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Enhancing graduation outcomes through challenge-based learning: A strategic proposal

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Abstract

This article examines the potential of Challenge-Based Learning (CBL) and Evidence-Based Software Engineering (ESBE) as a strategy for higher education, combining quality teaching with the development of professional skills. The article specifically aims to mitigate all-but-thesis syndrome in degree programmes. The methodology comprises three phases: the initial phase, development phase and the validation phase. Phase 1. An exploratory literature review was conducted to identify relevant theoretical and methodological components to support the proposal. The review highlighted the adaptation of the all-but-thesis (ABD) syndrome to undergraduate capstone projects and the use of Challenge-Based Learning (CBL) as a core theoretical framework. Additionally, the development of student-centered strategies involves adapting the ESBE method. Therefore, in the validation phase, the published data from defended degree projects at a public higher education institution were used as a case study. The findings of this study validate the proposal to integrate CBL and ESBE to address the research question. Practical implications: This proposal provides a foundation for formulating a strategy that links companies and universities through CBL. This could potentially reduce graduation delays and deliver technological solutions to relevant contexts. Furthermore, the proposal can be expanded to include additional theoretical elements and empirically extended to incorporate primary data sources for developing new indicators.

Keywords: Active methodologies, All-but thesis, Approach to problem-solving, Challenge-based learning, Evidence-based software engineering, Higher education.

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Contents

Contribution of this paper to the literature
The article presents a strategy to establish relationships between real problems from universities and different domains. This objective is to be accomplished by adapting the CBL. Additionally, it is argued that this approach will contribute to knowledge management in higher education.

1. Introduction

The COVID-19 pandemic challenged the global socioeconomic system in both advanced and emerging economies and forced a rethinking of social practices and productive systems (Ramírez Agudelo, 2020). Bustelo, Suaya, and Vezza (2021) state that talent and regulation as pillars of the labor market should be directed towards the adoption of new technologies; this rethinking is of particular importance in companies.

As previously mentioned, the study of the Permanent Observatory of the Software and Computer Services Industry of Argentina (OPSSI), an initiative of the Cámara de la Industria Argentina del Software (CESSI) is one of the main pieces of evidence (Bustelo et al., 2021). This study provides a comprehensive overview of the evolution of various aspects of the Software and IT Services (SIS) between 2015 and 2020 as well as in the first quarter of 2021 (CESSI, 2020a, 2020b).

In 2022, OPSSI published the findings of a study that surveyed 250 companies in the technology sector. The study received responses from 247 of these companies and included information regarding 26,000 employees. The WEF's The Future of Jobs Report 2023 presents an analysis of the evolution of jobs and skills in the workplace. This analysis takes into account socio-economic and technological trends and projects the outlook for the next five years.

In 2023, the World Economic Forum (WEF) conducted a study on the strategies employed by Argentine companies in the context of the SARS-COV-2 pandemic. These strategies will be validated in collaboration with companies and graduates from the Information and Communication Technology (ICT) sector. According to the OPSSI (CESSI, 2024) 58.73% of jobs in the software activity were recorded between 2015 and 2023.

The article presents a transdisciplinary proposal centered on Challenge-Based Learning (CBL). This active methodology strategy is explained. Its contribution to problem-solving in a university context is discussed. The proposal is also presented to mitigate the completion of undergraduate studies. The proposal is validated using as a case study some publications of final degree projects (FDP) defended in a public higher education institution.

The university was identified as a stakeholder in the public sector through the analysis of a case study. It was observed that the technological projects generated by the university model propose solutions to problems located in the territory. These final degree projects represent or correspond to solutions generated with computer science models, methods, and tools. The projects and their artefacts represent knowledge-intensive products.

In this manner, the information and communication technology (ICT) artefacts generated or co-generated from an academic context contribute to digital transformations and to the labor insertion of students in the framework of the so-called knowledge economy.

This transdisciplinary framework takes into consideration the following questions:

- The phenomenon of the "all-but-thesis" (ABT) or "all but dissertation" (ABD) syndrome is characterized by the abandonment or delay in the completion of postgraduate studies. Analogous manifestations are also evident in undergraduate degrees.
- In the context of higher education, there is a necessity to explore and adapt active methodologies, such as challenge-based learning (CBL) to address the challenges and complexities inherent in the context.
- It is important to acknowledge the existence of a variety of public policies that promote actions in line with the software industry. Secondly, there is a high demand for human resources in the information systems and services sector (ISS). The relevance and necessity of integrating students into the workforce before the completion of their studies are also highlighted.
- The interest and the need to reconcile degree completion projects with work and personal projections are also emphasized.

2. Literature Review

The ICTs, their models, methods and tools are transformative and innovative resources in 21st-century society. They actively contribute to continuous training, employment generation, problem-solving and increased productivity. Human resources are highly valued and in demand in today's market. Capitalizing on human talent with a view to social, productive and economic improvement with emphasis on regional modernization is viable.

The proposal was based on the following theoretical and methodological aspects: all-but-thesis syndrome and its adaptation to degree programs, active methodologies (e.g., challenge-based learning) and the Evidence-Based Software Engineering (ESBE) method. Furthermore, the consideration of other strategies, such as formative research, competencies or soft skills (e.g., teamwork and effective communication) is a possibility. The proposal is grounded in publications of final degree projects (FDP) defended in public higher education institutions.

2.1. All But Thesis Syndrome

In the context of postgraduate higher education, particularly within doctoral programs, the phenomenon in which professionals who have fulfilled all the necessary requirements neglect to complete the writing and defense of their theses is referred to as " all-but-thesis" or "all but the dissertation" (ABD). It is proposed that this concept be adapted to address the identified issue in undergraduate degrees.

A substantial corpus of literature exists on this subject, including works by Gallagher and Savage (2023), Rodríguez de los Ríos, Zavaleta, and Herencia (2020) and Agudelo et al. (2020) among others. For instance, De La Cruz Velazco, Poquis Velasquez, Valle Chavez, Castañeda Sánchez, and Sánchez Anastacio (2022) and Carlino (2004) have been cited. The former developed a diagnostic method to identify the difficulties associated with the completion of studies, group them and list the most appropriate strategies to contribute to the permanence and completion of university studies (De La Cruz Velazco et al., 2022). Carlino (2004) addressed internal and external issues as either hindrance or facilitators. Lee, Xu, and Jha (2025) explored ABD in participants' experiences of extended time to degree.

2.2. Active Methodologies in Higher Education

CONFEDI (2018) established graduate competencies for the different engineering degrees. Generic competencies refer to the professional competencies common to all engineers. They can be technological, social, political or attitudinal. Specific competencies refer to those common to the professions of the same terminal.

In the 21st-century, active teaching methodologies contribute significantly to the professional training of students in higher education. A selection of bibliography was made to situate the proposal of active methodologies in the discipline of engineering. Some of the approaches are mentioned below.

Rodríguez de los Ríos et al. (2020) reported that experiential learning and other active and interactive techniques emerged with the student as the center of the teaching process, assuming "responsibilities and being the protagonist of his own learning, of his training and competence development" (p. 19). These methodologies include problem-based learning, project-based learning, case studies, research-based learning, collaborative learning and challenge-based learning, among others. In a subsequent study, Vargas la Torre, Aruquipa Chavez, and Daveziez Martinez (2022) analysed problem-based learning, project-based learning, flipped classroom, collaborative learning and escape room as active methodologies.

Azeez and Aboobaker (2024) presented a bibliometric analysis of experiential learning from 1976 to 2022, using information from the Scopus database.

Salguero-Rosero and Pérez (2023) conducted a systematic literature review, applying the PRISMA model in the following databases: Web of Science, Scopus and SciELO. The researchers opted for 85 of the 646 articles identified, and determined the preference for cooperative learning and project-based learning. The data collection techniques employed included questionnaires and surveys with a particular emphasis on the impact of pedagogical decisions on academic performance and content acquisition. The methodology employed in this study aligns with the findings of previous research by authors, such as Olivero and Medina (2022), Taconis and Bekker (2023) and Vargas la Torre et al. (2022) who have underscored the significance of this approach in fostering the connection between university and professional environments. Leles, Zaina, and Cardoso (2024) presented a systematic review of the literature, applying the PRISMA model to identify 'methods, workload, resources, structure, technology and stakeholder integration. In the study, the authors demonstrated the effectiveness of summative and formative assessments.

2.3. Challenge-Based Learning

Challenge-based learning (CBL) is a learner-centred pedagogical approach that represents or abstracts a problem from a real context and proposes a solution and encourages the generation of links to professional performance (Van Den Beemt et al., 2023). Beattie (2024) defined CBL as a design approach that includes three elements: interactivity, play and challenge.

One of the most effective CBL strategies is that students and faculty can collaborate with diverse problem situations to solve the stated challenge, with or without the involvement of external stakeholders.

The genesis of CBL can be traced back to experiential learning (Kolb, 1984; Villarroel Henríquez, Gutiérrez Suárez, Bruna Jofré, & Castillo Rabanal, 2021) with related active strategies including problem-based learning and project-based learning. A literature review conducted by Leijon, Gudmundsson, Staaf, and Christersson (2022) in higher education settings between 2009 and 2020 revealed an escalating dissemination of CBL through publications. The review highlighted the connections of CBL with entrepreneurial learning, self-regulated learning, double-loop organisational learning and authentic learning.

Several research and case studies have been identified in the literature on the development of CBL. These include works by Rodríguez de los Ríos et al. (2020), Mariño (2023) and Ramírez Agudelo (2020). The relevance of CBL for developing training competencies for employability was specified by authors, such as De La Cruz Velazco et al. (2022) and Posso Pacheco, Cóndor Chicaiza, Mora Guerrero, and Segundo Leonidas (2023). A relationship between CBL and STEM (Science, Technology, Engineering and Mathematics) careers was established by Taconis and Bekker (2023). Furthermore, Doulougeri, Vermunt, Bombaerts, and Bots (2024) refer to CBL as a pedagogical approach in engineering education.

Galdames-Calderón, Stavnskær Pedersen, and Rodriguez-Gomez (2024) identified 64 studies from 2013 to 2023 in the Web of Science (WoS) and Scopus databases. The SLR, which was elaborated with the PRISMA method was complemented with the application of the Delphi method with expert panels. The review identified 20 studies emphasizing a shift in CBL teaching practices towards student-centred learning, categorized into four key dimensions: pedagogical approaches, technology integration, industry involvement and development support. CBL has been used in engineering as it suggests that learning involves the students' doing or acting concerning a subject of study (Salinas-Navarro & Garay-Rondero, 2020). Consequently, it is proposed that its application be extended to technological careers, such as computer science, informatics and information systems.

2.4. Formative Research

A literature review was conducted by Cachay Chonlon and Gonzales Soto (2024) in the Scopus, Scielo and EBSCO databases in 2022 to analyze formative research (FR) strategies as a method of development in university students. The research determined that 14 studies favoured aspects applicable in FDP, such as "deduction, critical analysis, observation, exposition and the ability to confront ideas" (Cachay Chonlon & Gonzales Soto, 2024).

Zhang, Wang, Xian, Wang, and Huang (2023) developed a bibliometric study on formative assessment in science education. The authors selected 94 articles and found that several publications about formative assessment increased between 2015-2016 and 2020-2022.

Salguero-Rosero and Pérez (2023) conducted a descriptive systematic review of articles published in EBSCO, Scopus, Scielo, Latindex and Elsevier from 2002-2022 with the objective of comprehensively mapping the theoretical and methodological approaches on the subject. In addition, Fernández, Dieste, Pesado, and García Martínez (2010) emphasised the significance of research training as a pivotal component in the professional training of university settings. Furthermore, Huang, Khatri, and Alhemaid (2023) recognised self-regulated and autonomous learning as relevant in higher education.

The position of Fernández et al. (2010) who consider degree projects to be an opportunity for formative research, is examined, particularly in the domain of computer science. Some epistemological considerations are outlined in Ramírez Agudelo (2020).

2.5. Soft Skills

Rumiantseva (2021) presented a review of soft skills in university students between 2010 and 2020. Mohammed and Ozdamli (2024) focused their review on soft skills in technology education.

Leles et al. (2024) presented CBL as a tool for the development of socio-technical competences by applying teamwork and interaction with external partners to experiment with real-world challenges.

Higher education institutions should focus their efforts on preparing the next generation of graduates for the labour market. CBL represents an opportunity that integrates academic aspects and the resolution of problems identified in reality. CONFEDI (2018) presented a set of soft skills with particular emphasis on teamwork and effective communication, which are implicitly and explicitly associated with the projects developed.

2.6. Evidence-Based Software Engineering

Evidence-based software engineering (Genero Bocco, Cruz Lemus, & Piattini Velthuis, 2014; Kitchenham, Dyba, & Jorgensen, 2004; Pizard et al., 2015) is a methodology that originates from the medical sciences. Fernández et al. (2010) state that alternatives to build empirical knowledge in a more efficient way than reported are presented. The present article proposes an adaptation of the ESBE which is validated with data concerning undergraduate degrees published in 2020 and 2022.

3. Methodology

The proposal consists of the following phases:

3.1. Initial Phase

- Exploratory literature review. It was conducted to select pertinent theoretical and methodological aspects that would provide a robust foundation for the proposal. The review identified the adaptation of the all-but-thesis Syndrome to end-of-degree studies and the active teaching methodology of challenge-based learning as the theoretical references that would best underpin the study. In addition, other student-centred strategies to be incorporated to facilitate employment and labour market insertion as formative research. Similarly, the cultivation of teamwork and communication skills is recommended.
- Adaptation of evidence-based software engineering as a methodological strategy is also suggested.
- Selection of relevant theoretical and methodological aspects to justify the proposal. The focus is on the exploratory review of the literature explained above.
- Definition of the validation study defined in the final phase.

3.2. Development Phase

- Design of the proposal, which makes it possible to capture, compile, systematise and disseminate the information and knowledge about the final degree projects generated and defended to propose a solution to real problems.
- Adaptation of the evidence-based software engineering method (Genero Bocco, 2014).
- Determination of data sources.
- Specification of the following questions: What works and for whom, where, when, and why?
- Definition of indicators of the effectiveness dimension to objectify the findings.

3.3. Validation Phase

- Source data: It can be a primary or secondary information source. In this case, evidence was obtained from processed FDP data published in Mariño (2023). The selected data sources contextualise the environment in which the experiences were developed and specify the spatio-temporal delimitation of the study.

4. Results and Discussion

The findings of the study are established as the development of a proposal consisting of the design phase and the validation phase. The proposal is based on an approach based on Evidence-Based Software Engineering (ESBE), challenge- based learning, and investigative training, which characterise these projects and contribute to fulfilling the academic requirements of the graduate degree program.

4.1. Design Phase

The research is analytical-descriptive, providing a quantitative view. The study can be longitudinal or cross-sectional, depending on the chosen source of information. The evidence-based software engineering approach is used.

Stage 1. Definition: Specification of the sources of information used in the study. Existing research on the final stages of degree completion at public higher education institutions was identified. The subject refers to the design and development of final projects. In these studies, the units of analysis were selected using criterion sampling to obtain more relevant and representative data. A distinction is made between designed and defended dissertations. In this study, completed and defended projects are considered. In the context of this program, students complete their studies as the defense requires preliminary approval of the total number of subjects in the curriculum.

Stage 2. Selection of the technique. The main source of data is the content of the selected publications. These include observations, the analysis of each of the projects, and the final report written by the participants in the sample. The research questions that guided the study are reflected in the definition of the indicators synthesized in each of these reports. The data were supplemented by the following answers:

- What works: The ICT product designed to provide a solution to a problem.
- For whom: The target audience, represented by the government, businesses, organisations in the environment or ICT demanders and their products.
- Where: The location of the implementation and transfer.

- When: The period of enquiry. In this case defined in the selected publications and belonging to the same subject.
- Why: The relevance of training professionals in the ICT sector which through design and technological development emerges as a product of the appropriation and adaptation of active methodologies focused on students. These products are evidence of the knowledge applied and generated by this discipline. In this proposal, challenge-based learning has been chosen integrating research training. Teamwork and communication skills have been identified.

Stage 3. Conduction and analysis. The source of the information was defined as the presentation in Mariño (2023). In other words, it is secondary information. Once the data had been collected, processing continued and the reported indicators were analysed, inferring the inclusion of others. The analysis of the results preceded the interpretation and reporting. Further indicators are planned.

Stages 4 and 5: Interpretation of results and reporting. The interpretation of the results allows the challenges raised in the study to be confirmed. The purpose of the report is to communicate the findings. Understanding the issues allows limitations to be identified and new studies to be proposed. Replication of the study with a different data source is presented as future work.

4.2. Validation of the Proposal to Contribute to the Completion of Studies

Following Seguel-Arriagada, Torres-Valderrama, and Jiménez Pérez (2024) active methodologies have been demonstrated to facilitate the training of individuals and professionals. This human capital faces the world with a creative and innovative vision in which new and constant challenges emerge.

Research training is incorporated to validate the proposal focused on challenge-based learning. The sources of data are the publications of the experiences reported for a given subject which represent this problem. The degree is associated with the field of information systems with high demand from the computer systems and services sector. Some of the indicators presented in Mariño (2023) were chosen that represent the findings provided by the analysis of the selected evidence. Tables 1 and 2 are illustrative and represent only the information that has been obtained and can be analysed.

As illustrated in Table 1, a set of representative indicators has been synthesized. The following data set provides an analysis of the percentage of students who defended FDP. Students are organised into teams (it should be noted that two students can develop one FDP); women who defended FDP; students who have implemented FDP during the year of defense; students have been affiliated with R&D projects within the discipline; students have been affiliated with interdisciplinary R&D projects; students who have been affiliated with the FDP about a grant; graduates mentoring students; graduates who have been incorporated into the teaching staff; graduates who have been studying postgraduate at this university.

Table 1. Indicators defined in the study

Items	Year
Students who defended projects	100.00%
Students organised into teams	15.79%
Women who defended projects	26.32%
Student with a project implemented (during the year it was defended)	31.58%
Students have been affiliated with R&D projects within the discipline.	10.53%
Students have been affiliated with R&D interdisciplinary projects.	5.26%
Students have been affiliated with the FDP about a grant.	5.26%
Graduates who are mentoring students.	5.26%
Graduates who have been incorporated into the teaching staff.	10.53%
Graduates who studying postgraduate at this university.	15.79%

Source: Mariño (2023).

As illustrated in Table 2, the R&D developments generated within the framework of FDP addressed issues pertinent to industry, government, academia, and the entrepreneurial ecosystem. The purpose of these indicators is to measure the number of defended productions that contribute to the theoretical-methodological application of disciplinary knowledge to propose an ICT solution to real problems. These indicators offer insight into the context of the university students' enrolment, the challenges they have faced and the issues identified by other stakeholders.

Similarly, as illustrated in Table 2, a comparison of the various indicators reveals a notable trend. The item Academy is characterized by its collaborative approach with professors and researchers, incorporating formative research as a fundamental component of this proposal. The domain of entrepreneurship is an emergent field for students.

Some implications:

- It is related to the definition of formative research modalities discussed in Fernández et al. (2010) and the acquisition of knowledge through experience and links with the business world mentioned by Olivero and Medina (2022).
- Genero Bocco et al. (2014) also contribute to the above; it is important to note that effective collaboration between industry and academia is imperative for successful completion of degree programs. This collaboration should include the following: "Involving management in the formulation of the problem and the management and conduct of the research. Addressing real industry problems. Aligning results with industry objectives." In a nutshell, the present study has demonstrated that CBL is a viable strategy for finishing the degree of university courses.

Table 2. Indicators defined in the study

Stakeholders	Year
Academy	42.11 %
Government	26.32 %
Industry	5.26 %
Entrepreneurship	26.32 %

Source: Mariño (2023).

Regarding competence in teamwork, the number of teams is utilised as the primary metric. It is specifically measured through the indicator. In the future, it is projected that surveys will be conducted to ascertain the composition of teams formed by students in relation to their peers, guidance teachers, other collaborators, subject teachers, or stakeholders from the relevant context. Additionally, it is planned to incorporate indicators to be explicit.

- The areas of disciplinary knowledge selected by the students to specialize in at the end of the degree course and to propose a technological solution
- The contribution of these ICT products to the social, economic and productive aspects of society.
- The number of students who linked their FDP with an internship or participation in extension projects.

The analysis of the selected publications addresses the CBL as a case study from a public university. These universities are part of the knowledge economy and the analysis is corroborated by evidence.

- The integration of knowledge acquired and deepened, and that emerging and required to propose the solution to the challenge posed and the competencies developed during academic training, lifelong learning opportunities, and pre-professional experiences, among others, are capitalized and materialized in the technological projects designed and developed. This assertion is feasible given the reports analysed that show the completion of degree studies.
- It is evident that a variety of circumstances, such as the high demand for the software industry or staff turnover in the ICT industry CESSI (2022) among other strategies related to the retention of IT talent can have an impact on the implementation or continued operation of these technological projects, indicating in technology transfer indicators. In other words, even when the technological projects defended work, the number of those that materialize in the transfer of products, services or knowledge as well as their maintenance over time, differs.
- The R&D developments generated in the framework of technological projects at the end of the degree deal with a delimitation of problems identified in the industry, government or society in which they are inserted, or that can be recognized by students or are offered by ICT stakeholders (see Table 2).
- According to Van Den Beemt et al. (2023) it is necessary to advance in experiential learning, accessing real situations as a reflection of learning by doing. Similarly, the R&D developments require preparation from formative research.

A new challenge emerges: how to manage access to the productions systematized in the articles chosen for validation to analyse whether they correspond to nano-challenges, mini-challenges, and curricular challenges presented in Ramírez Agudelo (2020) and thus contribute with other indicators in both tables.

The proposal of challenge- based learning in final-degree technological projects is consistent with the necessity for universities to identify and promote the capabilities and skills required by the industry during the training process. Furthermore, it is essential for them to establish the strategies to be developed to achieve the objectives. In validating the proposal, we participate in the identification and promotion of the capabilities demanded by the SIS, providing a curricular space for their development.

According to Leijon et al. (2022) these completion projects share characteristics of products associated with CBL, such as cognitive, constructive, and sociocultural perspectives. Similarly, some aspects of analysis and creativity are discussed in Villarroel Henríquez et al. (2021).

In this proposal, the FDP is defined as artifacts or products that result from active, experiential, relational, and practical learning. They arise from the analysis and interpretation of the problem and incorporate the creativity of students in the solution. These artifacts are situated within the individual and the organisation that demands and/or adopts them.

About CBL and teamwork competence, Mariño (2023) focuses on aspects related to individual responsibility and collaboration ability. In addition, communication skills are encouraged in written and oral formats, given that the evidence corresponds to the defended projects. The importance of effective communication skills in teamwork contexts is also emphasised.

The present study concurs with the findings of Cachay Chonlon and Gonzales Soto (2024) given that formative research contributes to the "orientation towards science and technology", it offers innovative challenges to propose solutions to the problems of the "professional and personal sphere" (Cachay Chonlon & Gonzales Soto, 2024). Formative research also contributes to effective communication skills. Moreover, the analysis of the findings associated with the case study indicates that formative research requires an examination of teamwork given that the participants can assume different roles in the process of designing and developing a research project as a part of the degree program. Furthermore, it is emphasized that research training associated with the self-regulation of the learning and experiences acquired contributes to the professional development of students.

Students need to develop their "communication skills," for example, when working on the design and implementation of each project. These ideas are the basis for the design and development of functional prototypes, projects defined to solve problems identified in the area.

The proposal can be extended by incorporating other sources of primary data that may lead to new indicators, among which are mentioned.

- Systematized data in databases, monitoring or student tracking forms.
- Database with the requirements of the stakeholders, i.e., the recipients of the ICT solutions.
- Documents related to the development and implementation of final products, working agreements, handover protocols, and others.
- Surveys used. Surveys will be carried out with two different groups. Firstly, those who have defended the study completion project, and secondly, key informants who account for the degree of validation or implementation of ICT technological products as a solution to a public order problem.
- Ethical and deontological issues. The following issues will be subject of ethical and deontological analysis: The codes of the professional entities related to the discipline in which these projects are generated. The related documents, such as the work agreements inherent to each of the proposals will be identified and analysed.

5. Conclusion

This proposal, which is theoretical, methodological, and empirical adopts a transdisciplinary approach. It originates from an adaptation of challenge-based learning which has been employed to mitigate ABT syndrome in a degree career context. Evidence-based software engineering has been incorporated for its methodological contribution.

Case validation demonstrates that this proposal could be further enhanced by integrating other active methodologies, such as formative research, along with essential professional skills like teamwork and effective communication. The inclusion of these elements is crucial for fostering professional development in a complex societal environment.

The proposal further entails the determination of the impact of ICT projects developed at the culmination of the degree program within a complex environment where the challenge lies in achieving personal and professional interests. As a result, the contributions of the public university to the relevant context can be clarified and disseminated.

These projects, their technological products and the human resources involved represent a valuable asset for both the university and society at large. Furthermore, the involvement of different stakeholders and organisations in innovation and digital transformation processes is a key element of the project.

Among the projected challenges are the following:

- The present study proposes to extend the research to analyse the impact of degree completion productions in relation to the current performance of students and current professionals. The aim is to identify how the knowledge and/or experience acquired in relation to these technological projects led to the development of specific technological and social skills that enabled new work and professional challenges.
- The study will be expanded in future validations by explaining the impact of the technological projects on the graduation competencies (CONFEDI, 2018) of the career in which the study is located.
- Investigations into teamwork and effective communication skills will be deepened given their relevance to personal and professional development.
- The proposal will be scaled for different sectors in addition to the public, promoting the university's connection with society, the government, companies and entrepreneurship among others.

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