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Challenge-Based Learning and Learning Development in Higher Education Students Enrolled in the Higher Technology Program in Negotiation and Sales

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ABSTRACT

The aim of this study was to analyze students' perceptions of the contribution of Challenge-Based Learning (CBL) to learning development in higher technological education, considering the dimensions of cognitive learning, critical thinking, academic motivation, meaningful learning, and collaborative learning. A quantitative, non-experimental, descriptive, and cross-sectional research design was adopted. The study involved 50 students enrolled in the Market Research course of the Higher Technology Program in Negotiation and Sales, who completed a market research project for a real organization as part of a challenge-based learning experience. Data was collected using a structured questionnaire consisting of 25 items measured on a five-point Likert scale. Descriptive statistics and Partial Least Squares Structural Equation Modeling (PLS-SEM) were employed to assess both the descriptive results and the psychometric properties of the instrument. The findings revealed favorable evaluations across all learning dimensions, with academic motivation (M = 4.50) and collaborative learning (M = 4.28) receiving the highest scores. The measurement instrument demonstrated satisfactory psychometric properties, with Cronbach's alpha and composite reliability values above 0.93 and Average Variance Extracted (AVE) values exceeding 0.74. Overall, the results suggest that students perceive Challenge-Based Learning as an effective pedagogical approach for promoting learning development through authentic, practice-oriented educational experiences.

Keywords: Challenge-Based Learning; Higher Technological Education; Market Research; Active Learning; PLS-SEM

1. INTRODUCTION

The transformation of higher education requires teaching methodologies that promote active, contextualized learning and foster the development of competencies for professional practice. In a context characterized by the rapid evolution of knowledge, digital transformation, and increasing labor market demands, traditional teaching approaches centered on content transmission are no longer sufficient to prepare students for complex problems that require analysis, creativity, collaboration, and evidence-based decision-making (Freeman et al., 2014; Doolittle et al., 2023). Consequently, active learning methodologies have gained increasing attention by placing students at the center of the learning process and promoting knowledge construction through authentic, real-world learning experiences.

Among these approaches, Challenge-Based Learning (CBL) has attracted growing interest because of its ability to integrate theoretical knowledge with the resolution of authentic

challenges. Unlike other active learning methodologies, CBL encourages students to address real-world problems arising from social, business, or community contexts by developing solutions through inquiry, collaboration, and critical reflection (De Los Ríos et al., 2020; Doolittle et al., 2023). Existing evidence suggests that this methodology contributes to learning development by strengthening key dimensions such as academic motivation, critical thinking, meaningful learning, and collaborative learning (Freeman et al., 2014; López-Fraile et al., 2021).

Within the field of business education, CBL is particularly relevant because it exposes students to situations that closely resemble organizational environments, where they are required to analyze information, identify needs, and formulate evidence-based solutions. In courses such as Market Research, this methodology facilitates the integration of theory and practice through the analysis of authentic business problems involving consumer behavior, research design, and strategic decision-making, thereby promoting contextualized learning experiences aligned with professional practice.

Despite the growing body of research on CBL, most empirical studies have been conducted in engineering, health sciences, and teacher education programs (Freeman et al., 2014; De Los Ríos et al., 2020). By contrast, research focusing on higher technological education programs related to business disciplines remains limited, particularly in the Latin American context. Furthermore, relatively few studies have examined, within a single evaluation framework, students' perceptions of the contribution of CBL to multiple learning dimensions, including cognitive learning, critical thinking, academic motivation, meaningful learning, and collaborative learning.

To address this gap, the present study examines students' perceptions of the contribution of Challenge-Based Learning to learning development in the Higher Technology Program in Negotiation and Sales, using the Market Research course as the educational setting. The pedagogical strategy consisted of conducting a market research project for a real organization, enabling students to evaluate the contribution of CBL to five learning dimensions: cognitive learning, critical thinking, academic motivation, meaningful learning, and collaborative learning.

Accordingly, the objective of this study was to analyze students' perceptions of the contribution of Challenge-Based Learning to learning development in higher technological education by assessing these five learning dimensions. To achieve this objective, a structured questionnaire was administered, and its psychometric properties were evaluated using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings contribute to the growing body of evidence on the implementation of CBL in higher technological education programs within the business field and provide practical insights for designing pedagogical strategies aimed at enhancing learning through authentic, student-centered educational experiences.

2. Literature Review

2.1. Challenge-Based Learning as an Active Learning Methodology

Challenge-Based Learning (CBL) is a student-centered active learning methodology that promotes knowledge construction through the resolution of authentic challenges derived from social, organizational, or professional contexts. Rather than focusing exclusively on the acquisition of disciplinary knowledge, CBL seeks to develop competencies that enable students to analyze complex situations, integrate knowledge from different domains, and design feasible solutions to real-world problems. From this perspective, the methodology

shifts the focus from teacher-centered instruction to a participatory, experiential, and action-oriented learning process (López-Fraile et al., 2021; García, 2022).

Originally developed by Apple Inc. between 2008 and 2011, CBL was subsequently adopted by higher education institutions because of its capacity to connect academic learning with professional and community-based experiences. The methodology typically involves identifying a Big Idea, defining a challenge, investigating the problem, designing and implementing solutions, and communicating the outcomes. These stages encourage inquiry, reflection, collaboration, and the application of knowledge in authentic contexts (De Los Ríos et al., 2020; López-Fraile et al., 2021).

From a pedagogical perspective, CBL is grounded in constructivist and experiential learning theories, which view knowledge as the result of continuous interaction between learners and their environment. Within this framework, instructors act as facilitators who guide inquiry processes, encourage critical reflection, and support students throughout the development of professional competencies rather than serving solely as providers of information (Escriche et al., 2021; García, 2022).

One of the main strengths of CBL lies in its ability to integrate disciplinary knowledge with the development of transferable competencies. Addressing authentic challenges requires students to mobilize conceptual knowledge, methodological skills, and interpersonal abilities while strengthening critical thinking, creativity, communication, collaborative learning, and complex problem-solving. These competencies are increasingly recognized as essential for responding to the challenges posed by digital transformation and rapidly evolving professional environments (Freeman et al., 2014; Doolittle et al., 2023).

Digital technologies further enhance the implementation of CBL by facilitating information retrieval and analysis, collaborative work, and the dissemination of results. They also promote interaction among students, instructors, and external organizations, creating more flexible, interactive, and context-based learning environments (De Los Ríos et al., 2020; García, 2022).

Although CBL shares several characteristics with Problem-Based Learning (PBL) and Project-Based Learning (PjBL), it differs by engaging students in open-ended challenges that require inquiry, innovation, interdisciplinary collaboration, and the development of solutions with social or organizational relevance. These characteristics make CBL particularly suitable for higher education, where professional training increasingly demands the application of knowledge in authentic settings and the development of competencies needed to address complex real-world problems (Ayala, 2020; Sánchez & Sotelo, 2021; Sepúlveda et al., 2024).

Overall, CBL has emerged as an effective pedagogical approach for competency-based education by providing authentic learning experiences that bridge theory and practice. Its implementation is particularly relevant in business-related programs, where solving real organizational challenges contributes to the development of analytical, strategic, and decision-making competencies required in professional practice.

2.2. Cognitive Learning (CL)

Cognitive learning encompasses the mental processes through which individuals acquire, organize, interpret, store, and apply knowledge to solve problems and function effectively in different contexts. From the perspective of cognitive psychology, learning extends beyond the acquisition of new information; it involves transforming knowledge through analysis, reflection, integration, and transfer, thereby promoting the construction of increasingly complex cognitive structures (Pintrich et al., 1991). Consequently, cognitive learning

represents a fundamental dimension of higher education because it determines students' ability to understand phenomena, establish conceptual relationships, and apply knowledge to novel situations.

The model proposed by Pintrich et al. (1991), operationalized through the Motivated Strategies for Learning Questionnaire (MSLQ), suggests that cognitive learning depends on the use of elaboration, organization, self-regulation, and critical thinking strategies. These strategies foster deep information processing and move beyond learning based solely on memorization. Within this framework, students assume an active role in knowledge construction by selecting, organizing, and integrating new information with their prior knowledge.

Previous research has consistently shown that active learning methodologies strengthen cognitive learning by promoting higher-order reasoning and increasing student engagement. Doolittle et al. (2023) argue that active learning enhances conceptual understanding and facilitates knowledge transfer through activities involving analysis, discussion, and problem solving. Similarly, the meta-analysis conducted by Freeman et al. (2014) demonstrated that active learning significantly improves academic performance while reducing failure rates among university students in science, engineering, and mathematics.

Within this context, Challenge-Based Learning provides a particularly favorable environment for cognitive learning because it engages students in authentic situations that require the integration of knowledge from multiple disciplines. Throughout the challenge, students identify problems, gather information, analyze evidence, evaluate alternatives, and justify decisions using well-supported arguments. This process promotes conceptual understanding while facilitating the transfer of knowledge to professional contexts by strengthening the connection between theory and practice (De Los Ríos et al., 2020; López-Fraile et al., 2021).

According to the revised Bloom's taxonomy, CBL primarily promotes higher-order cognitive processes such as analysis, evaluation, and creation. Rather than merely understanding disciplinary content, students interpret information, generate proposals, and design solutions to authentic problems, thereby strengthening analytical reasoning and decision-making skills (Anderson & Krathwohl, 2001; Ayala, 2020). Likewise, the ICAP framework proposed by Chi and Wylie (2014) demonstrates that interactive and constructive learning activities produce deeper learning outcomes than passive information reception, providing a strong theoretical foundation for the implementation of CBL.

In business-oriented programs such as Negotiation and Sales, cognitive learning is particularly relevant because professional practice requires interpreting market information, understanding consumer behavior, and designing evidence-based business strategies. In this regard, CBL promotes the development of analytical competencies by engaging students in authentic organizational challenges that integrate knowledge from market research, marketing, data analysis, and business management within a single learning experience.

2.3. Critical Thinking (CT)

Critical thinking is widely recognized as one of the essential competencies in higher education because it enables students to analyze information, evaluate evidence, formulate well-reasoned judgments, and make informed decisions when addressing complex problems. Rather than representing an isolated cognitive skill, it constitutes a higher-order intellectual process that integrates logical reasoning, reflection, argumentation, and self-regulation to interpret situations from multiple perspectives and develop evidence-based

solutions (Facione, 1990; Kember et al., 2000). In an environment characterized by digital transformation, information overload, and rapidly changing professional contexts, critical thinking has become indispensable for both academic achievement and professional practice.

According to Kember et al. (2000), reflective thinking develops progressively through four levels: habitual action, understanding, reflection, and critical reflection. The latter represents the highest level of reasoning because it involves questioning assumptions, reinterpreting previous experiences, and reconstructing knowledge through critical examination of available evidence. Consequently, critical thinking should not be viewed as an innate ability but rather as a competency that develops through learning experiences promoting inquiry, argumentation, and systematic reflection.

A growing body of research indicates that active learning methodologies play a significant role in fostering critical thinking by positioning students at the center of the learning process. In a systematic review of systematic reviews, Andreucci-Annunziata et al. (2023) concluded that instructional strategies such as problem solving, collaborative learning, and structured discussion produce better outcomes than traditional teacher-centered approaches focused primarily on content delivery. These methodologies enhance students' ability to interpret information, evaluate the quality of evidence, identify inconsistencies, and construct well-supported arguments.

Within this context, Challenge-Based Learning (CBL) provides an especially appropriate environment for developing critical thinking because it engages students in authentic challenges whose solutions are not predetermined. Throughout the learning process, students are required to identify problems, formulate relevant questions, collect reliable information, analyze evidence, compare alternative solutions, and justify their decisions using evidence-based arguments. These activities strengthen analytical reasoning, evaluation, and reflective thinking by encouraging continuous examination of both available information and the feasibility of proposed solutions (De Los Ríos et al., 2020; López-Fraile et al., 2021).

From a constructivist perspective, CBL promotes knowledge construction through students' interaction with authentic professional situations. The need to understand organizational phenomena, interpret information from multiple sources, and develop viable solutions encourages continuous processes of analysis, argumentation, and decision-making. Furthermore, collaboration with external organizations and stakeholders facilitates the transfer of learning to professional contexts, strengthening students' ability to formulate well-founded judgments and respond critically to complex real-world problems (Escriche et al., 2021).

Empirical evidence further supports the relationship between active learning methodologies and critical thinking. Quintero et al. (2017) demonstrated that problem-based instructional strategies significantly improve students' analytical, interpretative, and argumentative skills compared with traditional teaching approaches. Likewise, Andreucci-Annunziata et al. (2023) emphasized that critical thinking is strengthened when students engage in systematic inquiry and reflective activities requiring decisions to be supported by objective evidence.

In business-oriented programs such as Negotiation and Sales, critical thinking represents a strategic competency for interpreting commercial information, analyzing markets, understanding consumer behavior, and evaluating alternative courses of action for decision-making. In this regard, CBL provides an authentic learning environment in which students

analyze organizational data, assess multiple alternatives, and justify their proposals using empirical evidence.

Overall, the literature suggests that critical thinking is closely associated with the implementation of Challenge-Based Learning. By engaging students in authentic challenges, CBL promotes analytical reasoning, evaluation, argumentation, and reflective thinking, thereby supporting the development of evidence-based solutions and facilitating the transfer of learning to professional contexts. These characteristics justify its inclusion as one of the central dimensions examined in the present study.

2.4. Academic Motivation (AM)

Academic motivation is widely recognized as one of the key factors influencing students' academic performance and persistence throughout the learning process, as it affects the effort they invest, their perseverance when facing challenges, and their commitment to learning activities. From the perspective of educational psychology, academic motivation refers to the set of processes that initiate, direct, and sustain behavior toward the achievement of academic goals, thereby promoting student engagement and self-regulated learning (Pintrich et al., 1991). In this sense, motivation not only determines students' willingness to learn but also influences the quality of the cognitive strategies they employ to construct knowledge.

One of the most widely used frameworks for examining academic motivation in higher education is the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1991). This model conceptualizes motivation as comprising several components, including intrinsic and extrinsic goal orientation, self-efficacy, task value, and beliefs regarding control over learning. From this perspective, motivation emerges from the interaction between students' personal characteristics and the educational environment. When learning activities are perceived as meaningful, useful, and relevant to future professional practice, students tend to demonstrate greater interest in learning, more active participation, and stronger persistence in achieving academic goals.

Previous research consistently highlights the close relationship between academic motivation, student engagement, and academic achievement. Xie et al. (2020) found that students with higher levels of motivation also demonstrate greater cognitive and behavioral engagement, leading to improved academic performance. Similarly, Ito and Umemoto (2022) reported that interpersonal motivation enhances academic engagement by increasing participation, sustained effort, and emotional involvement throughout the learning process. Together, these findings emphasize that motivation is a fundamental condition for promoting deep and sustainable learning.

Within this context, active learning methodologies have proven particularly effective in enhancing academic motivation by positioning students at the center of the learning process and engaging them in activities with clear purpose and practical relevance. Unlike traditional teacher-centered approaches, active methodologies promote autonomy, decision-making, and responsibility for one's own learning, thereby increasing the perceived value of academic tasks and strengthening intrinsic motivation.

Among these methodologies, Challenge-Based Learning (CBL) provides especially favorable conditions for fostering academic motivation. By engaging students in authentic challenges, CBL enables them to recognize the relevance of the knowledge they acquire and perceive that their work extends beyond fulfilling course requirements to generating solutions applicable to real organizations or communities. The opportunity to investigate authentic

problems, develop alternative solutions, and observe the practical implications of their work enhance students' sense of purpose, increases their interest in learning, and strengthens their commitment to academic activities (López-Fraile et al., 2021).

Furthermore, CBL promotes learning experiences characterized by high levels of autonomy and responsibility. Throughout the challenge, students plan activities, distribute responsibilities, manage information, make decisions, and continuously evaluate their progress. These experiences strengthen students' perceptions of competence and control over their own learning, two factors widely recognized as essential for maintaining sustained academic motivation. Consequently, students assume a more active role in knowledge construction and become increasingly committed to achieving learning objectives.

Academic motivation is also closely associated with the concept of student engagement. Fredricks et al. (2004) define engagement as a multidimensional construct encompassing behavioral, cognitive, and emotional dimensions that reflect the extent of students' involvement in academic activities. When learning tasks present achievable challenges, demonstrate practical relevance, and encourage active participation in problem-solving, students are more likely to exhibit persistence, commitment, and satisfaction with the learning experience. Previous studies consistently indicate that motivation and engagement reinforce one another, contributing to improved academic outcomes and more active participation throughout the educational process (Xie et al., 2020; Ito & Umemoto, 2022).

In business-related programs such as Negotiation and Sales, academic motivation plays a particularly important role because learning requires integrating theoretical knowledge with practical experience aimed at addressing organizational needs. In this context, CBL enhances students' perceptions of the relevance and usefulness of course content by connecting learning activities with projects developed for real organizations. This authentic learning environment strengthens students' commitment to the learning process and supports the inclusion of academic motivation as one of the central dimensions examined in the present study.

2.5. Meaningful Learning (ML)

Meaningful learning represents one of the most influential theoretical foundations of contemporary education, as it explains how students construct new knowledge by integrating new information with their existing cognitive structures. According to Ausubel (1968), learning becomes meaningful when new concepts are related in a substantive and non-arbitrary manner to previously acquired knowledge, enabling learners to reorganize and expand their cognitive structures. From this perspective, learning extends beyond memorizing information; it involves understanding, interpreting, and applying knowledge across different contexts, thereby facilitating knowledge transfer and promoting long-term learning.

Unlike rote learning, which relies on the mechanical repetition of information, meaningful learning involves an active process of knowledge construction in which students establish relationships among concepts, reflect on available information, and generate new interpretations based on their previous experiences. This process promotes deeper conceptual understanding and enhances students' ability to apply knowledge in situations beyond those in which it was originally acquired. Consequently, meaningful learning is considered a key indicator of educational quality, particularly in higher education, where professional preparation requires evidence-based problem-solving and informed decision-making.

Research has consistently shown that active learning methodologies promote meaningful learning by placing students at the center of the educational process and encouraging continuous interaction between theory and practice. In a meta-analysis conducted across science, technology, engineering, and mathematics (STEM) programs, Freeman et al. (2014) demonstrated that active learning significantly improves both academic achievement and conceptual understanding compared with traditional lecture-based instruction. These findings indicate that active participation promotes deeper reasoning processes and facilitates long-term knowledge retention.

Within this context, Challenge-Based Learning (CBL) provides a particularly appropriate environment for fostering meaningful learning because it engages students in authentic challenges that require integrating theoretical knowledge with experiences developed in real-world settings. Throughout the challenge, students identify problems, collect and analyze information, formulate alternative solutions, and justify their decisions using empirical evidence. This process establishes continuous connections between academic content and professional practice, promoting applied understanding and facilitating the transfer of learning to comparable professional situations (De Los Ríos et al., 2020; López-Fraile et al., 2021).

One of the major strengths of CBL lies in its emphasis on contextualized learning. Addressing authentic challenges derived from organizations, businesses, or communities' enables students to recognize the practical relevance of academic content and assign meaning to newly acquired knowledge. Applying concepts related to market research, consumer behavior, data analysis, and business strategy encourages the integration of multiple knowledge domains while strengthening students' ability to respond to real organizational challenges.

Meaningful learning is further reinforced through continuous interaction, reflection, and feedback. The discussion of ideas, exchange of experiences, and collaborative evaluation of alternative solutions encourage students to reconsider prior conceptions, compare multiple perspectives, and progressively reconstruct their knowledge. Consequently, knowledge is no longer viewed as a collection of isolated concepts but rather as a resource for understanding and addressing authentic problems.

In business-oriented programs such as Negotiation and Sales, meaningful learning is particularly relevant because professional practice requires interpreting information, understanding organizational phenomena, and designing evidence-based strategies. Within Market Research courses, CBL facilitates this process by engaging students in applied research projects for real organizations, integrating knowledge from marketing, statistical analysis, consumer behavior, and business management into a contextualized learning experience.

Overall, the existing literature supports the view that meaningful learning represents one of the principal educational contributions of Challenge-Based Learning. By integrating prior knowledge with authentic learning experiences and contextualized problem-solving, CBL promotes deeper understanding and prepares students to apply knowledge effectively in professional contexts, justifying its inclusion as one of the central dimensions examined in the present study.

2.6. Collaborative Learning (CoL)

Collaborative learning represents one of the most important transferable competencies in higher education because it promotes the collective construction of knowledge through

interaction, communication, and shared responsibility among team members. From a pedagogical perspective, collaborative learning extends beyond the simple distribution of tasks by encouraging students to participate actively in discussion, negotiation, decision-making, and joint problem-solving processes. These collaborative interactions contribute to the achievement of common goals through positive interdependence and individual accountability (Johnson & Johnson, 2009).

In contemporary educational and professional contexts, collaborative learning has become increasingly important because organizations require professionals capable of working effectively in multidisciplinary teams, managing collaborative projects, and developing cooperative solutions to complex problems. In response to these demands, higher education institutions have progressively adopted active learning methodologies aimed at strengthening communication, leadership, coordination, and conflict-resolution skills, all of which are essential for professional practice.

From the perspective of educational psychology, Fredricks et al. (2004) conceptualize student engagement as a multidimensional construct encompassing behavioral, cognitive, and emotional dimensions. Within this framework, collaborative learning represents an important mechanism for strengthening student engagement by fostering continuous interaction, a sense of belonging, and active participation throughout the learning process.

Literature consistently demonstrates that collaborative learning positively influences both academic achievement and the development of professional competencies. Johnson and Johnson (2009) argue that students participating in structured cooperative learning experiences achieve higher levels of conceptual understanding, develop stronger communication skills, and demonstrate greater ability to solve complex problems than those learning individually. Furthermore, continuous interaction among team members facilitates knowledge sharing and the collective development of effective solutions.

Within this context, Challenge-Based Learning (CBL) incorporates collaborative learning as one of its fundamental pedagogical principles. Solving authentic challenges requires students to integrate knowledge, share information, distribute responsibilities, and coordinate actions to achieve common objectives. Unlike conventional group activities, CBL demands continuous communication, negotiation, and evidence-based decision-making, with each team member contributing individual knowledge and expertise to develop practical solutions for authentic organizational problems (De Los Ríos et al., 2020; López-Fraile et al., 2021).

Throughout the challenge, students collaboratively plan activities, analyze information, develop proposals, and present their findings. These experiences strengthen leadership, coordination, time management, and shared responsibility while promoting continuous dialogue, constructive feedback, and collective knowledge construction.

In business-related programs such as Negotiation and Sales, collaborative learning is an essential competency for strategic planning, market analysis, and innovation management. In this regard, CBL recreates professional dynamics commonly found within organizations, enabling students to develop cooperation, negotiation, and leadership skills through authentic learning experiences connected to real business contexts.

Beyond supporting professional competency development, collaborative learning also contributes to socio-emotional skills such as empathy, active listening, and respect for diverse perspectives, thereby fostering more participatory and inclusive learning environments. Overall, literature supports collaborative learning as one of the foundational

dimensions of Challenge-Based Learning, as it promotes shared knowledge construction, student engagement, and the development of competencies required for effective professional practice. These characteristics justify its inclusion as one of the central dimensions of the present study.

2.7. Application of Challenge-Based Learning in Higher Education

Challenge-Based Learning (CBL) has emerged as an innovative pedagogical approach in higher education because of its ability to integrate disciplinary knowledge with the resolution of authentic problems while promoting the development of professional competencies in real-world contexts. Evidence from higher education institutions indicates that its implementation enhances student participation and strengthens the application of knowledge to professional situations, overcoming many of the limitations associated with traditional teacher-centered instructional approaches focused primarily on content delivery (Freeman et al., 2014; De Los Ríos et al., 2020).

Within business education, CBL is particularly relevant because it exposes students to authentic organizational contexts in which they are required to analyze information, identify organizational needs, and develop evidence-based solutions. In courses such as Market Research, this methodology facilitates the development of applied research projects for companies and organizations by integrating knowledge related to consumer analysis, data collection and analysis, and strategic decision-making. As a result, learning extends beyond the classroom and becomes directly connected to professional practice (López-Fraile et al., 2021).

Research has also shown that CBL can be successfully implemented across face-to-face, blended, and online learning environments, provided that instructional design intentionally promotes collaboration, faculty guidance, and the effective use of digital technologies to facilitate interaction among participants. Across these different modalities, the essential phases of CBL—including challenge definition, inquiry, solution design, implementation, and communication of results—remain unchanged, supporting active participation and collaborative learning regardless of the instructional format (De Los Ríos et al., 2020; Escriche et al., 2021).

Taking together, literature supports CBL as a pedagogical approach well suited to higher technological education because it effectively integrates theory and practice, promotes competency development, and provides authentic, contextualized learning experiences. These characteristics justify its implementation in the Market Research course and support its adoption as the central pedagogical approach examined in the present study.

3. Methodology

3.1. Research Design

This study adopted a quantitative approach using a non-experimental, descriptive, and cross-sectional research design. The quantitative approach enabled the measurement of students' perceptions regarding the contribution of Challenge-Based Learning (CBL) to different learning dimensions through a structured questionnaire. A non-experimental design was selected because the variables were observed in their natural educational context without manipulation by the researchers, whereas the cross-sectional design reflected that data were collected at a single point in time after the implementation of the pedagogical intervention.

The study pursued three methodological objectives: (a) to describe students' perceptions of the learning dimensions developed through CBL; (b) to assess the psychometric properties

of the measurement instrument; and (c) to validate the measurement model using Partial Least Squares Structural Equation Modeling (PLS-SEM).

3.2. Data Collection Instrument

Data was collected using a structured questionnaire developed based on the theoretical foundations of Challenge-Based Learning and the five learning dimensions examined in this study. The instrument consisted of two sections. The first section gathered general information regarding the participants' academic context, whereas the second assessed students' perceptions of learning development across five latent constructs: Cognitive Learning (CL), Critical Thinking (CT), Academic Motivation (AM), Meaningful Learning (ML), and Collaborative Learning (CoL).

The instrument comprised 25 items, equally distributed across the five constructs (five items per construct). All items were measured using a five-point Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree).

Questionnaire items were developed from specialized literature and subsequently adapted to the context of the Market Research course to ensure conceptual consistency between each indicator and its corresponding theoretical construct.

To strengthen content validity, the items were drafted in a way that preserved conceptual coherence with the constructs defined in the specialized literature and were reviewed during the drafting process by the researchers to verify their clarity, relevance, and correspondence with the study's objectives. Subsequently, the quality of the instrument was assessed through the analysis of its psychometric properties using PLS-SEM, which confirmed adequate levels of reliability as well as convergent and discriminant validity.

3.3. Population and Sample

The study population consisted of the 50 students enrolled in the Market Research course within the Higher Technology Program in Negotiation and Sales at an Ecuadorian higher education institution.

Given the relatively small population size and full access to all enrolled students, a census approach was adopted; therefore, the sample was identical to the population (n = 50). This strategy enabled data collection from every participant involved in the educational experience, eliminating sampling error associated with participant selection and ensuring full representation of the target population.

3.4. Educational Context

The study was conducted during the implementation of Challenge-Based Learning in the Market Research course.

The proposed challenge required students to conduct a market research project for a language academy with the objective of identifying improvement opportunities and proposing strategic recommendations to strengthen its market positioning and competitiveness.

Throughout the project, students worked collaboratively in teams while completing the main stages of the market research process, including problem identification, objective formulation, research design, instrument development, data collection, data analysis, interpretation of findings, and the formulation of strategic recommendations for the organization.

This authentic learning experience integrated theoretical course content with a real organizational context, promoting the development of professional competencies through an active and contextualized learning process.

3.5. Research Procedure

The research was conducted in four sequential stages.

During the first stage, the academic challenge was designed and the learning activities to be completed throughout the semester were planned.

In the second stage, the Challenge-Based Learning methodology was implemented by organizing students into collaborative teams responsible for conducting the market research project requested by the participating organization.

During the third stage, after completion of the challenge, the questionnaire was administered voluntarily and anonymously. Participants were informed about the study objectives, and confidentiality as well as the exclusive academic use of the collected data were guaranteed.

Finally, in the fourth stage, the data was coded and cleaned using Microsoft Excel before being exported to ADANCO version 2.4.1 for statistical analysis.

3.6. Data Analysis

Statistical analyses were performed in two complementary phases.

The first phase consisted of descriptive statistical analyses, including the calculation of means and standard deviations to characterize students' perceptions across the five learning dimensions.

The second phase employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using ADANCO version 2.4.1. This analytical approach was selected because of its suitability for evaluating reflective latent variable models and its robust performance with relatively small sample sizes, a common characteristic of educational research.

The five constructs were specified as reflective latent variables (Consistent Mode A). The measurement model was evaluated according to the following criteria:

- Internal consistency reliability, assessed through Cronbach's alpha, rho_A, and Composite Reliability (CR).
- Convergent validity, evaluated using the Average Variance Extracted (AVE).
- Discriminant validity, assessed through the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT).
- Overall model fit, evaluated using the Standardized Root Mean Square Residual (SRMR).

Acceptance criteria followed established recommendations in the PLS-SEM literature. Values above 0.70 were considered acceptable for Cronbach's alpha, rho_A, and Composite Reliability; AVE values greater than 0.50 indicated adequate convergent validity; HTMT values below 0.90 supported discriminant validity; and SRMR values below 0.08 indicated satisfactory overall model fit and appropriate psychometric quality of the measurement model.

4. Results

4.1. Descriptive Results

Table 1 - Descriptive Statistics of the Learning Development Dimensions

Dimension	Mean	Standard Deviation
Cognitive Learning	4.17	0.70
Critical Thinking	4.03	0.86
Academic Motivation	4.50	0.63
Meaningful Learning	4.16	0.82
Collaborative Learning	4.28	0.71

Source: Authors' own elaboration.

The descriptive results indicate a favorable evaluation of Challenge-Based Learning (CBL) across all learning dimensions, with mean scores above 4.00 on a five-point Likert scale (Table 1). Overall, students reported positive perceptions regarding the contribution of CBL to their learning experience.

Academic Motivation obtained the highest mean score (M = 4.50, SD = 0.63), reflecting a high level of student motivation and engagement throughout the challenge. This finding suggests that addressing authentic organizational problems and connecting course content with a real business context enhanced students' interest and active participation in the learning process.

Collaborative Learning also received a high evaluation (M = 4.28, SD = 0.71), indicating positive perceptions of teamwork, cooperation, and the joint completion of learning activities. Similarly, Cognitive Learning (M = 4.17, SD = 0.70) and Meaningful Learning (M = 4.16, SD = 0.82) achieved high scores, suggesting that students perceived CBL as facilitating both conceptual understanding and the practical application of knowledge in authentic contexts.

In contrast, Critical Thinking obtained the lowest mean score (M = 4.03, SD = 0.86), although it remained within the positive range of the scale. The relatively higher variability observed for this construct suggests individual differences in students' perceptions of critical thinking development, possibly reflecting the complexity of the analytical reasoning, argumentation, and decision-making processes required throughout the challenge.

Overall, the descriptive findings indicate that students perceived Challenge-Based Learning as having a positive contribution across all five learning dimensions, with Academic Motivation and Collaborative Learning emerging as the highest-rated outcomes.

4.2. Measurement Model Evaluation

To assess the psychometric quality of the measurement instrument, the measurement model was evaluated using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach implemented in ADANCO version 2.4.1.

Table 2 - Internal Consistency Reliability and Convergent Validity of the Measurement Model

Construct	*Cronbach's Alpha*	*rho_A*	*Composite Reliability (CR)*	*Average Variance Extracted (AVE)*
Cognitive Learning (CL)	*0.9456*	*0.9466*	*0.9460*	*0.7780*
Critical Thinking (CT)	*0.9588*	*0.9597*	*0.9592*	*0.8247*
Academic Motivation (AM)	*0.9355*	*0.9374*	*0.9362*	*0.7461*
Meaningful Learning (ML)	*0.9611*	*0.9624*	*0.9616*	*0.8336*
Collaborative Learning (CoL)	*0.9478*	*0.9480*	*0.9478*	*0.7843*

Source: Authors' own elaboration based on the results obtained using **ADANCO 2.4.1**.

The measurement model demonstrated an adequate overall fit, with an SRMR value of 0.0717, which is below the recommended threshold of 0.08 for PLS-SEM models. This result indicates that the proposed model provides a satisfactory representation of the observed data.

Regarding internal consistency reliability, all constructs exhibited Cronbach's alpha, rho_A, and Composite Reliability (CR) values exceeding 0.93, substantially above the recommended minimum threshold of 0.70. These findings indicate a high degree of internal consistency among the indicators representing each latent construct.

With respect to convergent validity, the Average Variance Extracted (AVE) values ranged from 0.7461 to 0.8336, exceeding the recommended cutoff value of 0.50. These results confirm that each construct explains a substantial proportion of the variance of its respective indicators, demonstrating satisfactory convergent validity.

Discriminant validity was assessed using both the Heterotrait–Monotrait Ratio (HTMT) and the Fornell–Larcker criterion. The results satisfied the recommended thresholds, with all HTMT values remaining below 0.90, while each construct shared greater variance with its own indicators than with any other construct in the model. These findings provide evidence that the latent variables are empirically distinct from one another.

Overall, the measurement model demonstrated satisfactory internal consistency reliability, convergent validity, and discriminant validity, supporting the psychometric soundness of the instrument for assessing the learning dimensions associated with Challenge-Based Learning (CBL).

5. Discussion

The findings indicate that students perceived Challenge-Based Learning (CBL) as making a positive contribution to learning development in higher technological education. All five learning dimensions obtained mean scores above four on a five-point scale, suggesting that participants considered CBL an effective pedagogical approach for promoting active, contextualized, and student-centered learning.

Academic Motivation emerged as the highest-rated dimension, indicating that the incorporation of authentic challenges connected to real-world situations increased students' interest, participation, and commitment to the learning process. This finding is consistent

with the work of Pintrich et al. (1991), who emphasize the role of motivation in self-regulated learning, and with the studies of Xie et al. (2020) and Ito and Umemoto (2022), which demonstrate that higher levels of motivation are associated with greater academic engagement and participation. In the present study, conducting a market research project for a real organization enabled students to perceive greater relevance and practical value in the course content.

Collaborative Learning also received high evaluations, indicating that students perceived CBL as fostering interaction, shared knowledge construction, and the development of communication and coordination skills. These findings are consistent with Social Interdependence Theory (Johnson & Johnson, 2009), which argues that cooperative learning enhances both academic performance and interpersonal competencies. Likewise, the results support previous studies identifying collaboration as a fundamental component of Challenge-Based Learning when addressing complex problems in higher education (De Los Ríos et al., 2020; López-Fraile et al., 2021).

Regarding Meaningful Learning, students reported that CBL effectively connected theoretical concepts with their practical application in a real business environment. This finding supports Ausubel's (1968) theory, which argues that learning becomes meaningful when new knowledge is integrated with learners' existing cognitive structures. It is also consistent with Freeman et al. (2014), who demonstrated that active learning approaches promote deeper conceptual understanding and improve the transfer of knowledge to authentic situations.

Although Critical Thinking received a positive evaluation, it obtained the lowest mean score and exhibited the greatest variability among participants. This pattern suggests that developing competencies related to analytical reasoning, argumentation, and evidence-based evaluation require sustained educational experiences and structured opportunities for critical reflection. This interpretation is consistent with the work of Facione (1990), Kember et al. (2000), and Andreucci-Annunziata et al. (2023), who argue that critical thinking develops progressively through learning experiences that promote inquiry, reasoning, and reflective judgment.

This difference between academic motivation and critical thinking can be explained by the distinct nature of both processes. While motivation responds relatively immediately to meaningful, authentic experiences—such as facing a real business challenge, critical thinking constitutes a higher-order competency that is progressively consolidated through repeated cycles of analysis, feedback, and reflection (Kember et al., 2000; Andreucci-Annunziata et al., 2023). It is likely that the one-semester period was sufficient to generate a high level of motivational engagement, but insufficient to fully develop argumentation and critical evidence-evaluation skills, which would explain the greater dispersion observed in this dimension.

From a methodological perspective, the measurement instrument demonstrated satisfactory reliability and validity, providing evidence of its consistency for assessing the five learning dimensions examined in this study. Nevertheless, the relatively high reliability coefficients suggest the possibility of redundancy among some indicators, highlighting the need for future refinement and validation of the instrument using larger samples and more diverse educational contexts.

Overall, this study extends the existing evidence regarding the implementation of Challenge-Based Learning in Higher Technology Programs in Negotiation and Sales, an educational

context that remains underrepresented in the literature. The findings indicate that students positively value the incorporation of authentic business challenges into the Market Research course, providing empirical support for the use of CBL as an effective strategy for strengthening multiple learning dimensions within higher technological education.

6. CONCLUSIONS

The findings indicate that Challenge-Based Learning (CBL) is perceived by students as an effective pedagogical strategy for strengthening learning development in higher technological education. Consistent with the study objective, participants reported positive perceptions across the five learning dimensions evaluated—Cognitive Learning, Critical Thinking, Academic Motivation, Meaningful Learning, and Collaborative Learning—highlighting the potential of CBL to promote contextualized learning experiences focused on the practical application of knowledge.

Among the dimensions examined, Academic Motivation received the highest evaluation, suggesting that authentic challenges linked to real organizational needs increase students' interest, participation, and commitment throughout the learning process. Similarly, the high scores obtained for Meaningful Learning and Collaborative Learning indicate that CBL effectively integrates theory and practice while promoting shared knowledge construction and the development of competencies required for future professional practice.

Although Critical Thinking was positively evaluated, it exhibited the greatest variability among participants, suggesting that analytical reasoning, argumentation, and reflective judgment require complementary instructional strategies and sustained learning experiences to achieve further development.

From a methodological perspective, the study provides evidence supporting the psychometric quality of the proposed measurement instrument. The results obtained through PLS-SEM confirmed satisfactory levels of reliability and validity, supporting its application in future studies examining Challenge-Based Learning in comparable educational contexts.

This research contributes to the growing body of knowledge on Challenge-Based Learning by providing empirical evidence from a Higher Technology Program in Negotiation and Sales, a context that has received limited attention in previous studies. The findings support the incorporation of authentic business challenges into Market Research courses as an effective strategy for strengthening learning and narrowing the gap between academic education and the needs of the productive sector.

Based on these findings, several practical recommendations emerge for instructors and institutions interested in implementing Challenge-Based Learning in similar contexts. It is suggested that specific rubrics be incorporated to explicitly assess critical thinking throughout the development of the challenge—not only in the final product—along with intermediate formative feedback sessions that allow students to adjust their analysis and argumentation process. Likewise, it is recommended that instructors be trained in the facilitator role inherent to CBL, given that it differs substantially from traditional content-transmission teaching. Finally, extending CBL implementation across several academic periods could favor a more solid consolidation of higher-order competencies such as critical thinking.

The study presents several limitations that should be considered when interpreting the results. First, the information was based on self-reported data from students, which may

introduce social desirability bias—that is, a tendency to rate one's own learning more favorably. Second, the sample corresponded to a single group of 50 students from the same institution and program, which, while ensuring high representativeness of the context studied, restricts the generalization of the results to other populations or disciplines. Future research is recommended to expand the sample size, include institutions with different characteristics, complement measurement with additional sources (such as instructor evaluation or analysis of student deliverables), and develop longitudinal studies and structural models that further explore the relationships among the learning dimensions associated with Challenge-Based Learning.

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AUTHORS' CONTRIBUTIONS (CREDIT)

Conceptualization, LMC, MALV, KSS; methodology, KSS; validation, KSS; formal analysis, KSS; investigation, MALV, KSS; resources, MALV, KSS; writing—original draft preparation, LMC, MALV, KSS. All authors have read and agreed to the published version of the manuscript.

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CONFLICT OF INTEREST

The authors declare that they have no financial, personal, academic, or institutional conflicts of interest that could have influenced the design, conduct, analysis, or publication of this study.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request, provided that such requests comply with the principles of participant confidentiality and data protection.

ETHICS STATEMENT

This study was conducted in accordance with the ethical principles applicable to research involving human participants. Student participation was voluntary, anonymous, and confidential. Before completing the questionnaire, participants were informed about the objectives of the study, the exclusively academic purpose of the research, the confidential handling of the information collected, and their right to decline participation or withdraw from the study at any time without academic consequences. The data collected were used exclusively for scientific and research purposes, ensuring the protection of participants' personal information.

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