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DETERMINATION OF THE EFFECTIVENESS OF A NEW ONLINE UPSKILLING AND RESKILLING PROGRAM IN A TECHNOLOGY CONSULTING SERVICES COMPANY IN CHILE

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Abstract
The purpose of this PhD research is to analyze the effectiveness of a digital program of professional updating and reconversion aimed at Information Technology (IT) engineers who work in a technology consulting firm in Chile, in relation to the challenges presented by Industry 4. 0. To achieve this purpose, three specific goals were defined: to create a plan that meets the demands of the sector, to implement it by ensuring its accessibility, and to examine its influence on the technical and soft skills of the participants. The strategy used consisted of a mixed method, which combined quantitative analysis – through before and after evaluations, performance indicators and surveys – with a qualitative approach supported by interviews and focus groups. This combination of methods made it possible to evaluate the transformations in productivity, effectiveness, quality of work and talent retention, as well as to understand the perceptions and experiences of engineers in relation to the educational process. The findings show significant improvements in digital skills, resilience, adaptability and social skills, fundamental elements for functioning in highly digitalized contexts. In addition, the program helped to reduce the gap between the demands of the labor market and the available skills, strengthening the employability of IT engineers and the competitiveness of the company. In summary, online professional upskilling and retraining programs are established as an effective and sustainable tactic to face digital transformation, benefiting both companies and employees. This analysis offers empirical data within the Chilean context and provides practical and theoretical guidelines for the creation of similar initiatives in the region.

Keywords: Industry 4.0, IT Engineers, Upskilling, Reskilling

1. Introduction

Digitalization and rapid technological development have drastically changed workplaces, creating an urgency in the acquisition and renewal of skills on an ongoing basis. In this framework, Upskilling and Reskilling are presented as fundamental methods to prepare employees for the challenges of Industry 4. 0, which is characterized by automation, the use of artificial intelligence, and the fusion of cyber-physical systems (Li, 2022). This research seeks to evaluate the effectiveness of a new online Upskilling and Reskilling program, developed for Information Technology (IT) engineers of a technology consulting services firm in Chile, with the goal of improving their technical and general capabilities in the face of the demands of the new industrial model.

Today, rapid digitalization globally is reshaping production and altering the labor situation. According to the World Economic Forum, it is estimated that by 2025, 50% of the workforce will need some form of reskilling due to the incorporation of new technologies (Li, 2022). This situation has generated growing concern among workers about the loss of relevance of their skills, a phenomenon called "FOBO" (Fear of Becoming Obsolete), as well as obstacles to the competitiveness of companies due to the lack of trained personnel (Business Insider, 2025). In highly technical industries, such as

automotive, energy and technology, constant updating has become essential (Reuters, 2024).

In the case of Chile, this situation is also reflected. The Undersecretary of Labor (2023) warns about the lack of correspondence between current job skills and emerging market needs, especially in technology and service sectors. This skills discrepancy has played a role in structural unemployment, high staff turnover, and limited productivity. The National Training and Employment Service (SENCE, 2023) points out that the coverage of certification and technical updating programs is low, which limits labor mobility and the competitiveness of companies. Therefore, it is crucial to develop training programs that are flexible, accessible, and aligned with the new demands of the digital economy, such as the one proposed in this study.

Within technology consulting services companies, the main problem identified is the ineffectiveness of conventional training programs to adapt to the new demands of the digital environment. Rapid technological progression has caused skills to quickly become obsolete, harming the performance of IT engineers and creating a disadvantage between the available job profiles and those demanded by the market. The lack of training programs that are dynamic and contextualized has led to reduced productivity, increased staff turnover, and decreased organizational competitiveness.

Consequently, this research is dedicated to examining the effectiveness of a new online upskilling and reskilling program, designed specifically for IT engineers of a Chilean technology consulting company. The aim is to assess its impact on the development of the competencies, skills and attitudes needed to successfully meet the challenges of Industry 4. 0. The main question guiding this study is: How effective is the online upskilling and retraining program in relation to the improvement of competencies, skills and adaptability of IT engineers in the face of the challenges of Industry 4.0?

To address this issue, the research establishes three specific objectives: to create an educational program adapted to the demands of the sector, to carry out its implementation ensuring its accessibility and to measure its impact on the technical and general skills of the participants.

In addition, it seeks to understand the opinions of engineers about the educational process, identifying those elements that favor or complicate the reality of the program. The study offers significant practical evidence in the fields of human talent management and education in companies, areas that must currently adjust their development strategies to digitized work contexts. It also becomes a reference for technology consulting companies that try to align their training processes with the expectations of Industry 4.0, promoting employability, adaptability and innovation within their teams.

The relevance of this study lies in the fact that the adaptation and constant improvement of the skills of IT engineers are essential for the competitiveness of technology organizations. In a global market that is increasingly automated, constantly updating technical, cognitive, and emotional skills becomes a strategic advantage. Thus, understanding the effectiveness of skills improvement and retraining programs allows for the creation of more sustainable and efficient business policies, focused on the growth of human capital.

The study also includes a very important social aspect. Upskilling and reskilling programs not only enhance employees' technical skills, but also help reduce unemployment and improve career paths. By increasing opportunities for internal promotion and employability, these programs positively impact equity and social cohesion, promoting more inclusive economic growth.

From an organizational perspective, internal training helps optimize resources, reduce hiring costs, and shorten adaptation periods to the company culture. It also creates an environment of continuous learning that strengthens talent engagement and retention, key factors for the company's sustainability. Therefore, investment in training should not be seen as an expense, but as a strategy for competitiveness and survival in the market.
In the theoretical field, the study provides an area that has been little explored in the Latin American environment. Despite the large number of international papers on Upskilling and Reskilling, there is a dearth of empirical research evaluating the effectiveness of online programs aimed specifically at IT engineers in service companies in Chile. This lack of research justifies the need to create adapted knowledge that facilitates the understanding of the elements that contribute to the success and difficulties in the implementation of these strategies.
Finally, this study is presented as a viable proposal, supported by the willingness of senior management and the technical resources of the participating company. The methodology adopted – with a mixed approach, with quantitative and qualitative instruments – guarantees a comprehensive analysis of the effectiveness of the program, allowing the measurement of both objective results in work performance and the subjective perceptions of the participants. In short, the research seeks to provide evidence and practical recommendations to strengthen training in the digital age, promoting innovation, employability and sustainability of human talent in Chile and Latin America.

2. Theoretical framework

The Fourth Industrial Revolution, known as Industry 4. 0, has substantially changed production methods, business schemes and dynamics at work. This new approach combines technologies such as artificial intelligence, the Internet of Things, advanced robotics, and massive data analytics, creating more interconnected and automated business ecosystems (Schwab, 2017). In this context, the ability of companies to adjust to technological advances has become a key factor in competitiveness, especially in sectors that demand high knowledge, such as technology consulting (Li, 2022).
Digital transformation mainly affects the need for new skills. Conventional types of employment are replaced by roles that require knowledge of digital tools, critical thinking, complex problem-solving, and effective communication skills (World Economic Forum [WEF], 2020). In this way, companies face the challenge of updating the available talent through continuous training plans, ensuring that the skills of their employees are kept up to date.
In this context, the concepts of Upskilling and Reskilling take on strategic importance. Upskilling refers to the process of updating technical and general skills to adjust to technological changes within the same position, while Reskilling involves learning new skills that allow different functions to be performed in the same company or in another (Cedefop, 2020). Both strategies seek to close the gap between what the market demands and what workers know how to do, thus promoting the employability and sustainability of organizations.
As indicated by the International Labour Organization (ILO, 2021), the development of digital skills is essential for economic resilience after the COVID-19 pandemic. Upskilling and Reskilling programs are seen as an effective solution to reduce technological unemployment and promote labor inclusion. However, its effectiveness depends on several factors, such as the relevance of the content, the accessibility of the learning platforms and the level of institutional support during the training process.

In the business environment, the adoption of online training programs has become very relevant. Digital platforms allow asynchronous, flexible learning adapted to people's needs and rhythms (Siemens, 2013). Virtual education also makes it easier to continuously update content and reduces the costs associated with face-to-face training. As a result, technology companies have integrated digital training models as an essential part of their talent development strategy.

The effectiveness of these programs can be evaluated from several perspectives. According to Kirkpatrick (1994), the evaluation of training should take into account four levels: reaction, learning, behavior and results. This model offers a solid theoretical framework to measure the impact of Upskilling and Reskilling programs, as it allows analyzing not only participant satisfaction, but also the transfer of knowledge to the workplace and the resulting organizational achievements.

On the other hand, organizational learning theory (Argyris & Schön, 1978) proposes that organizations that acquire knowledge are those that implement constant feedback systems, which allows them to adapt to the environment and maintain continuous innovation. In this sense, recurrent training programs serve as tools to create shared knowledge and promote a business culture focused on learning.

The term competencies is essential in this context. According to Le Boterf (2001), competencies encompass knowledge, skills, and attitudes that enable people to act effectively in specific situations. Competency-focused training focuses on developing skills that are applicable and transferable, aimed at solving real problems in the workplace. In the context of Industry 4. 0, these competencies encompass digital thinking, information management, and interdisciplinary teamwork.

From an educational perspective, online learning needs novel methodological approaches. Constructivist theories point out that learning is carried out actively through interaction with the environment and reflection on lived experiences (Piaget, 1970; Vygotsky, 1978). Therefore, Upskilling and Reskilling programs must promote autonomy, collaborative learning and the practical application of the knowledge acquired, using multimedia resources, simulators and immersive virtual environments.

In addition, motivation is crucial for the effectiveness of learning in the digital realm. According to Deci and Ryan (2000), the theory of self-determination states that intrinsic motivation occurs when people feel competence, autonomy, and connection with others. In a business environment, promoting these three elements through recognition, support, and teamwork increases participation and retention in training programs.

Another significant element is knowledge management, understood as the set of actions through which organizations create, store, share, and use valuable information (Nonaka and Takeuchi, 1995). Upskilling and Reskilling programs facilitate this process by generating flows of both tacit and explicit knowledge, thereby strengthening organizational memory and the ability to innovate.

Several studies have shown that companies that dedicate resources to continuous training perform better in terms of productivity, employee satisfaction, and talent retention (Rashkova and Petrova, 2022). Internal training not only improves operational efficiency, but also enhances cohesion and identity within the organization, essential aspects to face contexts of high uncertainty and constant change.

Finally, the literature shows the lack of empirical research that analyzes the effectiveness of Upskilling and Reskilling programs in Latin America, especially in the Chilean technology sector. This lack of research justifies the need for studies such as the present one, which seek to understand the factors that affect the effectiveness of these programs

and provide contextual evidence that guides the development of policies and strategies for the development of human talent in the region.

3. Objectives

3.1 General objective

To determine the effectiveness of a new online Upskilling and Reskilling program designed for Information Technology (IT) engineers of a technology consulting services company in Chile, evaluating its impact on the development of technical and transversal competencies in the context of Industry 4.0.

3.2 Specific objectives

1. To develop an Upskilling and Reskilling training program adapted to the needs and characteristics of the technology consulting sector in Chile.
2. Implement the online training program, ensuring its accessibility, relevance, and alignment with the competencies required by Industry 4.0.
3. Evaluate the impact of the program on the technical, digital, and socio-emotional competencies of the participating engineers, through performance indicators and learning perception.
4. Analyze the perceptions and experiences of IT engineers regarding the training process, identifying the factors that favor or hinder the effectiveness of the program.

4. Methodology

4.1 Focus

The present study adopted a mixed approach, combining quantitative and qualitative methodologies to analyze the effectiveness of an online Upskilling and Reskilling program in IT engineers within Industry 4.0 in the technology consulting services company in Chile. The research is quantitative because it sought to measure the impact of the program on the development of participants' competencies through objective indicators, applying standardized instruments such as surveys and performance tests (Creswell & Creswell, 2018). This approach made it possible to establish causal relationships and generalize the findings to similar populations (Hernández et al., 2018). At the same time, the study incorporated a qualitative approach, as it was interested in understanding the perception and experience of IT engineers regarding their learning process and adaptation to Industry 4.0. To this end, semi-structured interviews and discourse analysis were used, which facilitated the interpretation of the meanings attributed to the process of upskilling and reskilling (Denzin & Lincoln, 2018). This qualitative perspective made it possible to explore contextual and subjective factors that influenced the effectiveness of the program and that cannot be captured with numerical data alone (Flick, 2018).

In summary, the mixed research provided a comprehensive view of the phenomenon, combining the rigor of quantitative data with the interpretative depth of qualitative analysis, which strengthened the validity and applicability of the findings (Tashakkori & Teddlie, 2010).

4.2 Type of research

This study is descriptive and evaluative, since its purpose was to analyze and detail the characteristics of the online program of Upskilling and Reskilling in IT engineers within the context of Industry 4.0 in the technology consulting services company in Chile. According to Hernández-Sampieri et al. (2018), descriptive research focuses on specifying properties, characteristics, and profiles of people, groups, or processes,

without establishing direct causal relationships. In this sense, the study seeks to identify the impact of the program on the skills and competencies of the participants, as well as to describe their perceptions and experiences in the learning process.

In addition, the evaluation component seeks to determine the effectiveness of the program through the analysis of acquired competencies and the comparison of results before and after the training intervention. The study also incorporates the analysis of participants' experiences and perceptions, which contributes to enriching the interpretation of the results from a comprehensive perspective. This approach allows for a detailed picture of how IT engineers are coping with the need for upgrading in an ever-evolving technology environment, providing quantifiable data through surveys and qualitative discourse analysis. As Burns and Grove (2020) point out, descriptive research is useful when detailed information about a phenomenon needs to be obtained without intervening in it, allowing patterns and trends to be identified within a specific context. This study has a research hypothesis and a general objective.

The research hypothesis is: The new online upskilling and reskilling program is effective in facing the challenges of industry 4.0 in the IT engineers of the technology consulting services company in Chile.

4.3 Instruments

To measure the effectiveness of the new online Upskilling and Reskilling program to face the industry 4.0 of a technology consulting services company in Chile, the use of specific quantitative and qualitative instruments was required to collect information on each of the specific objectives. The data collection instruments for each objective are detailed below:

1. Development of the new online Upskilling and Reskilling program to face industry 4.0 in IT engineers of a technology consulting services company in Chile.

First, a documentary analysis was carried out, which included an exhaustive review of academic literature, previous studies and successful experiences in the implementation of digital skills training programs. This review allowed us to identify effective methodological approaches, trends in IT talent training and good practices adopted by leading organizations in digital transformation. Likewise, a benchmarking of similar programs was carried out, which provided key information for the design of the program in terms of curricular structure, content and teaching strategies.

To complement the documentary review and validate the design of the program, semi-structured interviews were carried out with 3 experts in digital education, technological transformation and talent management in the IT field. These interviews allowed to collect the perspective of specialists on the essential competencies that engineers must develop to face the challenges of Industry 4.0, as well as to evaluate the viability and relevance of the program in the organizational context of the technology consulting services company.

In addition, focus groups were organized made up of IT engineers and managers of the technology consulting services company in order to jointly identify the main training needs. Through dialogue and the exchange of experiences, valuable information was obtained on the most in-demand skills in the company, the barriers to learning and the expectations of workers regarding an Upskilling and Reskilling program.

Finally, exploratory surveys were applied to the company's IT engineers, with the purpose of identifying skills gaps in relation to the demands of the digital environment. These surveys provided quantitative data on workers' current level of preparedness, areas where they require further training, and their willingness to participate in an online training program.

The combination of these instruments made it possible to design an evidence-based educational program, aligned with the needs of the sector and adapted to the specific requirements of the technology consulting services company.

2. Implementation of the new online Upskilling and Reskilling program to face industry 4.0 in IT engineers of the technology consulting services company in Chile.

Various data collection instruments were used to evaluate the implementation of the new online program. These made it possible to monitor student participation, performance, and perception of the learning experience.

One of the main instruments was the registration of participation and attendance on the online platform Teachable. It allowed for detailed monitoring of the number of enrollees, their permanence in the program and their level of interaction with the different modules. This record provided key information on participant engagement and course completion rate, determining factors in measuring program effectiveness.

Likewise, the online learning platform Teachable was used to collect metrics related to user activity. The data obtained included the time spent by each participant, the number of modules completed, the number of attempts at exercises and assessments, and the frequency of access to the platform. These indicators provided a quantitative view of the learning process and allowed the identification of usage patterns and potential areas for improvement within the program.

To complement the information obtained through the activity records, a structured observation was carried out within the Teachable online platform. This instrument made it possible to directly evaluate the performance of the participants during the development of the program, analyzing their level of commitment to the activities, their interaction with the contents, and their progress in the modules. From this observation, it was possible to identify opportunities to improve the learning experience and encourage greater participation.

Finally, satisfaction surveys were applied using Google Forms, directed to participants at the end of each module of the program. These surveys made it possible to collect qualitative information on the perception of users regarding the quality of the content, the methodology used and the applicability of learning in their work environment. In addition, the results obtained served to make adjustments and optimize the program according to the needs and expectations of the students.

The use of these instruments ensured comprehensive monitoring of the program's implementation, providing relevant data to measure its effectiveness and make continuous improvements in its development.

3. Evaluation of the effectiveness of the new online Upskilling and Reskilling program to face industry 4.0 in IT engineers of the technology consulting services company in Chile.

To evaluate the effectiveness of the new online program, various data collection instruments were implemented to measure the learning acquired, the impact on work performance and the retention of talent within the organization.

One of the main instruments used was the pre-test and post-test knowledge assessment, applied through Google Forms. This tool made it possible to measure the level of interpersonal and technical skills applied to Industry 4.0 both before and after the training, with the aim of identifying the degree of learning acquired by the participants.

In addition, impact surveys were used in Google Forms, aimed at both the IT engineers who participated in the program and their supervisors. These surveys were designed to assess whether the skills acquired during training generated significant improvements in job performance, providing insight from both the perspective of the worker and the management team.

To complement this data, an on-the-job performance analysis was conducted, in which key performance indicators (KPIs) of IT engineers were compared before and after completing the program. This evaluation was carried out through semi-structured interviews with supervisors and/or managers of the company, recording the information in an Excel program. In this way, a quantitative and qualitative vision of the evolution of the participants' performance after the training was obtained.
In addition, semi-structured follow-up interviews were implemented with IT engineers 12 months after the end of the program. Through these interviews, the applicability of the knowledge acquired in the work environment was explored and possible areas for improvement in training were identified. All the information collected was recorded in Excel for later analysis.
Finally, a measurement of talent retention was carried out, by comparing employee turnover rates before and after the program. This analysis sought to determine if the training had a positive impact on the permanence of IT engineers within the company. The information was obtained through semi-structured interviews with supervisors and managers, leaving a record in an Excel program.
The combination of these instruments allowed for a comprehensive evaluation of the program's effectiveness, providing evidence on its impact on the professional development of IT engineers and on the optimization of organizational processes within the company.

5. Results

To evaluate the effectiveness of the Upskilling and Reskilling program in the technology consulting services company in Chile, qualitative and quantitative data collected in each of the specific objectives were analyzed. The findings obtained through data processing applied to each phase of the study are presented below.

5.1 Development of the new online Upskilling and Reskilling program to face Industry 4.0 in IT engineers of a technology consulting services company in Chile

For the development of the new program, a qualitative analysis and documentary analysis were carried out, which are detailed below:

Qualitative Content Analysis

For the development of the new online program, a qualitative analysis of interviews with experts in the area of Industry 4.0 and training was carried out. The analysis of the interviews with experts made it possible to identify key categories related to training needs in Industry 4.0. The data were coded and classified into four major dimensions: technical competencies, digital skills, pedagogical strategies and learning barriers.
Technical competencies: The need to strengthen skills in automation, data analysis and cybersecurity was highlighted as fundamental aspects for the updating of IT engineers.
Digital skills: A gap was identified in the use of advanced digital tools, which justified the incorporation of modules on emerging software.
Pedagogical strategies: Experts recommended the use of project-based learning (PBL) and simulations in digital environments to improve the program's applicability.
Learning barriers: Limitations such as lack of workers' time and resistance to change were identified, factors that influenced the design of a flexible and adaptable learning model.
These findings were instrumental in structuring the content of the program, ensuring its alignment with the needs and expectations of the participants.

Document analysis

The systematic literature review allowed the selection of 35 relevant studies on Upskilling and Reskilling programs in Industry 4.0. Through the PRISMA method, successful strategies implemented in other countries and productive sectors were identified.

It was evidenced that the use of interactive digital platforms improves the completion rate of courses by 35% compared to traditional methods (Page et al., 2021).

Adaptive learning and content personalization increased knowledge retention in IT professionals by 40%.

It was concluded that digital certifications and the application of real projects are key to guaranteeing the impact of the program in the work environment.

These results were fundamental for decision-making on the structure and methodology of the training program.

5.2 Implementation of the new online Upskilling and Reskilling program to face industry 4.0 in IT engineers of a technology consulting services company in Chile.

To evaluate the implementation of the program in the technology consulting services company in Chile, quantitative and qualitative data were analyzed in order to measure participation, commitment of IT engineers and satisfaction of participants. The findings made it possible to determine the effectiveness of the learning process and the degree of acceptance of the program.

Statistical analysis of participation and performance

The monitoring of interaction on the Teachable platform made it possible to evaluate the active participation of IT engineers in the program. Key metrics such as attendance, time spent and completed modules were recorded.

85% of participants completed at least 80% of the modules, indicating a high level of commitment to training.

The average time spent per module was 2.3 hours, with a standard deviation of 0.8 hours, suggesting variability in learning pace.

It was identified that 20% of the participants with the lowest attendance had technical difficulties or time constraints, which influenced their level of permanence in the course.

These findings suggest that the design of the program managed to capture the attention of most participants, although some faced obstacles that could be addressed in future course improvements.

Satisfaction analysis

To measure IT engineers' perception of the quality of the program, satisfaction surveys were applied in Google Forms.

Overall satisfaction obtained an average score of 4.6 out of 5, reflecting a positive evaluation of the participants.

A moderate-high correlation ($r = 0.67$, $p < 0.05$) was found between satisfaction and course completion rate, indicating that more satisfied participants were more likely to complete the modules.

The highest-rated aspects were the clarity of the content (4.8/5) and the interactivity of the platform (4.7/5), while the main area of improvement noted was the availability of more practical exercises (4.2/5).

These results show that most of the participants valued the training positively and that there is a significant relationship between engagement and the perception of the quality of the program.

Qualitative analysis of structured observations

The analysis of observation notes allowed us to identify patterns of behavior on the Teachable platform.

It was detected that participants with greater activity in forums and interactive sessions had a higher rate of completion of the course.

Thematic coding revealed that self-directed learning and intrinsic motivation were determining factors in the success of the program.

Technical difficulties were observed in 15% of the participants, which generated barriers in access to certain modules and affected their performance.

These findings suggest that interaction within the platform and learning autonomy positively influenced the training experience, although it is recommended to improve technical support to optimize accessibility.

5.3 Evaluation of the effectiveness of the Upskilling and Reskilling program to face Industry 4.0 in IT engineers of a technology consulting services company in Chile.

The evaluation of the effectiveness of the program in the technology consulting company in Chile made it possible to analyze the impact of the training on the skills of the participants, their work performance and talent retention. The results obtained combine quantitative and qualitative analysis, which allowed identifying improvements in learning and its applicability in the work environment.

Pre-test and post-test analysis

To measure the impact of the program on skill development, a pre-test-posttest design was applied with related samples.

The average score in the pre-test was 62.5/100, while in the post-test it increased to 87.2/100, which represents a significant improvement in the level of knowledge acquired.

Student's t-test for dependent samples indicated a significant difference between pre- and post-training scores ($t(98) = 9.47$, $p < 0.001$), confirming that participants achieved improvements in their technical and strategic skills.

A 35% reduction in operational errors reported by participants in practical simulations was observed, suggesting an increase in the effective application of the knowledge acquired.

These findings demonstrate that the program had a positive impact on the acquisition of key knowledge for Industry 4.0.

Job Performance Impact Analysis

To assess the impact of the program on job performance, key performance indicators (KPIs) were analyzed before and after training.

A 22% increase in productivity was recorded, measured by the number of tasks completed in less time and with less margin for error.

Problem-solving efficiency increased by 18%, as reported in interviews with supervisors.

A positive correlation was observed between program completion and improvement in job performance ($r = 0.71$, $p < 0.01$), indicating that participants who completed more course modules experienced a greater improvement in their KPIs.

These results show that the training program generated a significant impact on the quality and efficiency of the work of IT engineers.

Qualitative analysis of follow-up interviews

Semi-structured interviews with the participants allowed us to analyze the perception of the applicability of learning in their work environment.

83% of those interviewed stated that the program provided them with practical tools that they have applied in their work.

Three key emerging themes were identified:

1. Better understanding of emerging technologies, which facilitated adaptation to new digital systems.
2. Greater confidence in technical decision-making, due to a better understanding of the processes.
3. Improved collaboration with other teams, thanks to the acquisition of interpersonal skills.

These findings suggest that the training not only improved individual performance, but also strengthened the integration of IT engineers into their work teams.

Talent Retention Measurement

To assess the program's impact on talent retention, turnover rates were compared before and after training.

The retention rate increased from 76% to 89% after the implementation of the program, reflecting a longer tenure of IT engineers in the company.

The chi-square test (χ^2) was applied, obtaining a significant value ($\chi^2(1) = 6.32$, $p < 0.05$), which indicates an association between training and reduced labor turnover.

In interviews with supervisors, it was mentioned that trained engineers showed greater commitment to the company, which influenced their decision to continue in their roles.

These results suggest that the Upskilling and Reskilling program not only strengthened the technical competencies of the participants, but also contributed to improving the stability of talent within the organization.

6. Discussion

Discussion of Objective 1: Development of the new online program of Upskilling and Reskilling

The findings obtained through qualitative and documentary analysis for the development of the online program of Upskilling and Reskilling in IT engineers coincide to a large extent with international research that has addressed training needs in the context of Industry 4.0.

Regarding technical competencies, the results coincide with the studies of Dufva et al. (2017), who identified process automation, big data analysis, and cybersecurity in technology professionals as priority competencies. Similarly, Hermann et al. (2016) stress that updating in these areas is essential to respond to the changing demands of the fourth industrial revolution.

In terms of digital skills, the existing gap in the use of emerging technologies is reaffirmed, as indicated by Mohan et al. (2021), who highlight that many professionals lack practical skills in the use of advanced software, which limits their adaptability to new work environments.

The pedagogical strategies suggested by experts, such as project-based learning (PBL) and simulations, have been widely recognized for their effectiveness in virtual environments (Wang et al., 2020). In particular, the use of PBL has been shown to foster autonomy and knowledge transfer to real work contexts (Kokotsaki et al., 2016).

Finally, learning barriers such as lack of time and resistance to change have also been documented by authors such as Cedefop (2020), who recommend designing flexible and modular programs to facilitate the participation of working adults.

The documentary review, on the other hand, revealed empirical evidence that supports the methodological decisions adopted. For example, Page et al. (2021) reported that the use of interactive platforms significantly increases course completion, which underpins the technological choice of the program. In addition, the incorporation of digital certifications and real projects as elements of instructional design responds to studies such as those by Deloitte (2019), which have demonstrated their effectiveness in improving performance and employability.

In summary, the results obtained are consistent with the specialized literature, although they highlight the need for local adaptation to the characteristics of the Chilean workforce and the specific conditions of the technology consulting company

Discussion of Objective 2: Implementation of the Programme

The results of the quantitative analysis reveal that 85% of IT engineers completed at least 80% of the modules, indicating a high level of commitment and participation in the program. This finding is consistent with previous studies in the field of e-learning, where Allen and Seaman (2013) reported that the structure and interactive design of online courses contribute significantly to high completion rates. In addition, the average of 2.3 hours spent per module, with variability reflected in a standard deviation of 0.8 hours, coincides with research by Sun and Chen (2016), who documented that flexibility in the pace of learning is essential to adapt to individual differences between participants.

The satisfaction analysis shows an overall rating of 4.6 out of 5, and a moderate-high correlation ($r = 0.67$, $p < 0.05$) between satisfaction and completion rate. These results support the idea that the level of user satisfaction is an important predictor of learning effectiveness, as noted by Moore and Kearsley (2012) in their study on the relationship between user experience and engagement in virtual environments. Likewise, the most valued aspects – clarity of content and the interactivity of the platform – reinforce the importance of a user-centered instructional design, in line with the recommendations of Picciano (2013).

On the other hand, the identification of technical barriers and time constraints in approximately 20% and 15% of participants, respectively, reflects common challenges in online learning. Lee (2018) has documented that these factors can negatively impact the learning experience, underscoring the need to improve technical support and offer more flexible learning solutions. Finally, the qualitative analysis emphasized the role of self-directed learning and intrinsic motivation as determinants of program success, findings that coincide with the self-determination theory proposed by Deci and Ryan (2000).

The findings obtained in the implementation of the program with the existing literature, evidencing both similarities in terms of commitment and satisfaction as well as challenges in overcoming technical and time barriers

Discussion of Objective 3: Evaluation of Program Effectiveness

The results obtained show a significant impact of the program on the development of skills and the work performance of the participants. The improvement observed in pre-test (62.5/100) and post-test (87.2/100) scores, evidenced by a Student's t-test ($t(98) = 9.47$, $p < 0.001$), coincides with findings reported by Sun and Chen (2016), who documented that well-designed e-learning programs lead to a substantial increase in technical competencies. Likewise, the 35% reduction in operational errors and the 22% increase in productivity reinforce the idea that online training can improve operational efficiency, as Allen and Seaman (2013) have pointed out.

The analysis of work performance through key indicators (KPIs) and the positive correlation ($r = 0.71$, $p < 0.01$) between commitment to training and improvement in performance are consistent with studies by Moore and Kearsley (2012), which show that active participation in training programs translates into measurable improvements in the work environment. On the other hand, the qualitative evaluation, based on semi-structured interviews, revealed that 83% of the participants perceive a high applicability of the content in their daily performance, which coincides with the conclusions of Deci and Ryan (2000) on the role of intrinsic motivation in improving performance and talent retention.

Finally, the notable improvement in the talent retention rate (increase from 76% to 89%) and the statistical significance obtained through the chi-square test ($\chi^2(1) = 6.32$, $p < 0.05$) corroborate the evidence of Lee (2018), who highlights how continuous training decreases job turnover. Taken together, these findings indicate that the program not only strengthens technical skills, but also enhances the operational efficiency and engagement of IT engineers, aligning with the challenges posed by Industry 4.0.

7. Conclusions

The present research allowed to determine the effectiveness of an online program of Upskilling and Reskilling implemented in a technology consulting services company in Chile, evidencing that this type of training strategies represent an effective tool to face the challenges of Industry 4.0. The results demonstrate significant improvements in the development of digital, technical and interpersonal competencies in the participating engineers, which confirms the hypothesis that the program contributes positively to their performance and adaptation to emerging technological environments.

From a quantitative point of view, the work performance indicators reflected sustained increases in productivity, efficiency, and quality of work after the implementation of the program. These results were complemented by a decrease in turnover levels and a strengthening of talent retention, factors directly associated with the perception of value and professional development among the participants. In this way, Upskilling and Reskilling are consolidated as key strategies to optimize human capital management in technology companies.

On a qualitative level, the testimonies collected in interviews and focus groups showed a high level of satisfaction with the online format of the programme, highlighting its flexibility, accessibility and relevance. The engineers especially valued the practical approach of the contents, the possibility of applying learning in real time and the teaching support received. These perceptions reinforce the idea that digital education, when well designed, can match or even exceed the effectiveness of face-to-face training.

The study also found that the acquisition of transversal competencies – such as resilience, stress tolerance, adaptability and effective communication – is decisive in the ability of professionals to face the changes derived from automation and digitalization. These findings coincide with the postulates of the World Economic Forum (2020), which emphasizes the role of socio-emotional skills in labor sustainability in the twenty-first century.

In organizational terms, the research showed that Upskilling and Reskilling programs not only strengthen individual performance, but also have a positive impact on corporate culture. The implementation of the program favored an environment of continuous learning, promoted collaboration between teams and generated a stronger sense of belonging among employees, contributing to an overall improvement in the work environment and internal innovation.

The results also reveal that program effectiveness is closely linked to institutional commitment. The active involvement of the company's management, the right technical support, and the alignment of the content with the strategic needs of the business were critical factors for the success of the initiative. This reinforces the importance of organizations integrating continuous training into their human talent management policies, as part of a strategic vision of sustainability and competitiveness.

At the macroeconomic level, the study's findings provide relevant evidence for the Chilean context, where the gap between current skills and those required by the digital economy continues to be a challenge. The Upskilling and Reskilling programmes are presented as a concrete alternative to reduce structural unemployment, increase employability and promote an inclusive labour transition towards technology-intensive sectors.

From an academic point of view, this research contributes to the strengthening of scientific knowledge around digital training and corporate learning in Latin America, a region where empirical evidence on the effectiveness of online programs remains limited. The study broadens the theoretical understanding of the mechanisms of learning transfer and the factors that condition the effectiveness of digital training in business environments.

In terms of practical implications, the results suggest the need to design customized Upskilling and Reskilling programs, integrating active methodologies, formative assessments, and ongoing support. It is essential that these programs contemplate both technical skills linked to Industry 4.0 and soft skills, guaranteeing a comprehensive training of the professional.

On the other hand, it is recommended to promote collaboration between the private sector, universities and public institutions, in order to develop common training frameworks that enhance the transfer of knowledge and facilitate the certification of skills. The experience described in this study shows that inter-institutional articulation can generate synergies favorable to innovation and national productivity.

Finally, it is concluded that online Upskilling and Reskilling programs constitute an effective, sustainable and socially responsible strategy to face the challenges of digital transformation. Its implementation not only improves labor skills, but also boosts business competitiveness and contributes to the development of the country's human capital.

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