



A Literature Review on the Evaluation of E-Learning Effectiveness in Taiwanese Corporations

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ABSTRACT

Purpose: Corporations have increasingly recognized the significance of employee training through e-learning for better sustainability, flexibility in terms of time and space, boosting national competitiveness, and to promote a culture of lifelong learning. This literature review examined the effectiveness of e-learning in Taiwanese corporations and its corresponding research outcomes, aiming to explore the balance between academic theories and practical management strategies. **Methodology:** By using the literature analysis methodology, 38 scholarly articles published from 2005 to 2022 were retrieved from the National

Digital Library of Theses and Dissertations in Taiwan. These studies helped to investigate the current state of research on the effectiveness of corporate e-learning and understand the impact of various factors on e-learning in enterprises. **Findings:** This study facilitated a compilation of past and current insights on the effectiveness of e-learning and placed a more effective focus on learning theories and key corporate decision-making. The findings indicated that research on e-learning effectiveness is rich in the fields of management, human resources, and education; however, scattered literature in engineering and communication highlighted issues related to technology adoption not limited to the fields. **Implications:** It is hoped that future research in diverse disciplines would contribute to the evaluation of e-learning effectiveness, providing a broader range of perspectives.

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Introduction

Since the Industrial Revolution in the 18th century, human civilization has transitioned from traditional agricultural production to a rapidly developing industrial era. After several industrial revolutions, the 21st century entered an era dominated by the Internet and characterized by a knowledge economy. Historically, each major change had significantly propelled the evolution of civilization. In addition, people caught in the digital

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wave experienced a transformation in the fundamental patterns of daily life (Stearns, 2020). Unlike the era of the Industrial Revolution, where coal energy laid a strong foundation for economic development, in the current knowledge economy, individuals and corporate organizations can quickly grasp and apply information gain substantial rewards. This trend has indirectly altered the operating models of human economies, evolving from traditional labor compensation models to human resource management models (Aslam et al., 2013).

Improving the knowledge, skills, and related capabilities of workers was positively correlated with maintaining a competitive advantage in corporate organizations (Anwar & Abdullah, 2021). Educational training has had a long-lasting and significant impact on corporate sustainability practices related to environmental, social, and governance criteria. As technology evolved, companies transitioned from traditional centralized coaching-style training to utilizing multimedia types such as video presentations, computer-assisted instruction, and even online e-learning. These changes not only reflected how enterprises actively incorporated technology into educational training, but also highlighted the crucial role of technology in enhancing employee abilities and organizational efficiency. Additionally, research indicated that virtual reality (VR) training outperformed traditional training in improving conceptual and spatial understanding, enjoyment, self-efficacy, and perceptions of learning, further demonstrating the significance of modern technology in corporate training strategies, especially within the ever-changing economic landscape (Baceviciute et al., 2022).

The wave of globalization has also transformed human perceptions of geographical constraints (Dash, 2024), and amid a rapidly changing environment, people's responses to challenges have become more intense than ever before. Consequently, the concept of lifelong learning has emerged as a fundamental skill necessary for modern individuals. In response to such trends, the education market has flourished. However, as the era of globalization intersected with the development of the Internet, the daily information overload faced by individuals also saw explosive growth. Although the education market adapted by developing various e-learning models, many innovative concepts still radically changed how information was accessed. Integrating economic subsidies and personalized interventions with massive open online courses (MOOCs) enhanced educational access and improved online learning outcomes, potentially boosting labor market resilience and professional growth in developing countries (Novella, Rosas-Shady, & Freund, 2024).

In 2021, the National Development Council of Taiwan initiated a national development program, utilizing digital media to foster a new generation of human resources (National Development Council, 2021). The program focused on enhancing high-security information and communication technology infrastructure and completing digital transformation measures in response to technological trends such as 5G mobile broadband and Internet of things. It aimed to continually strengthen information and communication technology infrastructure and cross-agency data transmission security, thereby increasing public trust in the government. Additionally, the initiative promoted the development of national geospatial data infrastructure, establishing high-quality three-dimensional spatial data circulation and services. Utilizing corporate power and collective intelligence, the program managed regulatory adjustments, government service transformation, and digital

talent training to foster economic development. Simultaneously, with the evolution of the Coursera platform, in 2015, the department of information and technology education (Ministry of Education, 2015) propelled the MOOCs platform, inviting universities to develop digital content for online courses. Following this, the Executive Yuan (2016) launched the Digital Nation and Innovative Economic Development Plan (DIGI+) for 2017-2025, aiming to develop training content in specialized fields and integrate learning technologies into high-value industries. The goals were to enhance the competitiveness of the citizens through e-learning and extend the national commitment to lifelong learning.

Besides, following the outbreak of COVID-19 pandemic, e-learning methods accelerated the replacement of traditional in-person training (Sousa & Rocha, 2019). This development in e-learning platforms completely shattered the barriers of knowledge dissemination, allowing access to first-hand information provided by top scholars and overcoming the limitations of time and geography through e-learning methods. After the widespread use of online learning applications, the focus in e-learning predominantly shifted on the creation of digital content and the reduction of barriers to using electronic devices. With the proliferation of smart devices and Internet applications, today's learning environments allow anyone willing to access relevant course content online to meet the demands of the knowledge economy. Despite the availability of a vast array of learning resources on open platforms that satisfy the public's need and desire for knowledge and skills, corporate organizations frequently voice concerns about the scarcity of human resources. For most companies, training related to professional skills varies depending on the industry sector, which is why larger organizations often develop their own e-learning content to meet their specific talent development needs.

The motivation for this study stemmed from the researcher's role in managing education and training within a large corporation. Observations have shown that, even when learners are immersed in an e-learning environment, they still encounter unexpected bottlenecks that disrupt the learning process and further impact the effectiveness of learning. Over the past five years, the researcher has experienced upgrades and transitions in learning platforms and participated in the setup and implementation of factory systems. Although internal post-training evaluations are conducted within the organization, the information provided from an operational management perspective is limited to quantitative completion rates of courses, making it difficult to effectively assess the learning outcomes of professional training. The objective of this study, therefore, was to provide recommendations for corporations implementing digital learning solutions, drawing lessons from past failures to minimize unknown risks, and effectively integrating learning theories with key corporate decision-making. From the perspective of educational training, by this study, the authors aimed to bridge the gap between academic insights and practical applications in corporate e-learning, helping businesses design more effective learning strategies that align with their organizational goals and enhance overall training outcomes.

Specifically speaking, this study, explored the effectiveness of e-learning in Taiwanese corporations and examined the current state of research outcomes on corporate e-learning in the academic world, aiming to understand the impact of various factors on e-learning in enterprises, and explore the balance between academic theories and practical management strategies. For this purpose, the study utilized the literature review method retrieving data

from the National Digital Library of Theses and Dissertations in Taiwan. The research questions of the study were framed as follows:

1. What were the publication years and the volume of literature available on the evaluation of e-learning effectiveness in corporations?
2. What was the distribution of academic departments and disciplines of the literature related to the evaluation of e-learning effectiveness in corporations?
3. Which research methodologies were employed in the literature concerning the evaluation of e-learning effectiveness in corporations?
4. What industries and professional roles were the subjects of the studies in the literature on e-learning effectiveness in corporations?
5. How were the levels of achievement measured and reported in the literature concerning the effectiveness of e-learning in corporations?

Theoretical Framework & Literature Review

Theoretical Underpinnings

Theoretical evaluation frameworks for e-learning effectiveness in corporations often include dimensions such as content, instructor, learner, organization, assessment, and technical systems (Zareisaroukolaei et al., 2024). Measuring knowledge transfer is crucial, with novel methods proposed for assessing effectiveness and efficiency (Nagy & Duma, 2023). Recent research on e-learning effectiveness in corporations highlights several key aspects such as instructional planning, incorporating technologies such as VR and artificial intelligence (AI) (Ikhsan, 2022; Kaizer et al., 2020). Social VR environments show promise for deep and meaningful learning (Mystakidis, Berki, & Valtanen, 2021), while machine learning techniques are being explored to optimize e-learning models (Aslam et al., 2021). Besides, it is understood that e-learning capabilities can enhance organizational learning through affordances such as flexible scheduling and knowledge sharing (Giannakos, Mikalef, & Pappas, 2022; Rosen, 2023). Educational design models such as ADDIE (i.e., analysis, design, development, implementation, and evaluation), Bloom's taxonomy, and Kirkpatrick's model are also widely used for designing and evaluating e-learning effectiveness (Razzaiq et al., 2022; Spatioti, Kazanidis, & Pange, 2023). Other research trends focus on online students, teachers, and interactive learning environments (Valverde-Berrosco et al., 2020).

Additionally, factors influencing e-learning effectiveness including quality of instruction, technical systems, and content (Al-Adwan et al., 2021), and social cognitive theory, problem-solving skills, and critical thinking, contribute to learning performance and sustainability in e-learning environments (Almulla & Al-Rahmi, 2023; Salami & Bhatti, 2022; Singh et al., 2022). By integrating all these factors, theories and models can provide a comprehensive framework for designing, implementing, and evaluating e-learning systems.

The Evolution of E-Learning

The concept of e-learning originated in the era of the rise of computers and the Internet, reflecting an innovative approach to technology applications (Collins & Halverson, 2018).

At that time, technology was employed to bridge the gap for students who were unable to participate in traditional courses, ensuring they could achieve the same educational outcomes. Moreover, e-learning has been proven to be an effective educational technology for employee development (Jethwani & Ramchandani, 2022; Tsai & Li, 2024). It specifically highlights that positive goal orientations and self-regulated learning strategies significantly enhancing learning satisfaction and outcomes. This further demonstrates the importance of e-learning in modern education and professional development.

Currently, e-learning has become a crucial platform for learners and educators in the transfer of knowledge and skills, offering a variety of learning modalities such as online courses, webinars, virtual classrooms, gamified learning, mobile learning, and blended learning. Concurrently, digital badges, as an innovative technology in online education, are empirically validated through hands-on training. For instance, a three-level Zoom-based training program at Hawler Medical University, with about 120 teachers participating, awarded digital badges to recognize the mastery of e-learning skills of successful participants (Alkhateeb, Hormzyar, & Taha, 2024). This practice not only significantly enhanced the teachers' motivation and professional growth, especially during the COVID-19 pandemic, but also increased their learning satisfaction and outcomes, with 91.5% of participants feeling more motivated and 90.6% reporting improved understanding. Additionally, most teachers considered digital badges a genuine and practical proof of learning achievement, planning to incorporate them into their professional development portfolios. This underscores the potential of e-learning tools like digital badges to enhance teaching quality and support self-regulated learning, facilitating the setting of learning goals, tracking progress, and adjusting learning according to individual needs, thereby further advancing the development and application of educational technologies.

Factors Influencing the Promotion of E-Learning in Corporations

Several factors have influenced the success of implementing e-learning in corporations. For example, factors like fundamental technological infrastructure, including hardware, software, and network capabilities, have played a key role. Organizational culture has also supported continuous learning and adapted to new technologies. Providing adequate training and support to both educators and learners has been crucial; therefore, organizations have also had to navigate regulatory, privacy, and ethical factors, especially those concerning the management of personal data (Qazi, Sharif, & Akhlaq, 2024). Economic factors, too, have played a role such as budget constraints affect the quality and scope of e-learning initiatives; since well-funded programs likely to offer more comprehensive solutions (Pham & Tran, 2024; Porfírio, Felício, & Carrilho, 2024). These factors together have highlighted the complexity of e-learning, emphasizing its importance in modern education and corporate settings, while also pointing out the challenges that need to be managed for successful adoption and effectiveness.

Alexandro and Basrowi (2024), in a recent study, have emphasized the significant impact of e-learning and technology adoption in a corporate environment, for enhancing employee training and competitiveness. The study highlighted the importance of factors such as leadership and organizational structures, in successfully integrating digital

technologies, and investigated their impact on educational outcomes and processes. The study also broadened its scope by considering factors such as government investment and historical development, considering the development of specific elements such as digital leadership, digital talent scholarships, and learning management systems, through the government support. By making use of structural equation modeling to understand the direct and mediating effects of digital plans among university stakeholders, it also emphasized the mediating role of smart digital organizations in enhancing technology adoption, thereby providing insights to factors that tailored digital strategy implementations across different organizational backgrounds.

Advantages and Challenges of E-Learning

E-learning has provided numerous significant advantages, such as accessibility and flexibility, enabling learners to access educational content at any time and from any location, and incorporating a variety of modes like online courses, webinars, virtual classrooms, gamified learning, and blended learning, all of which cater to different learners' needs and preferences. Additionally, technologies such as VR, augmented reality, and mixed reality have been applied in the metaverse, offering immersive and interactive experiences that significantly enhanced student engagement (Jagatheesaperumal et al., 2024; Kohar, 2022). However, e-learning has also faced challenges; it has heavily depended on reliable technology and Internet access, which could become a barrier in under-resourced areas, and it might not fully replicate the social dynamics of traditional classroom settings, potentially limiting social interaction (Aljawawdeh, 2024; Campayo Muñoz, 2023). Moreover, creating engaging and effective digital content has required substantial resources and expertise.

Methodology

Research Design

The study adopted a literature review research strategy (Arslan, 2023) to organize and classify the information related to the sampled texts, such as publication year and volume, distribution of academic departments, research methodologies used, type of industries, and job titles of the study subjects, as well as the levels of achievement reached. Kirkpatrick (1998) four-level evaluation model, a widely recognized framework for assessing training effectiveness within organizations, was used to conduct a comprehensive evaluation of the effectiveness of e-learning implementations within these corporations, exploring the current state and effectiveness assessments of e-learning outcomes.

Research Sample

The research subjects of the study were identified based on the Standard Occupational Classification system of the ROC (Ministry of Labor, 2010). All subjects were initially classified and coded into 19 industrial categories such as Agriculture, Forestry, and Fishery (A01); Mining and Quarrying (A02); Manufacturing (A03); Electricity and Gas Supply (A04); Water Supply and Pollution Remediation (A05);

Construction (A06); Wholesale and Retail Trade (A07); Transport and Storage (A08); Accommodation and Food Services (A09); Publishing, Audiovisual and Broadcasting Communications, and Information Technology Services (A10); Financial and Insurance Services (A11); Real Estate (A12); Professional, Scientific, and Technical Services (A13); Services Agents (A14); Public Administration and Defense; Compulsory Social Security (A15); Education (A16); Health Care and Social Work Services (A17); Arts, Entertainment, and Recreation Services (A18); Other Services (A19).

However, suitable adjustments following expert recommendations were made according to the industry. A few industry sectors were reclassified as unified categories to more closely align with contemporary business and societal understanding, thereby building specific research categories, because of which original 19 categories were condensed into 11 categories. For instance, four categories of Mining and Quarrying (A02), Electricity and Gas Supply (A04), Water Supply and Pollution Remediation (A05), and Financial and Insurance Services (A11), were merged as one regulated category called Regulated Industries (B02). Likewise, two categories of Construction (A06) and Real Estate (A12), were also merged into one category Construction Industry (B04). Table 1 and Table 2 summarize the industry classification in more detail.

The job title classifications in the sampled industries were also made according to Standard Occupational Classification system of the ROC ([Ministry of Labor, 2010](#)). The initial classifications and coding of job titles comprised 10 categories: Legislators, Senior Officials, and Managers (C01); Professionals (C02); Technicians and Associate Professionals (C03); Clerical Support Workers (C04); Service and Sales Workers (C05); Skilled Agricultural, Forestry, and Fishery Workers (C06); Craft and Related Trades Workers (C07); Plant and Machine Operators, and Assemblers (C08); Elementary Laborers (C09); Armed Forces Occupations (C10). However, following expert recommendations, job titles with high similarity were consolidated into unified categories, reducing the original 10 categories into five. For instance, two categories of Professionals (C02) and Armed Forces Occupations (C10), were merged into a single category of Professional Personnel (D02). Likewise, a new category of Operational Staff (D03) comprised four old categories of Technicians and Associate Professionals (C03), Clerical Support Workers (C04), Craft and Related Trades Workers (C07), Plant and Machine Operators, and Assemblers (C08), and Elementary Laborers (C09). Table 3 and Table 4 summarize the job title classification in more detail.

Research Instrument and Procedure

In a literature review research design, the instrument is a systematic review of the sampled studies to establish the research direction and examine the research focus in the selected studies. During research, extensive reading of the sampled studies is done to build a knowledge database and generate motivation for the topics of interest in the selected studies. The reading of the texts enables reviewing, organizing, and analyzing the data to narrow down research themes and identify pertinent issues worth further exploration. From the research background and motivation, the systematic review of studies also helps to establish the main thrust and boundaries of the study, leading to the drafting of the research objectives and the design of the research questions to be addressed. In other

words, this phase also leads to the formulation of specific research questions and determination of study's scope.

Data collection

The data of this research comprised master's and doctoral theses published from 2005 to 2022, retrieved from the database of the National Digital Library of Theses and Dissertations in Taiwan. The research focused exclusively on studies related to corporations operating within Taiwan, excluding those with operations abroad, such as Taiwanese businesses in China and Indonesia, among others. Keywords like "corporate" and "e-learning" were used to identify relevant studies. The theses belonging to e-learning innovations for primary school students with hearing impairments (Ko, 2006), as well as those related to companies not based in Taiwan, were excluded from this review. The focus was strictly on enterprises located in Taiwan and found within the scope of this review. Additionally, the researchers had set no specific year range for data collection, given that E-learning National Science and Technology Program ran from 2002 to 2007, it was believed that relevant studies would emerge in the years following the program's execution. Therefore, all research studies published after 2005 until 2022 were included in this review.

Data Analysis

Employing a quantitative approach, the sampled theses and dissertations were analyzed on several variables such as volume number, authors' institutions, and years of publication. The sampled studies were preliminarily reviewed, organized, and analyzed to narrow down the research themes and identify pertinent issues worth further exploration. For this purpose, the study extensively categorized and coded the methodology, subjects' industry sectors, professional types, and categories of learning effectiveness for in-depth analysis. A specific code was assigned to each category to streamline the data collection and analysis process. After summarizing the data, Kirkpatrick's four-level evaluation model (reaction, learning, behavior, and results,) evaluation model assesses the applicability of each level in evaluating the effectiveness of corporate e-learning. The authors also explored which level each of the sampled studies had achieved, how learning effectiveness was evaluated, the challenges encountered, and what were the potential future research directions to further understand the status of effectiveness assessments in corporate e-learning.

The existing data on the academic department of the students, the year and number of publications, and the research methodology were already well-documented and clear on the thesis database, and, thus, did not require revalidation. However, the authors based the initial classification of the industry and job titles on the occupational standards. Following expert review and recommendations, a second round of classification was also conducted. All studies were subsequently organized and consolidated into categories, to facilitate a quantitative statistical analysis in each category. The statistical analysis was performed on all classifications to discuss the findings and understand the levels of e-learning effectiveness achieved by enterprises in the given time interval.

Results and Findings

Categorization and Classification

Right at the outset, the studies sampled for the review were categorized in accordance with industry sectors and job titles, using the Standard Occupational Classification system of ROC (Ministry of Labor, 2010). Table 1 shows the preliminary classification codes of industry sectors represented in the sampled studies, totaling 19 categories, namely: Agriculture, Forestry, and Fishery (A01); Mining and Quarrying (A02); Manufacturing (A03); Electricity and Gas Supply (A04); Water Supply and Pollution Remediation (A05); Construction (A06); Wholesale and Retail Trade (A07); Transport and Storage (A08); Accommodation and Food Services (A09); Publishing, Audiovisual and Broadcasting Communications, and Information Technology Services (A10); Financial and Insurance Services (A11); Real Estate (A12); Professional, Scientific, and Technical Services (A13); Services Agents (A14); Public Administration and Defense; Compulsory Social Security (A15); Education (A16); Health Care and Social Work Services (A17); Arts, Entertainment, and Recreation Services (A18); Other Services (A19).

Table 1

Industry Classification Codes

Code	Industry sector
A01	Agriculture, Forestry, and Fishery
A02	Mining and Quarrying
A03	Manufacturing
A04	Electricity and Gas Supply
A05	Water Supply and Pollution Remediation
A06	Construction
A07	Wholesale and Retail Trade
A08	Transport and Storage
A09	Accommodation and Food Services
A10	Publishing, Audiovisual, and Broadcasting Communications, and Information Technology Services
A11	Financial and Insurance Services
A12	Real Estate
A13	Professional, Scientific, and Technical Services
A14	Services Agents
A15	Public Administration and Defense; Compulsory Social Security
A16	Education
A17	Health Care and Social Work Services
A18	Arts, Entertainment, and Recreation Services
A19	Other Services

However, following experts' recommendations, these categories were reclassified by merging similar industry sectors into unified categories, to closely align with contemporary business and societal issues. For instance, a new category Regulated Industries (B02) combined Mining and Quarrying (A02), Electricity and Gas Supply (A04), Water Supply and Pollution

Remediation (A05), and Financial and Insurance Services (A11) into one regulated sector, due to their need for special government permissions. Likewise, Construction (A06) and Real Estate (A12) were merged into one category as both were related to building and real estate transactions; Wholesale and Retail Trade (A07) and Transport and Storage (A08) were integrated into Sales and Logistics (B05) category, due to their high correlation in product sales and distribution processes. Three categories were renamed and recoded: one, Publishing, Audiovisual and Broadcasting Communications, and Information Technology Services (A10) was renamed as Multimedia and Information Services (B07), to better reflect the modern understanding of the industry; two, Public Administration and Defense & Compulsory Social Security (A15) was renamed as Government and Defense (B08) to better match current interpretations; three, Health Care and Social Work Services (A17) was renamed and recoded as Healthcare and Social Work (B10), to align more closely with current terminology. Finally, four categories viz., Professional, Scientific, and Technical Services (A13), Services Agents (A14), Arts, Entertainment, and Recreation Services (A18), and Other Services (A19) were integrated into one category, Comprehensive Services (B11), reflecting the diverse aspects of the service industry. The rest of the categories remained unchanged. To sum up, the original 19 categories were reclassified into 11 categories. Table 2 presents the names and codes of new (revised) industry classification codes, against the previous codes and sectors.

Table 2

Revised Industry Classification Codes

New code	New industry sector	Previous codes and sectors
B01	Agriculture, Forestry, Fishery, Livestock	<ul style="list-style-type: none"> • A01 - Agriculture, Forestry, and Fishery
B02	Regulated Industries	<ul style="list-style-type: none"> • A02 - Mining and Quarrying. • A04 - Electricity and Gas Supply. • A05 - Water Supply and Pollution Remediation. • A11 - Financial and Insurance Services.
B03	Manufacturing	<ul style="list-style-type: none"> • A03 - Manufacturing
B04	Construction Industry	<ul style="list-style-type: none"> • A06 - Construction. • A12 - Real Estate.
B05	Sales and Logistics	<ul style="list-style-type: none"> • A07 - Wholesale and Retail Trade. • A08 - Transport and Storage.
B06	Accommodation and Food Services	<ul style="list-style-type: none"> • A09 - Accommodation and Food Services
B07	Multimedia and Information Services	<ul style="list-style-type: none"> • A10 - Publishing, Audiovisual and Broadcasting Communications, and Information Technology Services
B08	Government and Defense	<ul style="list-style-type: none"> • A15 - Public Administration and Defense; Compulsory Social Security
B09	Education	<ul style="list-style-type: none"> • A16 - Education
B10	Healthcare and Social Work	<ul style="list-style-type: none"> • A17 - Health Care and Social Work Services
B11	Comprehensive Services	<ul style="list-style-type: none"> • A13- Professional, Scientific, and Technical Services. • A14 - Services Agents. • A18 - Arts, Entertainment, and Recreation Services. • A19 - Other Services.

In line with the Standard Occupational Classification system of the ROC (Ministry of Labor, 2010), the classifications and coding of job titles were also done as shown in Table 3. A specific code was assigned to each category to streamline the data collection and analysis process. A total of 10 categories were created: Legislators, Senior Officials, and Managers (C01); Professionals (C02); Technicians and Associate Professionals (C03); Clerical Support Workers (C04); Service and Sales Workers (C05); Skilled Agricultural, Forestry, and Fishery Workers (C06); Craft and Related Trades Workers (C07); Plant and Machine Operators, and Assemblers (C08); Elementary Laborers (C09); Armed Forces Occupations (C10).

Table 3

Job Title Classification Codes

Code	Job title classification
C01	Legislators, Senior Officials, and Managers
C02	Professionals
C03	Technicians and Associate Professionals
C04	Clerical Support Workers
C05	Service and Sales Workers
C06	Skilled Agricultural, Forestry, and Fishery Workers
C07	Craft and Related Trades Workers
C08	Plant and Machine Operators, and Assemblers
C09	Elementary Laborers
C10	Armed Forces Occupations

Following experts' recommendations to refine the focus of the research, job titles with high similarities were merged and recoded into unified categories. This reclassification reduced the original 10 categories into five, with job titles updated to better align with contemporary corporate and societal understandings. For instance, Professionals (C02) and Armed Forces Occupations (C10) were merged into a single category, Professional Personnel (D02) since both old categories required specific professional skills acquired through specialized training, with military personnel needing expertise in military equipment and operations. Five categories viz., Technicians and Associate Professionals (C03), Clerical Support Workers (C04), Craft and Related Trades Workers (C07), Plant and Machine Operators, and Assemblers (C08), and Elementary Laborers (C09) were integrated into one category of Operational Staff (D03). All the roles stated in old categories focused on fundamental operational skills and did not require the high level of professional training, and personnel could commence work with minimal training. The rest of the categories were renamed and recoded to better reflect their inherent role and understand their scope more clearly. Table 4 presents this revised job title classification against the previous codes and job titles.

The two experts, who reviewed the classifications and provided recommendations to remove discrepancies and eventually merge and recode categories and job titles, were employed in large corporations with substantial experience in e-learning and effectiveness assessment. Their insights ensured that the categorization accurately reflected contemporary enterprise needs. The first expert, who had over eight years of experience,

was employed in the semiconductor industry, working for Taiwan's first wafer fabrication company, established over forty years ago with headquarters in Hsinchu, Taiwan. This company has service points in China, the United States, Europe, Japan, Korea, and Singapore, employing around 20,000 global staff. In addition to his regular duties, this expert also served as a mentor to new employees, teaching them how to use the company's e-learning systems and imparting expert knowledge. He also conducts senior employees' training, contributes regularly to departmental and factory training sessions, helps design internal professional courses, and records instructional videos, bringing a wealth of e-learning experience to this research. The second expert, a professional manager with over 10 years' experience in the information technology industry, works for a leading data storage company that provides foundational infrastructure for data storage worldwide. With a rich background in self-study through digital platforms, this expert had obtained multiple certifications and possesses extensive teaching experience. He was skilled in developing learning materials, building knowledge systems, training instructors, and enhancing team capabilities. His work involved conducting corporate training, market education, and partner training through both physical and e-learning methods.

Table 4

Revised Job Title Classification Codes

New code	New job title classification	Previous codes and job titles
D01	Management Personnel	<ul style="list-style-type: none"> • C01 - Legislators, Senior Officials, and Managers
D02	Professional Personnel	<ul style="list-style-type: none"> • C02 - Professionals. • C10 - Armed Forces Occupations. • C03 - Technicians and Associate Professionals.
D03	Operational Staff	<ul style="list-style-type: none"> • C04 - Clerical Support Workers. • C07 - Craft and Related Trades Workers. • C08 - Plant and Machine Operators, and Assemblers. • C09 - Elementary Laborers.
D04	Service and Sales Personnel	C05 - Service and Sales Workers
D05	Agriculture, Forestry, Fishing, and Livestock Industry	C06 - Skilled Agricultural, Forestry, and Fishery Workers

The next step was to formulate practical recommendations based on strengths, weaknesses, opportunities, and threats (SWOT) analysis to assess the effectiveness of corporate e-learning. The SWOT analysis is widely utilized as an objective tool for major corporate decision-making. This method, commonly used for strategic planning and competitor analysis, involves a comprehensive integration and summary of an organization's internal and external conditions and resources (Mu'min et al., 2024). Each component of the SWOT analysis serves a specific purpose. For instance, the *strengths* component allows to evaluate the organization's advantages and core competencies, including market share, brand image, expertise, and technological leadership; the *weaknesses* component allows to objectively assess the organization's

disadvantages and weaknesses, such as poor brand image, lack of experience, insufficient funding, and poor management; the *opportunities* component allows to explore potential opportunities for the organization, such as new markets, new products, regulatory changes, technological innovations, and fluctuations in competitors'; finally *threats* component allows to determine external threats beyond the organization's opportunities, including changes in competitive conditions and shifts in overall trends. The SWOT analysis facilitated the identification of planning methods, implementation techniques, outcomes, and challenges faced by corporations in their e-learning initiatives, and to ensure higher reliability and relevance to current corporate contexts.

Statistical Analysis of Studies on the Effectiveness of Corporate E-Learning

This study focused on evaluating the effectiveness of e-learning within Taiwanese enterprises, utilizing studies published under the National Digital Library of Theses and Dissertations in Taiwan during 2005 to 2022. Out of about 69 studies found related to corporate e-learning effectiveness and analyzed for this review, only 38 studies had met the study's criteria, and 31 studies were excluded from the scope of this research. These excluded studies fell into three categories: (1) first, 27 papers were deemed irrelevant to corporate e-learning effectiveness as they discussed factors such as the implementation of e-learning systems, strategies for deploying corporate e-learning, discussions on e-learning pathways among university students for recruitment purposes, and qualitative studies that did not quantify data on corporate learning outcomes; (2) second, 02 studies were removed as their complete version was not accessible due to restrictions from the National Digital Library (NDL). It was found that several studies in the NDL were physically located in large storage areas, where their retrieval proved administratively challenging. Although faster access could be obtained through the NDL Delivery Service, copyright laws limited the photocopying of these theses to only one-third of their content, thus preventing a complete review of the research data; (3) third, 02 studies focused on enterprises outside Taiwan locations, and were thus excluded, because the current review aimed to examine the effectiveness of e-learning within Taiwanese enterprises only.

A statistical analysis of all sampled 38 studies was carried out, which resulted in an agreement rate of 78.95% for industry classification across 38 studies, with eight discrepancies. For job titles, the agreement rate was 81.58%, with seven discrepancies.

Publication Years of Literature on Corporate E-Learning Effectiveness

The earliest publications among the total of 38 papers that the authors had selected for this research were of 2005 (Chiu, 2005; Yang, 2005). The number of publications peaked in 2010 with six papers (Chen, 2010; Hsieh, 2010; Hsu, 2010; Liu, 2010; Liu, 2010, Tsai, 2010) and then declined over the years, with one publication each in 2014 (Chou, 2014), 2015 (Chen, 2015), 2016 (Wei, 2016), and 2020 (Lin, 2020). No studies were published in 2018, 2019, 2021, and 2022. Yang (2004) discussed how enterprises adopted e-learning as a new training method, driven by the pursuit of efficiency. As the E-learning National Technology Plan was executed from 2002 to 2007, the peak of publications in 2010 could be attributed to this initiative. The subsequent decrease in publications post-2011 coincided with the end of the plan. The Taiwanese government had provided guidance and financial support for

e-learning development from 2002 to 2007, which encouraged enterprises to integrate e-learning systems and invest in resources for their employees.

Drawing from years of experience in e-learning within a major corporation, it was also observed that initial government intervention and funding attracted various enterprises to adopt e-learning systems. This adoption was felt from the top management to the grassroots level employees, highlighting the importance and necessity of e-learning within enterprises. As e-learning became more stable or technologically mature within companies, the focus of research shifted geographically to locations in the United States, Japan, China, and other countries. In addition, the e-learning systems and strategies were entirely revamped to accommodate employees from diverse national and cultural backgrounds. It was found that even as e-learning stabilizes, it is crucial to continually review and adapt corporate e-learning systems to meet the rapidly changing global demands.

Distribution of Literature by Department and Number of Publications per Year

Table 5 illustrates a distribution of academic departments, revealing that management-related departments published the highest number of publications on the subject with nineteen papers, followed by human resources-related departments with eleven papers, education-related departments contributing six papers, while engineering and communication departments each adding one relevant paper. The predominance of management-related research aligns with its direct connection to corporate operations. The human resources department typically manages the training and effectiveness evaluation of e-learning within companies (Liu, 2010). Education departments focused on aspects that required enhancement for better learning outcomes. Though engineering and communication departments published only one paper each, their contribution was pertinent to the assessment of e-learning effectiveness in corporations. This diverse academic involvement underscores the multidisciplinary nature of corporate e-learning effectiveness research, highlighting a broad interest across different fields. The array of departmental research indicates an ongoing interdisciplinary approach to enhancing the scope and depth of studies in corporate e-learning effectiveness.

Table 5

Distribution of Literature by Academic Department and Publication Year

No.	Department	Number of publications	Representative authors	Publication years
1	Management Related	19	Chen (2009); Hsieh (2010)	2009 and 2010
2	Human Resources	11	Chiu (2005); Yang (2006)	2005 and 2006
3	Education	6	Fan (2011); Wei (2009)	Various
4	Engineering	1	Chen (2010)	2010
5	Communications	1	Chen (2007)	2007

Research Methodology Used in Sampled Studies

The 38 studies sampled for this review employed a variety of research methods. Table 6 presents a comprehensive overview of these methods. It was found that the survey research method was most prevalent, accounting for 76% of instances (Chang, 2013; Chang,

2021; Lee, 2011). Interview method made up 16% (Chen, 2010; Lai, 2013; Yang, 2006), and case studies method was the least utilized, constituting 8% of the methods (Chen, 2009; Chiu, 2005; Yang, 2005). Yang (2004) noted that assessments of learning effectiveness predominantly rely on evaluative methods, particularly surveys, a finding that aligns with the predominance of survey methods in past studies.

Table 6

Distribution of Research Methods Used in the studies

Method	Frequency	Percentage
Survey	38	76
Interview	8	16
Case Study	4	8
Total	50	100

Industry Distribution and Job Titles in the Literature

Table 7 presents the distribution of industry sectors in the sampled studies. It is evident that the three most represented industries were Manufacturing (B03) (Chiu, 2005; Huang, 2008; Yang, 2005), Licensed Industries (B02) (Chen, 2012; Tsai, 2010; Yang, 2006), and Comprehensive Services (B11) (Chou, 2014; Lin, 2020; Ren, 2011). These industries had effectively adopted e-learning to facilitate training and allow employees to manage their learning schedules and outcomes (Yang, 2017). Manufacturing (B03) was the most frequent, often requiring extensive use of e-learning systems (Wei, 2009). This infers that industries often need to quickly absorb and disseminate the latest information or company announcements, particularly the manufacturing sector (B03), where the use of e-learning systems help acquiring new work-related knowledge or search for required information (Fan, 2011), including mandatory annual courses such as core values training, sexual harassment prevention, and anti-bullying campaigns.

In contrast, the least represented industries were Agriculture, Forestry, Fisheries, and Livestock (B01), Construction (B04), and Medical and Social Work (B10). These sectors utilized e-learning less frequently, possibly due to the high cost and time investment relative to perceived benefits (Chiu, 2012). The nature of work in Agriculture, Forestry, Fisheries, and Livestock (B01) and Construction (B04) involves fieldwork that limits hardware availability, making e-learning less feasible. However, though Medical and Social Work (B10) sectors are well-equipped, the focus on physical operations reduces the prevalence of e-learning in these fields.

Table 8 shows the distribution of job titles within the sampled studies. The findings indicate that the most prevalent occupation was the entry-level workforce (D03), which also constituted the majority within corporations. Newcomers in companies require extensive and frequent training, with the content of these training sessions being uniform and fixed. The adoption of e-learning allows companies to reduce the frequency of courses and human resource costs (Chen, 2009; Chiu, 2005). The second most common category was the managerial level (D01). The effectiveness of e-learning serves as an evaluative metric for the management layer (D01), providing a reference to understand and track employee learning outcomes and enabling managers to identify and analyze issues.

Table 7*Distribution of Industries in the Literature*

Industry Category	Code	Quantity	Percentage
Agriculture, Forestry, Fishery, Livestock	B01	1	1
Regulated Industries	B02	16	21
Manufacturing	B03	17	22
Construction Industry	B04	1	1
Sales and Logistics	B05	9	12
Accommodation and Food Services	B06	2	3
Multimedia and Information Services	B07	3	4%
Government and Defense	B08	3	4%
Education	B09	2	3
Healthcare and Social Work	B10	1	1
Comprehensive Services	B11	15	20
Others	B12	6	8

Table 8*Distribution of Job Titles*

Job Title	Code	Quantity	Percentage
Management Personnel	D01	20	30
Professional Personnel	D02	9	13
Operational Staff	D03	26	39
Service and Sales Personnel	D04	2	3
Agriculture, Forestry, Fishing, and Livestock Industry	D05	0	0
Others	D06	10	15

The Levels Achieved in the Literature

Kirkpatrick's four-level evaluation model (reaction, learning, behavior, and results) is frequently used to evaluate the effectiveness of corporate e-learning. The primary objective of utilizing this model was to assess which level was achieved by each of the sampled studies in this review, how learning effectiveness was evaluated, what challenges were encountered, and what were the potential future research directions to further understand the status of effectiveness assessments in corporate e-learning. This approach is consistent with the findings of Dalimunthe (2022), who also employed Kirkpatrick's four-level evaluation model to assess the effectiveness of pre-service teacher internship programs.

Kirkpatrick's four-level evaluation model is a widely recognized framework for assessing training effectiveness within organizations. The model allows to evaluate training across four levels: Reaction, Learning, Behavior and Results. The Reaction level allows to assess learners' immediate responses to training because feedback is typically gathered through surveys, focusing on learners' perceptions of the content and the instructors. For example, evaluations often measured satisfaction with the training's structure and delivery. The Learning level allows to measure learners' acquired knowledge or skills, using various testing methods before and after the training sessions. Assessments might include quizzes or practical tests to gauge the retention of new information. The

Behavior level allows to evaluate the application of learned skills or knowledge in the workplace over time. This often involves observations by supervisors or feedback from peers to determine if the training has had a lasting impact on work practices. Finally, the Results level allows to measure the training's impact on organizational outcomes. This could involve analyzing performance metrics such as productivity rates or customer satisfaction levels to determine the training's effectiveness in achieving business goals.

It was found that the sampled studies attained various levels of effectiveness as measured by the Kirkpatrick four-level training evaluation model. Table 9 exhibits the count of studies that reached various levels of effectiveness. The first level of reaction was attained by 37 studies (Chen, 2006; Kao, 2009; Tsai, 2007), employing methods such as surveys, combined surveys and interviews, and case studies, with the majority using surveys (Hsieh, 2010; Lee, 2011; Lin, 2020), accounting for almost 80%. This indicates that surveys are the predominant method of data collection for evaluating the effectiveness of corporate e-learning. Hsiao's (2008) study confirmed the effectiveness in terms of learner satisfaction, thus achieving this level.

The second level, learning was achieved by 05 studies (Chen, 2009; Chiu, 2005; Huang, 2008; Liu, 2010; Luor, 2008), employing surveys and interviews, as well as case studies. Chen (2009) designed a questionnaire that incorporated both the first and the second level, or administered post-training tests to effectively assess learning. Huang (2008) conducted tests following e-learning courses, thereby attaining this level. Two (02) papers achieved the third level, behavior (Chen, 2009; Chiu, 2005), using case studies in conjunction with interviews and surveys. Chiu (2005) reported effective outcomes at this level in terms of job performance, with significant gains noted in employee satisfaction, learning outcomes, and workplace application from surveys, corroborated by supervisors' recognition of applied work performance, thereby reaching this level. Lastly, two (02) studies (Chen, 2009; Chiu, 2005) achieved the fourth level, results, utilizing case studies with interviews and surveys. Chen (2009) tracked employees' e-learning outcomes through the company's performance system and noted a 7% increase in sales benefits within a year, meeting this level's assessment criteria. In Chiu (2005), the case company used internal experts to reduce training costs, and actual cost expenditures were evaluated for benefits and effectiveness.

Table 9

Distribution of Achieved Levels in Literature

Level	Evaluation level	Number of papers	Percentage
1	Reaction	37	80
2	Learning	5	11
3	Behavior	2	4
4	Results	2	4

Discussion

In relation to the first research question (What were the publication years and the volume of literature available on the evaluation of e-learning effectiveness in corporations?), the study found that the volume of publications correlated closely with specific years. Notably, under the impetus of national technology initiatives for e-learning,

there was a gradual increase in publications, peaking in 2010 with six articles released (Chen, 2010; Hsieh, 2010; Hsu, 2010; Liu, 2010; Liu, 2010; Tsai, 2010). This peak reflected a strong corporate interest and commitment to e-learning systems and related programs. However, following the conclusion of these governmental initiatives, there was a significant decline in the publication volume. Particularly in the years 2018, 2019, 2021, and 2022, almost no studies were published, suggesting a potential decrease in attention to e-learning research and application within the corporate sector. This reduction in research was unfortunate, as it impeded understanding and improvement of the actual effectiveness of e-learning in enterprises. It underscores the need for both corporations and governmental agencies to reconsider their support and resource allocation to this field, to foster ongoing innovation and effective evaluations.

In relation to the second research question (What was the distribution of academic departments and disciplines of the literature related to the evaluation of e-learning effectiveness in corporations?), it was observed that research on the effectiveness of e-learning in corporations was predominantly concentrated in the fields of management, human resources, and education. Additionally, sporadic studies in engineering and communications disciplines were identified, indicating that discussions on the integration of technology were not limited to traditional fields such as management, human resources, and education. Furthermore, Generative Artificial intelligence (GAI) enhanced educational governance and information exchange in academia but also raised ethical concerns. Engineering research emphasized improvements in efficiency, safety, and error detection and called for ongoing review and bias resolution of the technology. Through the integration of GAI, studies in communications and cultural fields aimed to enhance user experiences and positively affect corporate reputations. In healthcare, the focus was on the role of Chatbots in medical tasks, particularly highlighting the importance of training and privacy solutions (Al Naqbi, Bahroun, & Ahmed, 2024). These findings hope to inspire more researchers from various fields to contribute, thereby enriching the perspectives and depth of evaluations of e-learning and GAI effectiveness in corporations.

In relation to the third research question (Which research methodologies were employed in the studies concerning the evaluation of e-learning effectiveness in corporations?), it was found that the dominant approaches included surveys, interviews, and case studies. It was typical for studies to employ a combination of these methodologies to enrich their analyses. The literature review indicated that surveys were the most frequently utilized method, a preference that likely stems from their practical applicability in corporate environments. Surveys enable businesses to implement e-learning initiatives while effectively collecting feedback, thereby facilitating an ongoing assessment of their impact. This multifaceted methodological approach ensures a comprehensive evaluation of e-learning outcomes within corporate settings. In a similar vein, in numerous studies in AI, scholars also employed diverse techniques for data collection, with surveys laying the groundwork for both qualitative and quantitative research in AI. Experimentation was notably the most favored method within AI studies. As AI technology progressed within the information systems domain, both experiments and surveys became indispensable for hypothesis testing, understanding AI in practical contexts, comparing algorithms, and identifying unexpected biases and challenges (Ofosu-Ampong, 2024). This comparison underscores the significance of employing a variety of research methodologies to tackle the intricate dynamics of

technological applications across both business and academic landscapes.

In relation to the fourth research question (What industries and job title were the subjects of studies in contemporary literature on e-learning effectiveness in corporations?), it was observed that competitive trends have led enterprises across all sectors to engage extensively in the implementation of e-learning systems. This involvement was not limited by organizational rank; but to personnel at all levels, including management personnel, professional personnel, operational staff, and service and sales personnel, who all had participated in e-learning initiatives. According to Liu (2010), global development trends have driven the necessity for all members within corporations to update their knowledge continually to keep pace with global changes and growth. Consequently, studies have demonstrated that e-learning has been adopted across various industries and by different professional categories, serving as benchmarks for evaluation. These findings suggest that, despite potential environmental constraints, corporations should evaluate their strengths and weaknesses and allocate resources to e-learning to strengthen their competitive position.

In relation to the fifth research question (How were the levels of achievement measured and reported in the literature concerning the effectiveness of e-learning in corporations?), it was found that surveys were the predominant method of evaluation. Specifically, studies assessing the first level (reaction) within Kirkpatrick's model often relied on surveys as their foundational methodology. According to Bhat and Rainayee (2024), the highest frequency of assessments at the reaction level was conducted using surveys, highlighting their widespread application in evaluating e-learning effectiveness within corporate environments.

This research thus indicated that evaluations typically incorporated multiple methodologies. For instance, evaluations of the first level (reaction) combined surveys with interviews in four studies (Chen, 2010; Lai, 2013; Wei, 2016; Yang, 2006) and surveys with a case study approach in one (Yang, 2005). The second level (learning) was similarly assessed using both surveys and interviews, while the third (behavior) and fourth levels (results) utilized a blend of case studies, interviews, and surveys. This adoption of mixed methods underscores the nuanced approach required to comprehensively assess e-learning effectiveness. The less frequent use of interviews, primarily due to their qualitative nature, highlights the challenges in deriving quantifiable metrics essential for rigorous evaluation. Enhancing research with a combination of surveys and interviews could deepen data collection and elevate the quality of evaluations across all four levels, thereby providing more detailed insights into the effectiveness of corporate e-learning.

Conclusion and Recommendations

This study primarily investigated the effectiveness of e-learning within enterprises located in Taiwan. A literature review of 38 papers were sourced from the National Digital Library of Theses and Dissertations in Taiwan using the keywords like "corporate" and "e-learning." Each paper was classified based on several criteria including academic department of the graduate students, the publication year and quantity of theses, the research methodology, and the industry and job titles of the research subjects, as well as the effectiveness of the learning. The research findings evidenced that though most companies were able to reach the first level (reaction) of the four-level evaluation model, but very few could advance to the fourth level (results). It was found that assessments at

the first level were often conducted immediately post-training, requiring less time and cost. The second level (learning) necessitated pre-tests and post-tests to accurately gauge the effectiveness of e-learning, but most companies only conduct post-tests or do not evaluate this level at all. Furthermore, even fewer companies undertake assessments at the third level (behavior) and the fourth level (results) due to the need for long-term observation and data collection.

It was evident that if companies could allocate more resources and time to evaluate the effectiveness of e-learning, they could significantly enhance the benefits of their e-learning initiatives. In the studies analyzed in this review, scholars predominantly utilized survey methods, which were quantitative and facilitated quick and convenient statistical analysis. However, precisely quantifying the effectiveness at all levels is challenging, with initial calculations typically only reaching the first level (reaction). Hence, the study recommends that research should not only rely on quantitative methods, but also should also incorporate qualitative research techniques such as interviews and case studies, to delve deeper and present the data in a quantifiable manner. By cross-validating quantitative and qualitative methods, research can achieve greater completeness.

This study also focused exclusively on the evaluation of e-learning effectiveness within corporations in Taiwan, utilizing literature from the National Digital Library of Theses and Dissertations in Taiwan published up until 2023. The research was confined to theses and dissertations, excluding other forms of publications such as journals and magazines. It specifically targeted enterprises located within Taiwan, excluding those in other regions such as China or Indonesia, Taiwanese businesses, and addressed the challenge of accessing complete data due to corporate confidentiality and limitations in available literature. These constraints reflect the study's focus and resource limitations, suggesting that addressing these gaps in future research could significantly enrich the field of corporate e-learning effectiveness evaluation.

The study also delved into evaluating the effectiveness of e-learning in enterprises, often assessed using the SWOT model. Drawing from practical experience, several key insights emerged. Firstly, the maturity of e-learning system technology enables enterprises to employ a four-level evaluation approach, facilitating relatively straightforward assessment at first and second levels (reaction and learning, respectively). Data collection before and after courses aids in this process. Leveraging evaluation outcomes, enterprises can refine various aspects, including system functionality, course content, and hardware infrastructure, fostering overall development. However, challenges arise in quantifying benefits at the third (behavior) and fourth level (results), such as in measuring job performance and leadership skills post-learning. Additionally, the evaluation process may be impeded by external factors and implicit effects inherent in e-learning (Peng, 2004), demanding considerable time and resources. Nevertheless, applying the four-level evaluation framework presents an opportunity to gauge the impact of e-learning on workforce skills and knowledge acquisition, thereby enhancing workplace efficiency, quality, and personal development. Ultimately, this empowers employees to contribute effectively to enterprise objectives, bolstering its competitive edge.

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