of what is considered teaching today" (Kolb, 2015).

Interrelationship between the approaches pedagogical

A strong interrelationship is evident among pedagogical approaches, and how their combination enhances their benefits. For example, experiential learning has been linked to problem-based learning and project-based learning (Rossetti, 2023), as well as to inquiry-based learning (Ali, 2023). Competency-based learning derives from meaningful learning (Rossetti, 2023), while situated learning relates to the zone of proximal development of collaborative learning (Polly & Byker, 2020).

The findings of this research highlight problem-based learning as a central and essential pedagogical approach, due to its close relationship with inquiry-based learning (Castro-Martin and Silva-Lorente, 2022). Furthermore, it has served as a basis for the evolution of other approaches, such as project-based learning (Tsybulsky & Muchnik-Rozanov, 2021), challenge-based learning (Leles, 2024), and competency-based learning (Campos et al., 2020).

Kolb's experiential learning concepts significantly influenced other pedagogical approaches, demonstrating a strong connection in several key aspects. In this sense, challenge-based learning, as proposed by Membrillo-Hernández *et al.* (2019), is based on the idea that students must actively confront complex and challenging situations, applying a combination of theory and practice that resonates directly with Kolb's experiential principles.

Situated learning incorporates the concept of the zone of proximal development, which demonstrates the importance of social support and scaffolding provided by more experienced peers or tutors. This support helps students achieve levels of proficiency they could not achieve independently (Li *et al.*, 2022).

Likewise, Ribeiro *et al.* (2024) point out that Ausubel's theory of meaningful learning, combined with Kolb's experiential learning, strengthens the comprehensive teaching-learning process.

Problem-based learning has been the basis for other approaches, such as project-based learning, with the difference that the latter encompasses areas that do not necessarily focus on problem-solving. It has also given rise to challenge-based learning, which is situated in a specific context and entails greater responsibility for execution by the company (Membrillo-Hernández *et al.*, 2019).

Ruiz and Estrada (2021) state that research-based learning (Boyer, 1990) seeks to strengthen research and critical thinking skills, being especially suitable for application alongside other approaches, such as collaborative learning, problem-based learning or project-based learning.

Figure 1 demonstrates the strong interrelationship between virtually all of the approaches presented, allowing us to demonstrate how they can be integrated and adapted to enrich the learning processes in supervised professional practices.

The theoretical approaches described converge in their commitment to active, contextualized learning oriented toward the construction of meaningful knowledge through experience. They all emphasize the importance of involving students as protagonists of their own learning process, fostering critical reflection (as in reflective practice and experiential learning), the application of knowledge in real-life contexts (situated learning, PBL, PBLy, and PBL), and the resolution of problems relevant to their environment. Furthermore, they highlight the value of collaboration (collaborative learning), research (CL), and the development of practical skills (PSS) as key elements in developing individuals prepared for the challenges of today's world (Figure 1).

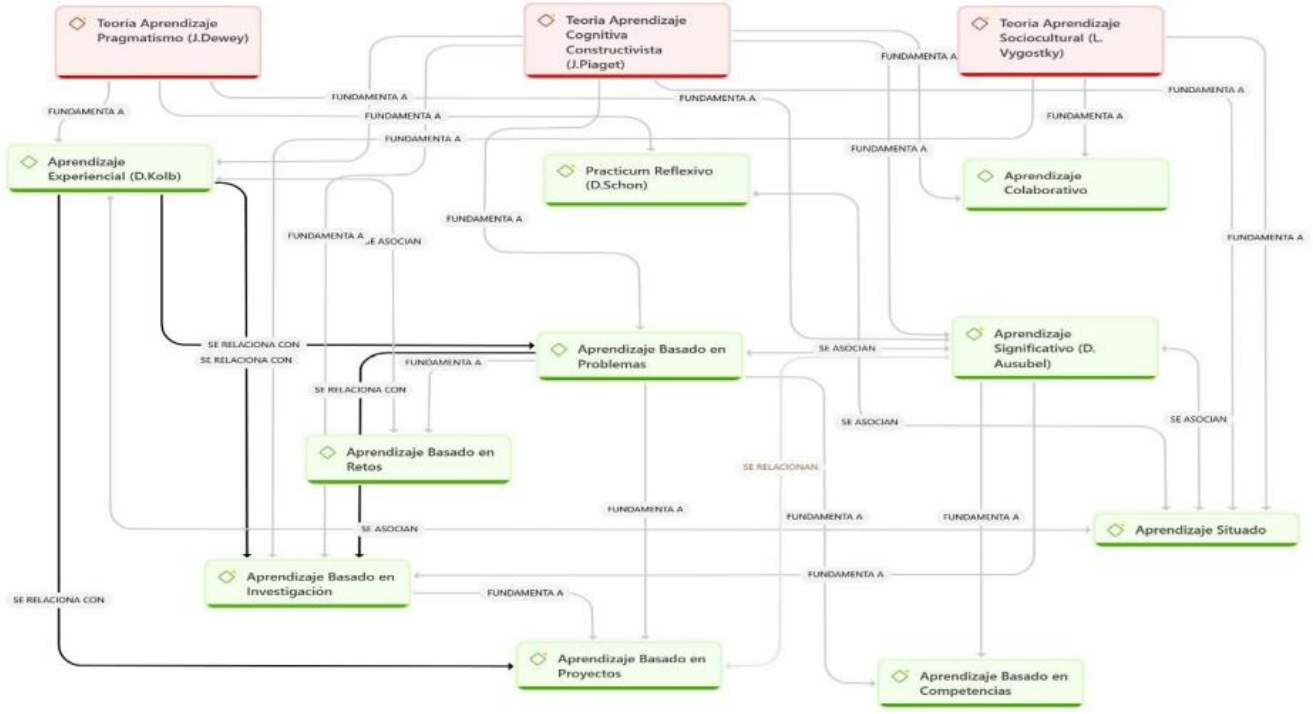

Figure 1. Theoretical foundations of learning and interrelations of pedagogical approaches

Note: figure imported of the program Atlas.ti-25

Results of the analysis of frequency of words

The analysis of content of the documents reviewed showed that the five words of higher frequency and congruent between all the approaches pedagogical are: learning, practical experience, reflection, critical thinking and mentoring, in that order.

It is logical to find the recurrence in the words "learning" and "practical experience", since the object of the study is precisely in relationship with the learning in he context of professional practices, so that, by eliminating these two words, the three that remain relevant are: reflection, critical thinking and mentoring or tutoring, as can be seen in the word cloud in Figure 2. According to the context of the articles reviewed, the definitions of these terms are presented below (Figure 2).

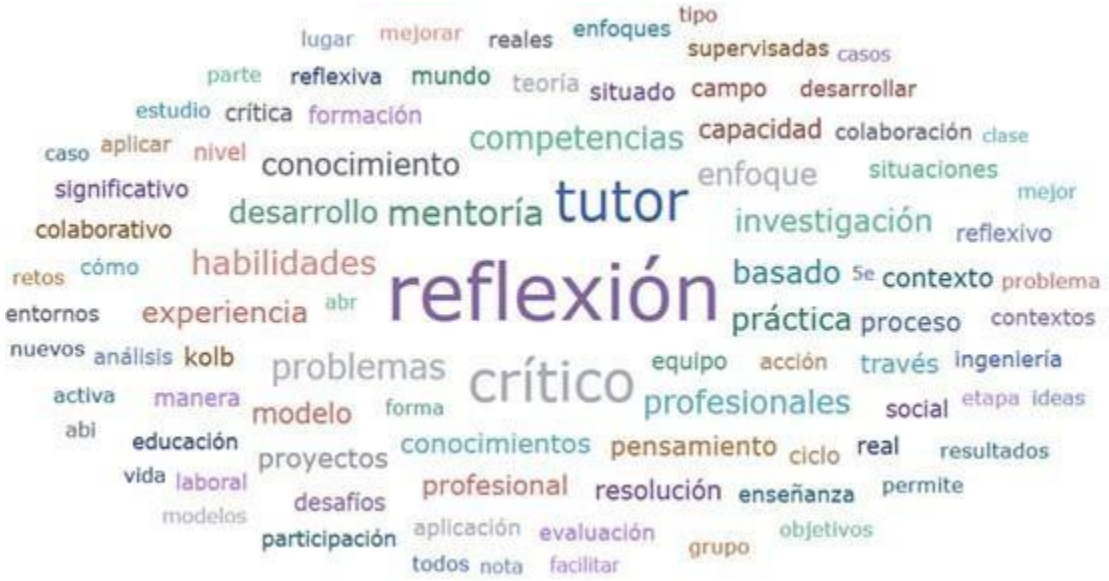

Figure 2. Cloud of words of the ten approaches pedagogical object of analysis
Note: Figure imported of the program Atlas.ti-25

Reflection: This is the key component par excellence, since all approaches refer to the exercise of reflection as an integral part of the proposed process. As Kodeles and Mesl express it: "Reflection is what enables the creation of new knowledge and meanings" (2024, p. 77). The presence of reflection is transversal throughout the learning process and, as Kodeles and Mesl (2024) point out, it is important to evaluate the quality of the reflection achieved at the end of the professional practice. Therefore, one of the main roles of the teacher is to guide the practitioner to improve their reflective skills (Schön, 1992).

Critical thinking: This is the second most frequently cited word. It is not mentioned as a component of a specific approach, but rather appears in the context of a professional competence. In this regard, the ten pedagogical approaches present critical thinking as the main professional competence strengthened by its implementation. Seven of the ten approaches mention it explicitly, and it is indirectly referenced in all of them (Ali, 2023; Castro-Martín and Silva-Lorente, 2022).

Mentoring or tutoring: This is the third most frequently used term and is identified in the context of the main roles that must be exercised in the application of the pedagogical approaches presented. Eight of the ten approaches express this explicitly. It is understood as the role of the tutor, conceived as a guide and facilitator of the reflective process, in addition to challenging practitioners in the

development of critical thinking skills. For this reason, it is also suggested that the teacher assigned as a tutor must be competent in reflective practice and trained to guide and strengthen this process in practitioners (Niemi, 2023).

Components strategic clue recurring in the ten approaches pedagogical

From the code-document table created in Atlas.ti, based on the codes identified throughout the literature reviewed, 11 key strategic components were extracted that pedagogical approaches agree are necessary for optimal implementation. These components were grouped into three categories:

a) Prior to the development of professional practice - three components.
b) During professional practice - five components.
c) At the end of the professional practice - three components.

The most relevant components in the stage prior to the development of the practice are:

a) Context analysis. It is essential to carry out an analysis and evaluation of the internal and external environment which frames the practical experience. External aspects refer to the evaluation of the type of company, its culture, the activities that can be carried out, and the availability of mentoring personnel to accompany the interns. Regarding the internal aspects of the student, it is recommended that they recognize their learning style (Kolb, 2015).
b) Activity planning. Planning the practice is a macro component within the previous efforts; in this specific case, it implies that the practices has well-defined objectives and clear with respect to the competences which are sought to be developed. These aspects must be considered and agreed upon among the three main stakeholders: the student, the instructor, and the company's guide.
c) Tutor Competence. Before the start of the practice, it must be ensured that the assigned teacher has the necessary skills to act as tutor or mentor. Similarly, this aspect must be reviewed with the company's staff who will accompany and guide the interns throughout their professional experience. Of the relevant aspects during the internship, five key components are identified, with the concept of reflective practice being the common theme in the ten pedagogical approaches reviewed. Specifically, the five components are:
    1. Reflection. 30% of the citations in the reviewed literature agree in pointing to reflective practice as the most relevant aspect of professional experience. This should be developed in a formal, systematic and continuous manner (Bay, 2020), seeking to be

carried out as soon as possible after exposure to the experience (Kodele and Mesl, 2024). Reflection should be aimed at linking practical observations with the theoretical concepts worked on in the curriculum (Schön, 1992), encouraging the creation of professional networks (Li *et al.*, 2022; Jimarkon *et al.*, 2022) and evaluate the future career plan (Bay, 2020).

2. Tutor-intern dialogue. 25% of the quotes emphasize the importance of maintaining constant dialogue between the tutor and intern, in spaces of trust and relaxation that allow the student to express themselves without restrictions. It is recommended that these interactions preferably take place in small groups, or even individually in one-on-one meetings (Nissim & Danial-Saad, 2023).
3. 360° feedback. 16% of the appointments highlight the importance of receiving feedback in a comprehensive way, not only from the instructor or tutor, but also from colleagues and other practitioners. Polly and Byker (2020) and Nissim and Danial-Saad (2023) recommend implementing the 360° feedback methodology, in which practitioner performance is assessed from different perspectives by those who were involved in practice activities.
4. Incorporation into a multidisciplinary team. Integrating the intern into a team that addresses problems from different perspectives enhances the results of collaborative work and, at the same time, expands their professional network (Membrillo-Hernández *et al.*, 2019; Tsybulsky & Muchnik-Rozanov, 2021).
5. Specialized seminars. Scheduling seminars on innovative technical topics is another key strategy. These can focus on topics directly linked to professional practice, on improving reflective practice, or on the relationship between professional competencies strengthened in practice and the job competencies demanded by the market (Rossetti, 2023; Figueroa, 2020).

By last, the components key that HE recommends incorporate to the end of the practice are:

a) End-of-practice evaluation. This is the most frequently cited component for this phase, and it is essential to have a final evaluation that seeks to confirm the achievement of the stated objectives (Rossetti, 2013; Bay, 2020).
b) Oral presentation to an audience. Three of the ten approaches state that at the end of the practice, students must present their report to an audience, which may be the community of practice with which they were associated or may be a board of executives of the company

with presence of the teachers tutors, either to the rest of the interns of the academic period promotion (Membrillo-Hernández *et al.*, 2019).

c) Writing a scientific article or case study. It is common among the reviewed approaches to point out that at the end of the internship, the student should have strengthened their research capacity and generated knowledge, which is evidenced by writing a scientific article on one of the relevant aspects of their internship (Bay, 2020).

Figure 3 visualizes the overlap between pedagogical approaches and how they contribute to key strategic components. It is evident that experiential learning (EL) contributes to most of the components, and that reflection and context analysis are the most frequently cited components in most of the different strategic approaches (Figure 3).

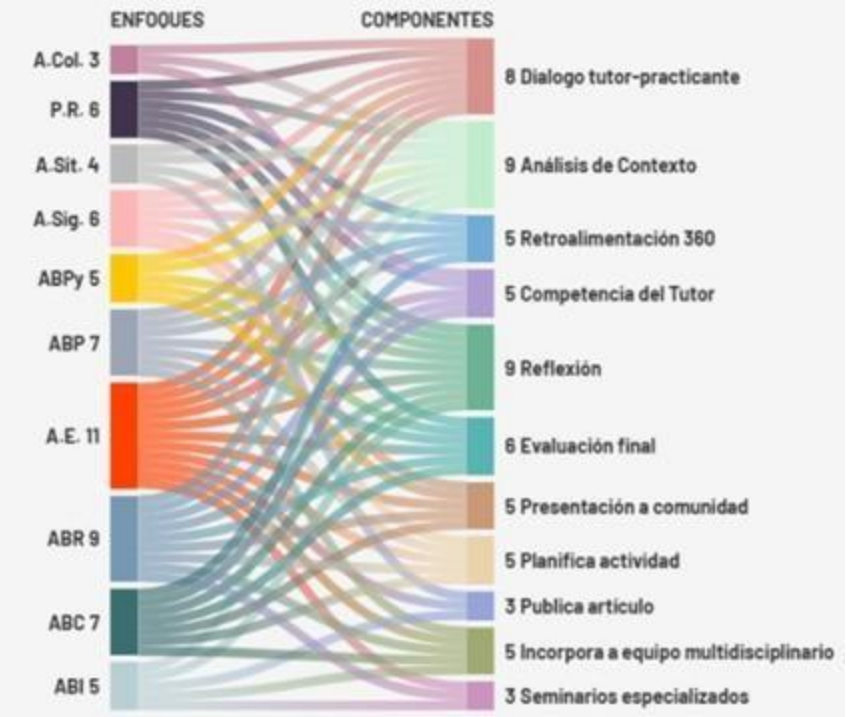

Figure 3. Diagram of concurrence between approaches pedagogical and components strategic
Note: Figure obtained from the analysis of the program Atlas.ti-25

Competencies professionals reinforced

In relation to the benefits that these approaches provide in the context of supervised professional practices, it is recurrently observed that their implementation favors the development of professional skills required by the current labor market, encourages collaborative work, optimizes the labor insertion of recent graduates (Rossetti, 2023; Leles *et al.*, 2024) and provides significant benefits to the companies that receive the interns (Membrillo-Hernández *et al.*, 2019).

The most mentioned competencies in the literature are: critical thinking (Ruíz and Estrada, 2021), communication (Leles *et al.*, 2024), problem solving (Tsybulsky & Muchnik-Rozanov, 2021), analytical skills (Figueroa, 2020) and teamwork (Sistermans, 2020).

Challenges in the implementation of pedagogical approaches

The literature reviewed also highlights several limitations that must be considered to ensure successful implementation of pedagogical approaches in professional practices. These limitations represent significant challenges for educational strategy designers, including:

- The duration of the practice (Ruíz and Estrada, 2021).
- The competent training of the tutor teacher (Niemi, 2023).
- The degree of company involvement (Membrillo-Hernández *et al.*, 2023).

CONCLUSIONS

Findings from content analysis suggest that the revised pedagogical theories and approaches constitute a complementary framework providing a solid basis for strengthening competence building in supervised engineering career practice Industrial. This interaction demonstrates that no single approach, applied in isolation, is sufficient, but together they constitute an integrative framework with great educational potential.

Furthermore, the interrelationship identified between the approaches analyzed confirms the relevance of articulating their contributions in an eclectic model. Kolb's (2015) experiential learning and Dewey's (1989) pragmatism are consolidated as essential foundations that support reflective and situated practices, while providing coherence to emerging methodologies such as challenge-based and competency-based learning.

A cross-cutting finding across all approaches is the emphasis on reflective practice as a key component. Placing the student in an experiential space is relevant, but what truly transforms the experience into learning is the capacity and quality of reflection (Rossetti, 2023). The reflection that the practitioner carries out on their own actions enables the creation of knowledge, adds meaning, and favors both the assimilation and retention of prior knowledge (Schön, 1992; Ribeiro *et al.*, 2024).

Another key aspect is the interaction between stakeholders -students, academic tutors, business supervisors, and teammates- recognized as a critical component for the success of internships. This finding highlights the importance of collaborative work and knowledge transfer in real-life work contexts. In this sense, the study provides an integrative and eclectic perspective, highlighting how pedagogical approaches can complement each other to enrich competency development.

The information presented answers the initial questions by offering a comprehensive and contextualized analysis of the pedagogical approaches applicable to supervised professional practices. Based on the results, it is feasible to present an eclectic educational strategy that integrates the key components of the ten pedagogical approaches reviewed.

However, the research has some limitations: the literature selection could have been expanded with works in other languages, and although the use of Atlas.ti allowed for a detailed and structured analysis, the interpretation of the data ultimately rests with the researchers, which introduces a margin of subjectivity. Despite this, the consistency of the observed patterns and the convergence of the findings with previous studies support the validity of the results. In this sense, Herdoiza *et al.* (2024) state that "the integration of innovative pedagogical methodologies has been shown to have a significant impact on the development of critical and creative competencies in students" (p. 6002). For his part, Flores (2024) concludes that "the integration of active pedagogical methodologies and emerging technologies is essential to respond to the demands of the 21st century, offering opportunities to improve educational quality and prepare students for a globalized and digitalized environment" (p. 5049).

Consequently, it is concluded that the integration of these pedagogical perspectives constitutes an effective way to enrich professional practice experiences and enhance the comprehensive development of future industrial engineers. Finally, it is recommended to expand the study and undertake specific research on reflective practice, delving into methodologies for its optimization and

mechanisms to strengthen this competency in tutor teachers, who, as has been demonstrated, play a fundamental role in guiding trainees toward effective reflection during their professional practices.

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Conflict of interest

Authors declare no conflict of interests.

Authors' contribution

The authors participated in the design and writing of the article, in the search and analysis of the information contained in the consulted bibliography.