Digital Training and Competency Development in Higher Education

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ABSTRACT

This study analyses the impact of investing in digital training on competency development within Algerian universities, focusing on digital infrastructure, training programs, and digital educational resources. It examines these dimensions for their role in enhancing the administrative staff's technical, professional, and personal competencies. The research addresses a clear gap in the existing literature, specifically regarding limited evidence on how digital training influences competency development among administrative staff in Algerian higher education institutions. Digital training has become increasingly significant given rapid technological advancements and growing demands for sustainable institutional performance. A descriptive-analytical methodology was employed, and a questionnaire was distributed to a random sample of 50 administrative employees. Although this limited sample size was selected due to logistical and resource constraints and may affect the generalisability of findings, it provides valuable preliminary insights into digital training effectiveness in the studied context. The findings revealed significant positive relationships between investments in digital training and competency development. Digital educational resources had the most decisive impact, significantly improving technical and personal competencies. They were followed closely by training and development programs, which enhanced technical and professional skills. Although positively related, the digital infrastructure showed limited influence. The study recommends that universities, policymakers, and HR departments collaboratively implement an integrated strategy by investing in reliable digital infrastructure, designing specialised digital training programs tailored to staff needs, and expanding digital educational resources through innovative platforms. This strategic integration effectively promotes competency development, enhances institutional performance, and supports sustainable development.

KEYWORDS: *digital training. competencies. digital infrastructure. digital training programs. digital educational resources.*

JEL CLASSIFICATION: *O15, I23, M53, O33.*

1. INTRODUCTION

In the accelerating digital revolution, digital technologies have become a cornerstone for developing all sectors, notably higher education. Universities worldwide face growing challenges in adapting to labour market changes, making digital training necessary to enhance competencies and achieve sustainable development (Prokopenko et al., 2024). Digital transformation has been shown to improve education quality by adopting modern technologies that create a flexible and innovative learning environment. These advancements

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help universities align with contemporary demands while boosting their international competitiveness (Mohamed Hashim et al., 2022; Rodríguez-Abitia & Bribiesca-Correa, 2021; Stoyanova & Stoyanov, 2024). Additionally, integrating digital technologies into educational processes enhances teaching efficiency and facilitates providing advanced educational services (Castro, 2019).

Digital training is especially significant in higher education, where it plays a pivotal role in equipping staff with academic and professional skills. Training programs focusing on digital tools have been shown to enhance efficiency in task management, effective communication, and other daily responsibilities (Castro, 2019). Furthermore, investing in robust digital infrastructures, such as high-speed internet networks and e-learning systems, creates a comprehensive educational environment that fosters increased productivity and competency among staff (Glaeser & Poterba, 2021; Grimes et al., 2012). The availability of digital educational resources, including e-books and interactive content, further supports self-directed learning and contributes to developing critical thinking and personal skills (Sima et al., 2020).

Beyond being a mere technological application, digital training represents a strategic approach to fostering competencies in contemporary work environments. It facilitates academic operations through innovative technologies while streamlining administrative processes and improving technical skills associated with advanced tools and software (Fenech et al., 2019). Furthermore, digital training supports the development of leadership and management capabilities, empowering staff to enhance their creativity and productivity (Bos-Nehles & Veenendaal, 2019). Studies have demonstrated a strong correlation between digital transformation and improved academic and professional performance. This underscores the necessity of such investments in university settings (Chen et al., 2016; Teng et al., 2022).

Although previous research has extensively studied digital training in corporate contexts, limited attention has been paid to its impact on competency development among administrative staff in higher education institutions, particularly within the Algerian context.

The research addresses a clear gap by examining how investment in digital training influences competency development among administrative staff at Djillali Liabes University in Algeria, highlighting its importance given rapid technological advancements and growing demands for sustainable institutional performance. Therefore, the research problem is formulated as follows:
"What is the impact of investment in digital training on competency development among administrative staff at Djillali Liabes University in Algeria?"

Building on these findings, the following hypothesis is proposed:
Investment in digital training positively contributes to developing competencies among administrative staff at Djillali Liabes University.

This main hypothesis is supported by several sub-hypotheses derived from existing literature:

- Investment in digital infrastructure is positively correlated with competency development among administrative staff.
- Digital training programs significantly enhance job performance and productivity of administrative staff.
- Integrating digital educational resources positively impacts the administrative staff's technical and personal competencies.

The study aims to analyse the impact of digital training in its various dimensions – such as infrastructure, training programs, and digital educational resources – on the development of competencies among university staff. Specifically, it seeks to provide a practical model that can be implemented in academic institutions to improve the work environment and increase staff productivity. Additionally, the study contributes to bridging the knowledge gap regarding the relationship between digital training and competency development in university work environments**.**

2. THEORETICAL FRAMEWORK OF THE STUDY

This section presents the fundamental concepts and theories that underlie the study and links them to the research objectives. The theoretical framework explores digital training and its dimensions, highlighting their significance in enhancing competencies and improving human resource development within university institutions. By examining the role of digital training, this section provides a structured foundation for assessing its contribution to improving the performance and professional efficiency of administrative staff in Algerian universities.

Digital training uses modern technologies to design and implement training programs that enhance employees' professional and personal competencies. It offers high flexibility, allowing learners to access educational materials anytime and anywhere while fostering interactive learning environments that encourage collaboration and engagement (Lampropoulos et al., 2022; Chetry, 2024). Additionally, integrating artificial intelligence (AI) and augmented reality (AR) into digital training platforms has significantly increased learning effectiveness. Research highlights that immersive environments powered by these technologies enhance knowledge retention, accelerate skill acquisition, and create deeper engagement than traditional learning methods (Koumpouros, 2024; Sani et al., 2024).

In the university context, AI-driven adaptive learning systems have facilitated the implementation of personalised training programs, dynamically adjusting content delivery based on learners' progress. This adaptability has led to improved learning outcomes and greater satisfaction among university staff (Chetry, 2024; Sani et al., 2024). Universities that integrate AI- and AR-enhanced training programs gain a competitive edge, equipping their administrative personnel with essential competencies to navigate rapid technological changes and evolving administrative demands (Lampropoulos et al., 2022; Koumpouros, 2024).

Furthermore, digital training is crucial in institutional efficiency, improving operational processes through better coordination, streamlined decision-making, and enhanced workplace adaptability (Westerman et al., 2014). Institutions that invest in advanced digital infrastructure, e-learning systems, and data-driven educational resources foster innovation and ensure sustainable performance and long-term institutional growth (Redecker & Punie, 2017).

2.1. Definition of Competencies

Competencies are integrated skills, knowledge, and abilities that enable individuals to perform tasks efficiently and adapt to evolving work environments. They are multidimensional and cover technical, professional, and personal aspects essential for achieving institutional excellence and innovation (Agostino & Costantini, 2022; Bampasidou et al., 2024).

The growing digital transformation in higher education institutions has necessitated new competencies for administrative staff, particularly in managing digital systems, analysing data, and adapting to rapidly evolving technologies (Eynon & Young, 2021). However, existing

literature primarily focuses on students and faculty members, with limited research addressing the specific competency needs of university administrative employees (Koumpouros, 2024). This study addresses this gap by analysing how digital training contributes to competency development among university administrative personnel.

Competencies can be categorised into two primary types (Weinert, 2001):

- Core competencies: These include fundamental skills applicable across all fields, such as critical thinking, continuous learning, and problem-solving.
- Specific competencies: These refer to specialised abilities required for specific job functions, such as digital literacy, data management, and administrative decision-making in a university setting.

2.2. Dimensions of Competencies

- **Technical competencies:** Technical competencies refer to the ability to utilise digital tools, software, and data management systems effectively (Redecker & Punie, 2017). With the increasing adoption of AI-driven administrative platforms and cloud-based university management systems, administrative staff must develop skills in handling digital documentation, using enterprise resource planning (ERP) systems, and maintaining data security (Sani et al., 2024). Institutions that invest in digital training programs enhance their employees' ability to work seamlessly in complex digital ecosystems, improving institutional efficiency and workflow automation (Lampropoulos et al., 2022).
- **Professional competencies:** Professional competencies encompass decision-making, productivity, and problem-solving skills in administrative roles. Studies highlight that universities implementing structured digital training programs report increased staff efficiency, particularly in document management, online communication, and e-governance (Chetry, 2024). Research suggests that continuous professional development through digital training helps university administrators stay updated with policy changes, regulatory frameworks, and digital compliance requirements (Koumpouros, 2024).
- **Personal competencies:** Personal competencies involve communication, adaptability, and collaboration, which are crucial in team-based administrative settings (Kim & Bonk, 2006). Digital training platforms, particularly AI-enhanced interactive simulations, have been found to improve employees' interpersonal skills and adaptability to digital workflows (Tran & Nguyen, 2020). Given the increased reliance on remote work and virtual coordination in university administration, effectively navigating digital collaboration tools and virtual meeting platforms has become a critical skill for administrative personnel (Eynon & Young, 2021).

Developing well-rounded competencies among employees is crucial for ensuring institutional efficiency, adaptability, and competitiveness. Technical competencies allow staff to efficiently utilise digital systems and automation tools efficiently, reducing operational errors and increasing productivity (Redecker & Punie, 2017). Professional competencies, such as problem-solving and decision-making skills, are essential for effective institutional management and strategic planning (Agostino & Costantini, 2022). Personal competencies, including communication and collaboration skills, also improve teamwork and ensure smooth coordination between different departments within the institution (Koumpouros, 2024).

As complex institutions, universities rely on well-trained administrative personnel to facilitate academic and operational processes. A lack of digital competencies among staff can slow down digital transformation efforts, increase administrative inefficiencies, and limit the institution’s

ability to adapt to technological advancements (Sani et al., 2024). Therefore, investing in comprehensive training programs that improve technical, professional, and personal competencies is a strategic priority for institutions aiming to improve their performance, service delivery, and long-term sustainability (Chetry, 2024).

2.3. Definition and Dimensions of Digital Training

Digital training refers to the structured use of modern technologies in designing and implementing training programs to develop employees' skills and competencies. It encompasses various learning methodologies, including online learning platforms, virtual simulations, and AI-driven adaptive learning systems (Chetry, 2024; Koumpouros, 2024). The significance of digital training has grown substantially due to its flexibility, accessibility, and ability to deliver customised learning experiences, which improve professional and technical competencies in dynamic work environments (Sani et al., 2024).

- Digital Infrastructure: The digital infrastructure is the backbone of any digital training initiative, encompassing high-speed Internet access, advanced computing systems, and digital learning management platforms (Vishnu et al., 2024). A well-developed infrastructure ensures equitable access to educational resources, enhancing employees' technical competencies, and supporting seamless integration of digital tools in professional settings (Aldosemani, 2023; Teng et al., 2022). Institutions investing in advanced infrastructure enable employees to effectively engage with complex software systems, improving productivity and organisational efficiency (Grimes et al., 2012).
- Digital Training and Development Programs: Structured digital training programs are fundamental to workforce development, equipping employees with specialised skills to navigate digital work environments effectively (Taruchain-Pozo & Avilés-Castillo, 2023). These programs contribute to professional competency development, including problem-solving, adaptability, and decision-making (Yimam, 2022). Universities and organisations implementing AI-driven adaptive learning programs report higher learning retention and improved engagement, fostering career growth and institutional competitiveness (Chetry, 2024; Sani et al., 2024).
- Digital Educational Resources: Digital educational resources, including e-books, virtual training modules, and AI-powered learning tools, facilitate self-directed learning and improve critical thinking skills (Lau et al., 2018). These resources bridge the gap between theoretical knowledge and practical application, allowing employees to develop technical and interpersonal skills in real-time scenarios (Schumann et al., 2019). Research highlights that organisations leveraging digital learning tools experience increased knowledge transfer efficiency, boosting individual and institutional performance (Klochan et al., 2021).

2.4. The Importance of Digital Training Dimensions in Enhancing Competencies

Digital training plays a strategic role in competency development by integrating technical, professional, and personal skills essential for workplace success (Redecker & Punie, 2017). Institutions that systematically invest in digital training infrastructure and continuous skill development report enhanced organisational performance, increased workforce adaptability, and greater institutional resilience (Mishra & Koehler, 2006).

Studies further indicate that the synergy between digital infrastructure, structured training programs, and digital learning resources fosters higher productivity, increased innovation, and competitive advantages in digital-driven workplaces (Westerman et al., 2014).

The impact of digital training is particularly evident in universities that adopt AI-powered educational models, as these enhance employees' ability to manage administrative tasks, collaborate effectively, and develop leadership skills in a digital-first environment (Eynon & Young, 2021; Chetry, 2024).

2.5. Research Gap: The Need for Digital Training among University Administrative Staff

Higher education institutions worldwide are undergoing rapid digital transformation, integrating advanced technologies to enhance learning experiences, streamline administrative operations, and optimise institutional performance. While extensive research has been conducted on the impact of digital training on improving faculty members' teaching methods (Redecker & Punie, 2017) and enhancing students' academic performance (Kim & Bonk, 2006), limited attention has been given to the role of digital training in strengthening administrative competencies in universities (Koumpouros, 2024; Chetry, 2024).

Most existing studies emphasise the effectiveness of AI-driven online learning platforms in fostering student engagement and improving academic outcomes (Tran & Nguyen, 2020). Despite this, the digital upskilling of university administrative personnel remains unexplored, raising concerns about whether administrative staff can effectively adapt to the increasing use of digital systems in higher education institutions.

While digital training has been extensively examined in academic contexts, fewer studies have specifically explored the following:

- The impact of digital training on administrative efficiency and institutional productivity.
- Investing in digital skills enhances administrative staff decision-making, workflow automation, and service delivery.
- The specific digital competencies university administrators require to manage digital transformation processes effectively.

In Algeria, digital transformation efforts in higher education have primarily focused on enhancing student e-learning systems and integrating digital pedagogies for faculty members (Bahache, 2024). However, despite the increasing reliance on digital technologies in university management, the role of digital training in improving administrative efficiency remains underresearched.

Observations from Algerian universities indicate:

- Many institutions adopt digital learning management systems (LMS), but lack structured digital training programs for administrative personnel.
- University administrative staff face challenges transitioning to AI-driven decision-making processes and electronic documentation systems.
- The absence of a structured digital competency framework for university administrators limits their ability to support institutional digitalisation effectively.

This study aims to bridge this gap by analysing how investment in digital training enhances the competencies of administrative employees in Algerian universities. By assessing the effectiveness of structured digital training initiatives, the study seeks to provide empirical evidence on the role of digital upskilling in improving administrative efficiency, fostering adaptability to technological advancements, and strengthening institutional performance.

3. RESEARCH DESIGN AND METHODOLOGY

Selecting an appropriate research methodology is essential to achieving the study's objectives and ensuring the reliability of its findings. Given that this study aims to assess the impact of digital training on competency development among university administrative staff, the descriptive-analytical methodology was deemed the most suitable approach.

This methodology is widely used in social sciences and administrative studies as it enables a comprehensive description and an in-depth analysis of existing phenomena. In this study, the descriptive component provides an overview of the dimensions of digital training (digital infrastructure, training programs, and educational resources) and competencies (technical, professional, and personal). The analytical component, in turn, examines the relationships between these dimensions and evaluates the extent to which digital training contributes to competency development among university administrative staff.

This methodology systematically collects quantitative data through a structured questionnaire, allowing in-depth statistical analysis to derive precise conclusions about the study's subject. However, because of the sample size, the results remain limited in generalisability.

The following figure illustrates the study's conceptual framework, depicting the relationship between digital training and its dimensions (digital infrastructure, training and development programs, and digital educational resources) on the one hand, and competency development with its three dimensions (technical, professional, and personal) on the other. This model aims to clarify how investment in digital training enhances the competencies of university administrative staff.

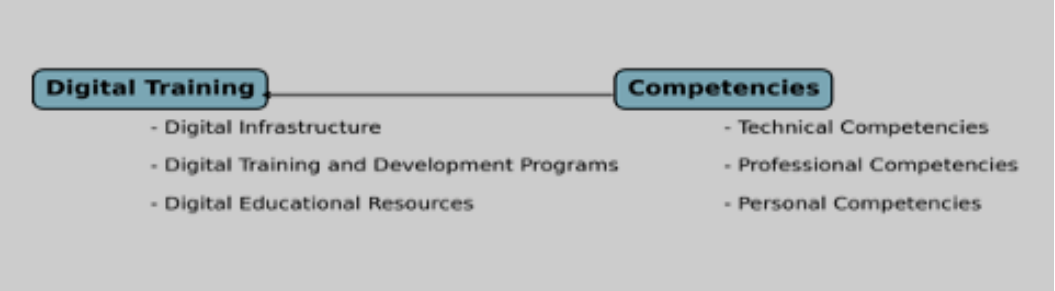

Figure 1. Study Model
Source: Prepared by the authors

This study was conducted on a sample of 50 administrative staff members from various faculties within Djillali Liabes University – the sample selection aimed to ensure a diverse representation of administrative roles while considering feasibility constraints.

3.1 Research Tool

A structured questionnaire was designed as the primary data collection tool to understand the relationship between digital training and the development of competencies among university administrative staff. The questionnaire was developed based on research instruments validated in prior studies. It consists of 30 items distributed across the study variables, in addition to four demographic questions aimed at gathering basic information about the participants. These items were developed based on standardised measurement scales widely used in previous research, as outlined in Table 1.

To ensure that the questionnaire aligns with the Algerian university environment, fundamental modifications were made to the wording of specific technical terms related to digital training. These adjustments aimed to enhance clarity for administrative staff, making the questions more straightforward to understand and respond to accurately. The revisions primarily involved restructuring technical terminology that may not have been familiar to the participants, ensuring that the phrasing reflects the actual digital tools used in Algerian universities.

For instance, in its original version, one of the questions was phrased as: "To what extent do you rely on institutional digital tools in your daily work?" However, the term "institutional digital tools" was too broad and could lead to varied interpretations among respondents. Therefore, the question was reformulated to be more precise and contextually relevant: "How often do you use digital platforms such as university e-management systems or electronic documentation tools?" This revision ensures a more explicit reference to the actual digital tools commonly used by university administrative staff.

Similarly, some questions containing specialised technical terms were refined to make them more comprehensible and relevant. For example, the original question, "To what extent do you rely on cloud computing technologies to perform your administrative tasks?" included the term "cloud computing," which might not be widely recognised by all participants. To improve clarity, it was reworded as: "Do you use cloud storage services such as Google Drive or OneDrive to save and share files in your work environment?" This revised version provides a more straightforward and more practical example, facilitating a more accurate response.

These modifications were not limited to linguistic clarity, but also involved restructuring some questions to make them more relevant to actual administrative practices in Algerian universities. With these refinements, the questionnaire became more precise and well-adapted, improving the quality of the collected data and minimising the possibility of misinterpretation or ambiguity. This enhanced the reliability of the study's findings and ensured that the gathered insights accurately reflected the role of digital training in developing administrative competencies.

Given the nature of this study, a five-point Likert scale was employed, with responses ranging from (1) Strongly Disagree to (5) Strongly Agree. This scale was selected because it captures subtle differences in participants' perspectives, allowing for a more detailed analysis of trends and relationships between variables. Likert scales are widely used in social sciences and organisational studies because they facilitate the quantitative assessment of subjective opinions, simplifying statistical analysis, and interpreting results.

Additionally, the Likert scale is particularly suitable for studies on digital competencies and training in workplace environments. According to methodological studies in social sciences, using a Likert scale in analysing data from university administrative staff enables the application of advanced statistical tests, such as regression analysis and variance analysis, thus improving the accuracy of results and reducing bias in interpretation (Redecker & Punie, 2017; Mishra & Koehler, 2006). Moreover, its extensive use in previous research on digital transformation in higher education makes it the optimal choice for assessing the impact of digital training on administrative competency development.

This study aims to collect reliable and analysable data by implementing precise modifications to the questionnaire design and selecting an appropriate evaluation scale. This approach facilitates a comprehensive understanding of the impact of digital training investments on the development of administrative competencies in Algerian universities. The methodological

rigour of this approach ensures that the questionnaire aligns with the local context, thereby enhancing the credibility of findings and contributing to the formulation of more practical recommendations for supporting digital transformation in higher education institutions.

Table 1. Study Variables and Dimensions with Referenced Sources for Questionnaire Design

Variable	Dimensions	Number of Items	Reference
Investment in Digital Training	Digital Infrastructure	05	(Bates,2000; Kim & Bonk, 2006; Agostino & Costantini, 2022)
	Training and Development	05	(Redecker & Punie, 2017; Zhao et al., 2021)
	Digital Educational Resources	05	(Mishra & Koehler, 2006; Moreira-Choez et al., 2024)
Development of Competencies	Technical Skills	05	(Ferrari & Punie, 2013; Rodafinos et al., 2024)
	Professional Competencies	05	(Redecker & Punie,2017; Trilling & Fadel, 2009)
	Personal Competencies	05	(Ferrari & Punie, 2013; Trilling & Fadel, 2009)
Total Questionnaire		30	

Source: Prepared by the authors

3.2. Statistical Programs and Tools Used for Analysis:

To achieve the study objectives and answer the research question. The study utilised the Statistical Package for the Social Sciences (SPSS), version 26. Various statistical tools were used to analyse the data collected from the questionnaire. Including:

- **Descriptive Statistics**: Descriptive statistics (means, standard deviations, and percentages) were used to describe the data and analyse the responses from the sample. These statistics provided a comprehensive view of the distribution of the studied phenomenon within the sample.
- **Reliability Test (Cronbach's Alpha):** Cronbach's Alpha coefficient was used to assess the study tool's internal consistency and reliability.
- **Validity Test (Correlation Analysis):** Pearson correlation analysis was conducted to measure the degree of agreement between the items and the main dimensions of the study. This test ensured that the items were measuring the intended constructs.
- Correlation Matrix: A correlation matrix was used to examine the strength and direction of the relationships between the variables and the dimensions of digital training and competencies.
- **Regression Analysis:** Simple linear regression analysis was applied to examine the causal relationship between the independent variable (dimensions of digital training) and the dependent variable (development of competencies). Multiple linear regression was also used to assess the combined impact of all dimensions of digital training on competencies.

3.3. Testing the Research Tool:

The reliability of the tool was tested using the Cronbach's Alpha coefficient. The table 2 summarises the results.

Table 2. Reliability Test of the Research Tool for Various Dimensions (Cronbach's Alpha Coefficient)

Variable	Dimension	Cronbach's Alpha
Investment in Digital Training	Digital Infrastructure	0.828
	Training and Development	0.812
	Digital Educational Resources	0.787
Development of Competencies	Technical Skills	0.901
	Professional Competencies	0.910
	Personal Competencies	0.832
Total Questionnaire		0.957

Source: Prepared by the authors based on SPSS version 26 outputs.

Table 2 shows that Cronbach's Alpha value for the total questionnaire was 0.957**,** indicating high reliability. All dimensions had values exceeding 0.7, which is considered an acceptable threshold. This demonstrate**s** strong internal consistency across the items, making the study tool reliable.

Validity Measurement:

The tool's validity was assessed by measuring the internal consistency using Pearson's correlation coefficient. The table 3 shows the results.

Table 3. Internal Validity Test of the Research Tool for Various Dimensions (Correlation Coefficients)

Dimension	Item 01	Item 02	Item 03	Item 04	Item 05
Digital Infrastructure	0.703**	0.848**	0.859**	0.789**	0.648**
Training and Development	0.760**	0.789**	0.820**	0.761**	0.713**
Digital Educational Resources	0.828**	0.692**	0.751**	0.711**	0.698**
Technical Skills	0.901**	0.948**	0.898**	0.890**	0.572**
Professional Competencies	0.871**	0.850**	0.848**	0.884**	0.833**
Personal Competencies	0.702**	0.904**	0.787**	0.840**	0.676**

Note: Values with ** indicate statistical significanceat the 0.01 level.

Source: Prepared by the authors based on SPSS version 26 outputs

The Pearson correlation analysis confirmed the tool's validity, which showed that the items within each dimension were strongly correlated with the overall dimension (values ranged from 0.572 to 0.948). These results demonstrate strong internal consistency and ensure that the research tool accurately measures the intended constructs.

3.4. Analysis of Sample Responses

To understand the sample's reactions toward the study dimensions – represented by the aspects of investment in digital training and competency development dimensions – means and standard deviations were calculated for employee responses to each item based on the 5-point Likert scale. The table 4 summarises the obtained results; the following findings can be derived:

Digital Infrastructure: The mean score for this dimension was 2.544. indicating dissatisfaction with the quality of the current digital infrastructure. The standard deviation of 0.823 reflects moderate variability in responses. Suggesting varying opinions among employees regarding the adequacy of the available digital resources.

Training and Development: The mean score of 2.632 reflects a neutral stance toward the effectiveness of the provided training programs. At the same time, employees did not strongly

reject these programs. The neutral response indicates room for improvement. The standard deviation of 0.774 shows relatively stable opinions with moderate variability.

Digital Educational Resources: This dimension scored a mean of 2.936, showing a neutral tendency toward positivity regarding the availability of digital educational resources. The standard deviation of 0.727 suggests stable opinions, with room for enhancing these resources to meet employee needs.

Technical Skills: With a mean of 2.848. This dimension reflects a neutral but slightly positive perception of employees' technical skill development. The standard deviation of 0.872 indicates moderate variability. Highlighting differing levels of technical skill development among employees.

Professional Competencies: The mean score of 3.136 indicates a neutral, yet positive tendency toward developing employee professional competencies – a standard deviation of 0.872 shows moderate dispersion in responses, reflecting some variability in perceptions.

Personal Competencies: This dimension achieved the highest mean of 3.232. indicating a positive tendency toward developing personal competencies such as critical thinking and effective communication. The standard deviation 0.731 suggests limited variability and relative stability in employee responses.

Table 4. Means and Standard Deviations of Employee Responses

Variable	Dimensions	Standard Deviation	Mean	Approval Degree
Investment in Digital Training	Digital Infrastructure	0.823	2.544	Disagree
	Training and Development	0.774	2.632	Neutral
	Digital Educational Resources	0.727	2.936	Neutral
Competency Development	Technical Skills	0.872	2.848	Neutral
	Professional Competencies	0.872	3.136	Neutral
	Personal Competencies	0.731	3.232	Neutral

Source: Prepared by the authors based on SPSS Version 26 Outputs.

Key Insights:

- Employees showed neutral perceptions across most dimensions, with an apparent positive inclination toward personal competencies, which scored the highest mean.
- Conversely. Dissatisfaction with the digital infrastructure. Which scored the lowest mean. Highlights an urgent need for improvement in this area.
- Most standard deviations ranged from low to moderate. Indicating relative consistency in employee responses across the sample.

Correlation Analysis

Pearson's correlation coefficient was used to examine the relationships between the independent variables and the dependent variable (see Table 5). The strength and direction of these relationships were assessed while checking for multicollinearity among the independent variables to ensure the robustness of the analytical model.

Table 5. Correlation Matrix between Variables and Dimensions

	Digital Infrastructure	Training and Development	Digital Educational Resources	Investment in Digital Training	Technical Skills	Professional Competencies	Personal Competencies	Competency Development
Digital Infrastructure	1	0.666**	0.542**	0.856**	0.629**	0.541**	0.581**	0.620**
Training and Development		1	0.712**	0.908**	0.846**	0.714**	0.676**	0.796**
Digital Educational Resources			1	0.851**	0.785**	0.779**	0.655**	0.791**
Investment in Digital Training				1	0.860**	0.772**	0.729**	0.840**
Technical Skills					1	0.869**	0.737**	0.931**
Professional Competencies						1	0.869**	0.973**
Personal Competencies							1	0.915**
Competency Development								1

Note: **Values marked with ** indicate significance at the 0.01 level.

Source: Prepared by the authors based on SPSS Version 26 Outputs

Insights from Correlation Analysis:

- Positive relationships were observed between all dimensions of investment in digital training (digital infrastructure, training and development, and digital educational resources) and competency development.
- The relationship between digital infrastructure and competency development was moderate (0.620), with a stronger impact on technical skills (0.629). This indicates the role of infrastructure in enabling the use of digital tools.
- Training and development had the strongest impact (0.796), particularly in technical competencies (0.846). This emphasises the importance of equipping employees to use technology efficiently.
- Digital educational resources also strongly correlate with competency development (0.791). Especially professional competencies (0.779).
- Overall, investment in digital training exhibited a strong positive relationship with competency development (0.840), highlighting the need for an integrated strategy encompassing digital infrastructure, training, and resources to improve technical, Professional, and personal competencies, thereby enhancing employee efficiency and institutional performance.

3..5 Research Limitations

Like any scientific study, this research has certain limitations that must be considered when analysing and interpreting the findings. These limitations stem from constraints related to sample size, the scope of the study, and the generalisability of results. However, they do not diminish the study's significance but rather provide a clear framework for understanding the applicability of its findings and guiding future research.

- **Sample Size and Generalisability**: The study sample consisted of 50 administrative staff members from various faculties within Djillali Liabes University, ensuring diversity among participants and reducing potential bias in the findings. However, the limited number of participants imposes some constraints on the generalisability of the results to all administrative staff in Algerian universities. Nonetheless, given that previous research on digital training has primarily focused on faculty members and students, this sample provides valuable exploratory insights into the research gap concerning administrative employees. It helps shed light on the impact of digital training on administrative competencies in higher education.
- **Accessibility and Diversity of the Sample**: Participants were selected based on their availability and willingness to participate. The study encountered some challenges in accessing administrative staff due to their demanding work schedules and the varying levels of readiness among university institutions to adopt digital training. Nevertheless, institutional diversity was ensured by involving staff from multiple faculties within Djillali Liabes University, allowing for the representation of diverse administrative environments within the institution. This enhances the credibility of the findings.
- **Methodological Constraints and Their Impact on Analysis**: Due to the limited sample size, the results derived from statistical analyses cannot be considered universally generalisable. Instead, they provide analytical insights based on the collected data. To address this, advanced statistical techniques, such as correlation and regression analyses, were employed to enhance the accuracy of the results. Additionally, the reliability of the research tool was verified using Cronbach's Alpha test, which yielded high values, indicating a strong internal consistency among variables.
- **The Need for Future Studies**: This study provides an initial understanding of the role of digital training in developing administrative competencies among staff at Djillali Liabes University. However, future studies should include more extensive and diverse samples and possibly adopt mixed research methodologies (quantitative and qualitative) to understand better how investment in digital training impacts administrative competencies in the long term. Expanding the research scope to include comparisons between different universities would also be beneficial in identifying training gaps and specific needs in a more detailed manner.

Despite these limitations, this study makes a valuable scientific contribution by highlighting the research gap on digital training for administrative staff at Djillali Liabes University. It also lays the groundwork for more extensive future studies that can help improve digital training strategies and enhance human resource efficiency in Algerian higher education institutions.

4. HYPOTHESES TESTING

4.1. Testing the Main Hypothesis

To test the main hypothesis, multiple linear regression analysis was applied to examine the effect of digital training investment dimensions (digital infrastructure, training and development, and digital educational resources) on competency development. The results obtained using SPSS are summarised below, in table 6:

Table 6. ANOVA Table

Source of Variance	Sum of Squares	Degrees of Freedom (df)	Mean Squares	*Fisher-statistic (F)**	Significance Level (Sig)
Regression	21.941	3	7.314	44.241	0.000
Residual	7.604	46	0.165		
Total	29.545	49			

Source: Prepared by the authors using SPSS Version 26.

The ANOVA analysis results demonstrate strong statistical significance for the regression model with a probability value of **Sig = 0.000**, which is less than the threshold of 0.05. This indicates a statistically significant relationship between the independent variables (digital infrastructure, training and development, and digital educational resources) and the dependent variable (competency development).

The *F-statistic value (F = 44.241)* * confirms that the model can explain the variations in competency development.

The total variance is 29.545. The model explains 21.941, leaving 7.604 as unexplained variance, reflecting other external factors outside the model.

Table 7. Regression Model Results

Model	Unstandardized Coefficients (B)	Standard Error	Standardized Coefficients (Beta)	*T-statistic (T)**	Significance Level (Sig)	Tolerance	VIF
Constant	0.347	0.250	//	1.388	0.172	//	//
Digital Infrastructure	0.101	0.095	0.107	1.063	0.294	0.547	1.829
Training and Development	0.412	0.121	0.411	3.396	0.001	0.382	2.615
Digital Educational Resources	0.471	0.115	0.441	4.106	0.000	0.485	2.061

Source: Prepared by the authors using SPSS Version 26.

The results confirm the absence of multicollinearity between the independent variables as variance inflation factor (VIF) values are below five and tolerance values are above 0.2. This ensures the reliability of the results and the independence of the variables.
The multiple regression equation can be represented as follows, based on the coefficients presented in table 7:

$$Y=0.347+0.101X_1+0.412X_2+0.471X_3 \quad (1)$$

Where:

- Y = Competency Development
- X_1. X_2. X_3 = Digital Infrastructure. Training and Development. And Digital Educational Resources. Respectively.

Key Findings:

The regression model exhibited strong statistical significance overall (Sig = 0.000. *F = 44.241**), indicating that the independent variables (digital infrastructure, training and development, and digital educational resources) significantly explain the variance in competency development.

- Digital Educational Resources had the highest impact (B = 0.471, Sig = 0.000), followed by training and development (B = 0.412, Sig = 0.001). This highlights their critical role in enhancing competencies.

- The effect of Digital Infrastructure was weak and statistically insignificant (B = 0.101. Sig = 0.294). While essential. Digital infrastructure alone may not substantially enhance competencies unless accompanied by effective training programs and digital resources.

4.2. Testing the Sub-Hypotheses

Sub-Hypothesis 1: Digital infrastructure investment and competency development have a significant positive relationship.

The correlation matrix analysis revealed medium-strength positive relationships between digital infrastructure and competency dimensions (see table 8).

Table 8. Correlation between Digital Infrastructure and Competency Dimensions

Competency Dimensions	Correlation Coefficient
Technical Skills	0.629**
Professional Competencies	0.541**
Personal Competencies	0.581**

Source: Prepared by the authors using SPSS Version 26.

Insights:

The strongest relationship was observed with technical skills (**0.629**). Emphasising the importance of reliable internet networks and advanced technological devices for improving employees' ability to use digital tools efficiently.

Moderate relationships with professional (**0.541**) and personal competencies (**0.581**) suggest that digital infrastructure supports productivity, creativity, and problem-solving by fostering a supportive environment.

These findings align with those of Redecker and Punie (2017), which highlight that digital infrastructure investment forms the foundation for competency enhancement.

Sub-Hypothesis 2: There is a significant positive impact of digital training and development on job performance.

The analysis confirms strong positive correlations between digital training and job performance dimensions (technical skills and professional competencies) (see table 9).

Table 9. Correlation between Training and Development and Job Performance Dimensions

Job Performance Dimensions	Correlation Coefficient
Technical Skills	0.846**
Professional Competencies	0.714**

Source: Prepared by the authors using SPSS Version 26

The regression analysis revealed a statistically significant positive impact of digital training and development on job performance (Sig = 0.000. B = 0.878). Confirming its role as a vital tool for competency improvement.

Sub-Hypothesis 3: Digital educational resources significantly positively impact technical and personal competencies.

Table 10. Correlation between Digital Educational Resources and Competency Dimensions

Competency Dimensions	Correlation Coefficient
Technical Skills	0.785**
Personal Competencies	0.655**

Source: Prepared by the authors using SPSS Version 26.

According to table 10, the impact on technical skills (**B = 0.943**. **Sig = 0.000**) was stronger than personal competencies (**B = 0.659**. **Sig = 0.000**).

These findings align with Agostino and Costantini (2022), emphasising the role of digital educational resources in enhancing technical and personal competencies, with a stronger focus on the technical dimension.

To evaluate the influence of digital educational resources on technical and personal competencies, we utilised simple linear regression by estimating two models. Before estimating the parameters for both models, an ANOVA table (Table 11) was constructed to validate the models.

Table 11. ANOVA Table for Testing Sub-Hypothesis 3

MODEL	Significance Level (Sig)	*F-statistic (F)**	Mean Squares	Degrees of Freedom (df)	Sum of Squares	Source of Variance
Digital Educational Resources and Technical Competencies	0.000	77.042	22.997	1	22.997	Regression
			0.298	48	14.328	Residual
				49	37.325	Total
Digital Educational Resources and Personal Competencies	0.000	36.154	11.251	1	11.251	Regression
			0.311	48	14.938	Residual
				49	26.189	Total

Source: Prepared by the authors based on SPSS Version 26 outputs.

Insights from ANOVA Results:

First Model (Digital Educational Resources and Technical Competencies): The model is statistically significant (**Sig = 0.000**), with an F-statistic = 77.042, reflecting its robustness. Digital educational resources explained a large portion of the variance in technical competencies (22.997), with relatively low unexplained variance (14.328). This highlights the strong positive influence of digital educational resources on technical competencies.

Second Model (Digital Educational Resources and Personal Competencies):

This model is also statistically significant (**Sig = 0.000**), with an F-statistic = 36.154. Digital educational resources explained a significant portion of the variance in personal competencies (11.251). The unexplained variance (14.938) was relatively higher than in the first model. This indicates a weaker impact on personal competencies than on technical competencies.

Digital educational resources play a critical role in enhancing both technical and personal competencies. However, their impact is stronger on technical competencies. This underscores

the importance of digital resources as a tool for boosting technical capabilities while achieving notable improvements in personal competencies.

The first model illustrates the effect of digital educational resources on technical competencies (Table 12), while the second model represents their impact on personal competencies (Table 13).

Table 12. Regression Results for Model 1 - Digital Educational Resources and Technical Competencies

Model	Significance Level (Sig)	*T-statistic (T)**	Standardized Coefficients (Beta)	Standard Error	Unstandardized Coefficients (B)
Constant	0.806	0.247	//	0.325	0.080
Digital Educational Resources	0.000	8.777	0.785	0.107	0.943

Source: Prepared by the authors based on SPSS Version 26 outputs.

Insights from Model 1:
The regression analysis confirms the' strong and positive effect of digital educational resources on technical competencies (Sig = 0.000).

The regression coefficient (B = 0.943) indicates that every unit increase in digital educational resources results in a 0.943-unit increase in technical competencies.

The standardised coefficient (Beta = 0.785) reflects the relative strength of the effect. Highlighting the critical role of digital educational resources in improving technical skills.
The constant (B = 0.080) represents the expected level of technical competencies without digital educational resources. Pointing to the influence of other contributing factors.

These findings affirm the effectiveness of investing in digital educational resources to improve technical competencies, making them a vital tool for enhancing technical skills in the workplace.

Table 13. Regression Results for Model 2 - Digital Educational Resources and Personal Competencies

Model	Significance Level (Sig)	*t-statistic (T)**	Standardized Coefficients (Beta)	Standard Error	Unstandardized Coefficients (B)
Constant	0.000	3.909	//	0.332	1.296
Digital Educational Resources	0.000	6.013	0.655	0.110	0.659

Source: Prepared by the authors based on SPSS Version 26 outputs.

Insights from Model 2:
The regression analysis indicates that digital educational resources have a positive and statistically significant effect on personal competencies (**Sig = 0.000**).

The regression coefficient (**B = 0.659**) suggests that each unit increase in digital educational resources results in a 0.659-unit increase in personal competencies.

The standardised coefficient (**Beta = 0.655**) highlights the importance of digital resources in developing personal skills, such as critical thinking and communication.

The constant (**B = 1.296**) indicates the expected level of personal competencies without digital educational resources. Suggesting the contribution of other factors to personal skill development.

The results confirm that digital educational resources positively and significantly affect both technical and personal competencies.

The effect on technical competencies (**B = 0.943**) was stronger than personal competencies (**B = 0.659**), underscoring their primary role in enhancing technical capabilities.

These findings align with those of Agostino and Costantini (2022), who emphasised the critical role of digital educational resources in improving skills in technical and personal dimensions.

5. RESULTS AND DISCUSSION

The theoretical framework underscores that digital training is a comprehensive strategy aimed at enhancing technical skills, as well as professional and personal competencies. This includes investment in digital infrastructure and the implementation of targeted training and development programs. Moreover, digital educational resources form the core of this strategy. These elements work synergistically to enable individuals and institutions to adapt to technological changes, enhancing productivity and efficiency in digital work environments. Studies such as Agostino and Costantini (2022), Mishra and Koehler (2006), and Redecker and Punie (2017) emphasise the significance of these dimensions in fostering institutional competitiveness and innovation.

Digital training not only improves technical skills related to digital tools, but also fosters critical thinking and effective communication. This dual focus enhances organisational performance and operational flexibility. Establishing digital training as a cornerstone for achieving sustainable development in both academic and professional contexts.

The empirical findings affirm the vital role of digital training investment in developing competencies across its dimensions. By exploring the impact of the three primary elements of digital infrastructure - Training and development, Digital educational resources on technical topics, Professional and personal competencies - the results reveal several key insights:

Digital Infrastructure Investment: While digital infrastructure positively influences competency development, especially technical skills. Its impact is limited. The relatively weak effect of the digital infrastructure on competency development (as indicated by the lower regression coefficient in Table 8) suggests that simply providing access to digital tools is

insufficient to drive meaningful skill improvement. Employees require structured guidance and hands-on experience to fully leverage technological resources (Westerman et al., 2014). The findings suggest that infrastructure alone cannot substantially enhance competencies without being complemented by effective training programs and accessible educational resources. This is consistent with Zhao et al. (2021), who highlight that digital transformation efforts must go beyond infrastructure investment to include continuous learning opportunities and user engagement strategies. Redecker and Punie (2017) highlighted that infrastructure is essential for improving access to digital resources and facilitating both academic and administrative processes.

Training and Development Programs: Digital training emerged as the most significant contributor to improving technical and professional competencies. The results indicate that investment in training programs effectively empowers employees to use technology efficiently. Resulting in enhanced job performance. This finding aligns with studies by Mishra and Koehler (2006) and Redecker and Punie (2017), who found that employees receiving structured digital training demonstrated significantly higher adaptability to new technologies and reported improved job satisfaction. Furthermore, recent research by Chetry (2024) highlights that organisations that invest in hands-on digital upskilling programs experience a 30% increase in employee efficiency compared to those that rely solely on infrastructure upgrades.
(Mishra & Koehler, 2006) confirmed the pivotal role of digital training in improving workforce performance and organisational outcomes.

Digital Educational Resources: These resources proved highly effective in developing technical skills and personal competencies. They play a crucial role in fostering critical thinking, interaction and communication skills. With a particularly strong impact on technical competencies. This finding is supported by Agostino and Costantini (2022), who argue that digital resources, such as e-learning platforms and AI-driven adaptive learning systems, provide learners with personalised learning experiences that enhance knowledge retention and application. Similarly, Tran and Nguyen (2020) emphasise that interactive digital platforms improve peer collaboration and encourage self-directed learning, leading to deeper engagement with training materials. Agostino and Costantini (2022) emphasised the centrality of digital educational resources in enriching technical skills and enhancing personal development.

The findings demonstrate that integrating investments in these three dimensions creates a robust framework for competency development. The data suggests that training and digital educational resources significantly amplify the impact of infrastructure investments. This is particularly evident in cases where infrastructure upgrades were paired with interactive training modules, leading to a substantial increase in competency scores (Sani et al., 2024).

The results reveal that training and resources amplify the value of infrastructure investments. While standalone infrastructure improvements may not yield significant competency gains.

The alignment of these results with previous studies reinforces the importance of a holistic approach to digital training. Mishra and Koehler (2006) emphasise that combining well-structured training programs and accessible digital resources leads to higher digital fluency among employees. Likewise, Eynon and Young (2021) assert that digital training facilitates smoother transitions to technology-integrated workflows, reducing resistance to digital change when implemented strategically. Redecker and Punie (2017) stressed the role of infrastructure as the foundation for competency development. Mishra and Koehler (2006) and Agostino and

Costantini (2022) highlighted the importance of training and educational resources in driving technical and personal growth.

Overall, the findings emphasise that investment in digital training must be approached as a multifaceted strategy that integrates infrastructure, continuous training, and high-quality digital resources. The strong impact of training and development programs suggests that digital upskilling initiatives should prioritise employee engagement and hands-on learning experiences rather than relying solely on technological availability. These insights provide valuable guidance for policymakers and university administrators seeking to enhance digital competencies among administrative staff, ensuring they are equipped to handle the demands of an increasingly digitalised work environment.

While this study provides valuable insights into the role of digital training in competency development, certain limitations should be acknowledged. The sample size, restricted to 50 administrative employees from faculties affiliated with Djillali Liabès University, may limit the generalisability of the findings. Additionally, the study focuses on self-reported data, which may introduce response bias. Future research should explore a broader sample across multiple institutions and incorporate qualitative approaches to provide a more comprehensive understanding of digital training's impact on administrative competencies.

6. CONCLUSIONS

This study provides empirical evidence that investing in digital training, including infrastructure, training programs, and educational resources, is a key driver for competency enhancement among university administrative staff. The findings indicate that a well-structured and integrated approach to digital training fosters a cohesive strategy for building human capital, particularly in university settings, thus contributing to institutional competitiveness and sustainable development.

Key Findings

The study highlights that among the three dimensions of digital training:

- Training and development programs strongly impacted competency enhancement, particularly technical and professional competencies. This suggests that mere access to the digital infrastructure is insufficient unless accompanied by well-designed hands-on training initiatives.
- Digital educational resources also played a crucial role in developing technical and personal competencies by providing interactive learning opportunities and fostering self-directed knowledge acquisition.
- While digital infrastructure is essential, its impact on competency development remains limited unless complemented by structured training programs and accessible learning resources.

Recommendations for Policy and Practice

To maximise the effectiveness of digital training in enhancing technical, professional, and personal competencies, the following recommendations are proposed, prioritising the most critical interventions:

- Prioritise structured digital training programs: Develop targeted training workshops that enhance technical and professional skills. These programs should be practical, interactive, and aligned with the specific needs of the university administrative staff.

- Strengthen the digital infrastructure: Invest in high-speed Internet networks, modern devices, and the development of robust technological infrastructure to support effective and seamless digital training initiatives.
- Expand access to digital educational resources: Increase institutional investment in e-learning platforms, digital libraries, and AI-driven educational tools to promote continuous learning and self-improvement.
- Adopt an integrated digital training strategy: Ensure the alignment of digital infrastructure, training programs, and educational resources within a cohesive institutional framework to optimise competency development outcomes.
- Enhance technical competencies through hands-on training: Provide immersive training sessions in emerging technologies, data management, and digital tools directly applicable to administrative workflows.
- Develop professional and personal skills through interactive methods: Encourage critical thinking, creativity, and effective communication by integrating gamified learning approaches, problem-solving exercises, and collaborative projects into training programs.
- Conduct regular evaluations and impact assessments: Periodically assess the effectiveness of digital training initiatives using data-driven performance indicators and employee feedback, ensuring continuous refinement and improvement.
- Foster a culture of digital learning and professional growth: Raise awareness about the strategic importance of digital competencies through institutional campaigns, workshops, and incentive-based learning programs.
- Build strategic partnerships for sustainable training initiatives: Collaborate with technology firms, educational institutions, and digital learning experts to support the continuous development of training programs with updated expertise and cutting-edge resources.

Future Research Directions

While this study provides valuable insights, further research is needed to deepen our understanding of digital training's long-term effects on competency development. Future studies should:

- Expand sample sizes and include comparative studies across multiple universities to improve generalizability.
- Explore the effectiveness of blended learning approaches that combine online and in-person administrative staff training.
- Investigate the role of AI and adaptive learning technologies in personalising training experiences for university employees.

Implementing these strategic recommendations and expanding research efforts can help institutions use digital training effectively to develop a highly competent, adaptive, and future-ready administrative workforce.

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