Assessing the impact of Artificial intelligence (AI) on digital training in the Egyptian banking sector

submitted by

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تقييم تأثير الذكاء الاصطناعي (AI) على التدريب الرقمي في القطاع المصرفي المصري

إعداد

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ABSTRACT

The rapid digital transformation in Egypt's banking sector is driven by the need for enhanced efficiency, innovation, adaptability, and customer service.

This shift also highlights the critical role of employee training in sustaining competitive advantage and ensuring effective operations. As artificial intelligence (AI) technologies become increasingly integrated into digital training environments, it is essential to evaluate their actual influence on learning outcomes and workforce development.

This study assess the impact of AI on digital training, including content design, implementation efficiency, evaluation processes, employee skill development and overall training effectiveness. For validating the proposed model and the developed research hypotheses, a cross sectional simple random sample (384 participants) was drawn from the Egyptian banking sector in Egypt. Results of the study revealed a strong, positive, and statistically significant relationship between AI and digital training aspects. Additionally, the combined effect of AI technologies accounts for 92.6 % of variation in digital training. Furthermore, the study asserts on the strategic importance of integrating AI in developing human capital, especially in rapidly evolving sectors like banking. Finally, the study provided a set of recommendations and action plan that can lead to effective and dynamic learning experience.

Keywords: Artificial intelligence (AI), Digital training, Digital training stages, Designing digital training content, Digital training implementation, Digital training evaluation, Digital training competencies and skills of trainers , Digital training effectiveness.

المستخلص:

يشهد القطاع المصرفي في مصر تحولًا رقميًا سريعًا، مدفوعًا بالحاجة إلى تعزيز الكفاءة، والابتكار، والقدرة على التكيف، وتحسين خدمة العملاء. كما يسلّط هذا التحول الضوء على الدور الحاسم لتدريب الموظفين في الحفاظ على الميزة التنافسية وضمان كفاءة العمليات التشغيلية. ومع تزايد

دمج تقنيات الذكاء الاصطناعي في بيئات التدريب الرقمي، أصبح من الضروري تقييم تأثيرها الفعلي على نتائج التعلم وتطوير القوى العاملة.

تهدف هذه الدراسة إلى تقييم تأثير الذكاء الاصطناعي على التدريب الرقمي، بما في ذلك تصميم المحتوى، وكفاءة التنفيذ، وعمليات التقييم، وتطوير مهارات الموظفين، وفعالية التدريب بشكل عام. ومن أجل التحقق من صحة النموذج المقترح وفرضيات البحث المطورة، تم اختيار عينة عشوائية بسيطة مستعرضة مكونة من ٣٨٤ مشاركًا من القطاع المصرفي المصري . وكشفت نتائج الدراسة عن وجود علاقة قوية، موجبة، وذات دلالة إحصائية بين تطبيقات الذكاء الاصطناعي ومكونات التدريب الرقمي. كما تبيّن أن الأثر المشترك لتقنيات الذكاء الاصطناعي يفسّر ما نسبته ٩٢,٦٪ من التباين في التدريب الرقمي.

وتؤكد الدراسة أيضاً على الأهمية الاستراتيجية لدمج الذكاء الاصطناعي في تطوير رأس المال البشري، لا سيّما في القطاعات سريعة التغير مثل القطاع المصرفي. وفي الختام، قدّمت الدراسة مجموعة من التوصيات وخطة عمل من شأنها تعزيز تجربة تعليمية فعّالة وديناميكية.

<u>الكلمات المفتاحية</u>: الذكاء الاصطناعي(AI) ، التدريب الرقمي، مراحل التدريب الرقمي، تصميم محتوى التدريب الرقمي، تنفيذ التدريب الرقمي، تقييم التدريب الرقمي، كفاءات ومهارات المدربين في التدريب الرقمي، فعالية التدريب الرقمي

Introduction

Nowadays most organizations are being faced by many revolutions in its operations including technological, communicational and informational changes. In order to be able to cope and adapt to these rapid changes, organizations are concerned with its human capital which is considered the source of its competitiveness . Therefore, continuous professional training and development for its human capital become crucial to ensure adaptability to the evolving technological advancements and for the success and the survival of any organization. However, depending on the traditional training and development methods became less likely to deliver its expected outcomes in today's dynamic learning environment.

Digital training and development is a relatively recent concept that has been used extensively after facing the dramatic improvement in technology. It can be considered

as new method for acquiring knowledge and skills through the use of some technological techniques through new creative method (Walker, 2024) .

The integration of artificial intelligence (AI) into digital training is reshaping education in extensive ways , offering unprecedented opportunities for personalized learning, scalability, and real time adaptability (Erbas & Maksuti, 2024; Smith, (2024). As organizations and institutions increasingly adopt AI driven tools such as intelligent tutoring systems, adaptive learning platforms as Coursera, and automated feedback mechanisms, the effectiveness and the accessibility of digital training have significantly improved (Baker, 2019; Shah et al., 2022). AI's ability to predict learner needs and adjust content with different learning styles to fit with the specified needs has transformed traditional training model , which is considered one size fits all model, into tailored model that focuses primarily on the learner capacity to enhance learning outcomes (Luckin et al., 2016; Heffernan& Heffernan, 2024; VanLehn,2011).

For example, AI driven tools such as chatbots provide 24/7 support, reducing the reliance on human instructors while maintaining learner engagement (Abdel Wahab, H., 2023; El-Shihy et al., 2023; Chen et al., 2020). Similarly, machine learning algorithms enable predictive analytics to detect risks that learners encounter and recommend interventions resulting in enhancing learners' retention rates (Popenici & Kerr, 2017; Rodrigues et al., 2019).

Therefore, the main focus of this research is to assess the impact of applying AI on digital training in one of the most important sectors in Egypt, namely banking sector.

2. Theoretical Foundation and hypotheses development

This section presents the literature review related to the theoretical frameworks of the variables being studied. It will be divided into the following three sections:

1. Artificial intelligence (AI) (the independent variable).

2. Digital training (the dependent variable).

3. The relationships between AI and digital training (Arguments discussions leads to hypothesis development).

2.1 Artificial Intelligence (AI) :

Artificial Intelligence (AI) has rapidly become a cornerstone of digital transformation across various sectors, including education, healthcare, manufacturing, and financial services. It enables machines to think, learn and act in ways that mimic human abilities but often faster and more adaptable (Claned, 2024; Erbas & Maksuti, 2024). As AI technologies continue to evolve, it becomes crucial to examine their main components and dimensions to understand their implications.

2.1.1 Main Components of Artificial Intelligence

AI consists of several interrelated technologies that enable systems to imitate cognitive functions. ***Machine Learning (ML)*** is one of the primary components, allowing systems to learn from data inputs and improve their performance without direct programming. It includes supervised, unsupervised, and reinforcement learning methods that support tasks ranging from classification to decision-making (Mihret, 2020).Another component is ***Natural Language Processing (NLP),*** which enables machines to interpret, generate, and interact through human language in an effective way . NLP powers tools such as virtual assistants and automated customer service platforms (**Chu et al., 2022**). Another component is ***Computer Vision***, it interprets and processes visual data, plays a critical role in applications like image recognition and real-time video analysis. ***Expert Systems*** use knowledge bases and logical rules to mimic human decision-making. These systems have been used in diagnostics and training simulations, and financial forecasting. Additionally, ***Robotics*** integrates physical automation with AI to perform tasks in dynamic environments, often guided by sensors and machine learning algorithms (Matsuzaka & Yashiro, 2023; Russell & Norvig, 2020)

2.1.2 Dimensions of Artificial Intelligence

According to **(Pandey et al., 2021, Halagatti et al., 2023)** Several critical dimensions are responsible for developing and implementing AI systems:

- Transparency and Explainability: This dimension refers to the clarity with which AI processes and outcomes can be understood by humans. It addresses the "black box" problem in AI, aiming to ensure that decision-making processes are interpretable and justifiable (Arrieta et al., 2020).

- Ethics and Fairness: This dimension involves safeguarding against bias, discrimination, and inequality in automated decisions. Fairness in algorithm design is vital, particularly in sensitive sectors like education, finance, and healthcare (Binns, 2018).

- Security and Privacy: As AI systems often rely on large datasets, a key priority is to ensure data protection and maintain user privacy. Compliance with regulations such as the GDPR (General Data Protection Regulation) is essential when handling personal information (Floridi & Taddeo, 2016).

- Scalability and Adaptability: Effective AI solutions must be scalable to handle increasing datasets and adaptable to diverse usable contexts. This ensures its ability to function for long term periods and relevance for the changeable organizational needs (Smith, 2024).

2.2 Digital training

Training and development can be considered one of the most important HRM functions. It is mainly related to developing the employees' abilities, talents and competencies. It is considered as a planned and continuous process. (Dessler, 2017).

In the context of ongoing digital transformation, digital training has emerged as a cornerstone of workforce development across various sectors. It refers to the use of digital tools and technologies to deliver learning and development content to employees, enabling flexible, scalable, and personalized training experiences (Pappas, 2015). It was viewed by (Walker, 2024) as a new method for having knowledge and skills through the use of technological techniques and implementing new creative methods .Unlike traditional training methods, digital training utilizes multimedia tools , virtual environments, and interactive modules delivered via computers or mobile devices to enhance learning outcomes and improve access across geographically dispersed teams (Gegenfurtner et al., 2019; Sitzmann et al., 2006; Heffernan& Heffernan, 2024).

2.2.1 Importance of digital training

Several scholars asserted that digital training importance lies in its ability to support continuous learning, customize diverse learning styles, and rapidly equip employees in response to changing organizational demands (Carvalhais & Azevedo, 2024; Halagatti et al., 2023; Olaruposiar, 2022; and Dooley, 2022). This method has demonstrated valuable opportunities in sectors that require frequent adaptation to technological changes, such as finance, healthcare, and education (Salas et al., 2012). Moreover, digital training can contribute to cost reduction, increased training efficiency, and improved learner engagement when it is adequately implemented (Gegenfurtner et al., 2020; Farouk, 2022).

2.2.2 Components of digital training process

Scholars have identified several core components of digital training process that determine its overall effectiveness.

2.2.2.1. Design digital training content:

Training content design is crucial. It refers to the structural creation of instructional content and materials that are accessible digitally. It focuses on aligning content with

learning objectives, learner's specific needs, and platform compatibility to facilitate meaningful engagement (Azevedo & Carvalhais, 2024) . A well-structured, relevant, and interactive content serves as the cornerstone for creating engaging and meaningful learning experiences (Clark & Mayer, 2016; Woolf, 2010).

2.2.2.2. Digital training delivery and implementation

It plays a role in shaping learner access and participation. According to Dooley (2022), it entails the execution of digital training programs, including scheduling the sessions, integrating the platforms, user onboarding, and coordination of technical and human resources to ensure smooth delivery .The integration of learning management systems (LMS) and mobile platforms facilitates accessibility (Al-Fraihat et al., 2020).

2.2.2.3 Digital training evaluation

Are essential to assess the effectiveness of training programs. As defined by Rossi et al. (2004) digital training evaluation is the planned and systematic process of examining how digital learning initiatives are designed, delivered, and experienced, with the goal of understanding their quality and identifying areas for improvement.

It focuses on measuring learner reactions, knowledge acquisition, behavioral changes, and organizational results during or immediately after training delivery (typically include pre- and post-training assessments), using digital tools such as analytics dashboards, LMS metrics, AI-driven assessments (Kirkpatrick & Kirkpatrick, 2006; Noe, 2020). *From the researcher perspective*, it can be viewed as a process oriented, its main goal is gathering data for improvement and accountability and focuses on short term outcomes

2.2.2.4 Digital training competencies and skills of trainers

Digital capabilities of trainers and learners significantly influence the success of digital training initiatives. It refers to the competencies required by trainers to design, deliver, and evaluate digital training. It includes technical skills, digital background, content

management, and the ability to engage learners in virtual environments (Gegenfurtner et al., 2020; OECD, 2016).Trainers must be equipped with the skills to utilize digital tools effectively along with the experience in core content (Gegenfurtner et al., 2020).

2.2.2.5 Effectiveness of digital training

Is increasingly recognized as a crucial indicator of success in modern learning environments. It reflects the extent to which digital training achieves its intended outcomes, such as skill development, learner satisfaction, and behavioral change in the workplace (Noe, 2020; Yusuf, S. O.,2023). As organizations increasingly adopt technology to enhance its learning models, evaluating how well digital training meets educational and performance goals becomes essential (Almuraqab, 2020). *From the researcher perspective*, it can be viewed as an outcome oriented, its main goal is measuring the success or failure of training and focuses on long term outcomes.

In summary, digital training represents a strategic investment for organizations seeking to foster innovation, improve workforce agility, and maintain competitiveness in the digital era. Understanding its core dimensions including design, implementation, evaluation, and digital readiness is essential for maximizing its potential impact.

2.3 The relationship between Artificial Intelligence (AI) and digital training

The integration of Artificial Intelligence (AI) technologies into digital training environments has become a metamorphic force in evolving learning practices in organizations. AI offers advanced tools that support the automation, personalization, and optimization of training processes (Al-Emran et al., 2023; Hashim et al., 2022). AI in digital training refer to the use of intelligent technologies such as machine learning, natural language processing (NLP) , and predictive analytics to automate, personalize, and enhance learning experiences and administrative functions in training systems. In this study, AI encompasses tools like chatbots, adaptive learning platforms, and data-driven feedback mechanisms applied to training environments (Holmes, W.,2019). Through adaptive learning systems, AI helps tailor educational content to individual

specific learner needs, thereby enhancing engagement and knowledge retention (Luckin et al., 2016; Rodrigues et al., 2019; Pandey et al., 2023).

One of the primary benefits of AI in digital training is its capacity to analyze huge amounts of data in real time, enabling the development of customized learning systems (Chen et al., 2020). This feature is critical in large scale training programs, where human instructors may struggle to provide personalized attention to each participant. AI-powered platforms also facilitate instant feedback, track progress, and detect performance gaps, ensuring a more targeted approach to employee development (Zawacki-Richter et al., 2019).

Moreover, AI application extend beyond content delivery. Tools such as chatbots, virtual teaching assistants, and recommendation systems foster ongoing support and encourage learner autonomy, which is essential in remote and hybrid training contexts (Popenici & Kerr, 2017). These systems contribute to continuous learning by making resources available whenever needed and encouraging independent learning behaviors.

Additionally, the adoption of AI in training programs aligns with the organizational goals for agility and innovation. In sectors like banking, where regulatory demands and customer expectations change rapidly, AI enabled training solutions provide a scalable and efficient way to upskill employees and maintain competitiveness (Yusuf et al., 2023, Gegenfurtner et al., 2020).

Despite its benefits, the implementation of AI in training environments also raises challenges such as ensuring data privacy, mitigating algorithmic bias, and preserving the human element in learning (Arrieta et al., 2020). Nevertheless, when applied carefully, AI can significantly improve the design, implementation, evaluation, trainees' abilities, skills and talents and overall effectiveness of digital training initiatives. Based on these researches and studies' findings, the researcher argue that :

H$_1$: AI have a positive and significant impact on digital training.

When examining the relationship between AI and digital training process , it can be asserted that the integration of artificial intelligence (AI) into digital training has transformed the traditional learning environment by offering more adaptive, efficient, and personalized training experiences (VanLehn,2011) . AI tools support the ***design phase*** by enabling data-driven content creation that aligns with learners' preferences and prior knowledge (Holmes et al., 2019). During the ***implementation phase,*** platforms empowered by AI can automate training delivery, manage learner progression, and enhance engagement through interactive elements such as chatbots and virtual assistants (Abdel Wahab, H., 2023; El-Shihy et al., 2023; Dooley, 2022; Zawacki-Richter et al., 2019). In the ***evaluation phase***, machine learning algorithms contribute to real time performance assessment, facilitating instant feedback and identifying gaps for improvement (Chen et al., 2020; Alwi, 2021; Baker, 2014). These advancements suggest that AI does not only facilitate the coordination of training processes but also improves its strategic value in organizational learning environments (Azevedo & Carvalhais, 2024; Muresan, 2023; Erbas et al., 2024; Claned, 2024 and Al-Emran et al., 2023). In light of the above mentioned discussion, the researcher proposed the following hypotheses :

H$_2$: AI have a positive and significant impact on digital training processes

Based on the previously developed hypothesis, the following three hypotheses are derived as follows:

H$_{2a}$: AI have a positive and significant impact on designing digital training content.

H$_{2b}$: AI have a positive and significant impact on digital training implementation.

H$_2$c: AI have a positive and significant impact on digital training evaluation

The success of digital training initiatives is strongly influenced by both the technical capabilities of the training system and the digital competencies of trainers. Trainers

equipped with skills in digital tools, online facilitation, and content formation and arrangement are better positioned to deliver impactful and interactive learning experiences (Gegenfurtner et al., 2020; OECD, 2016). Additionally, the ability to adapt to emerging technologies, provide timely feedback, and manage virtual systems are essential traits in modern training environments (Fraij et al., 2024).

Organizations that invest in the continuous development of trainers' digital skills tend to achieve higher learner satisfaction and improved training outcomes. Therefore, the effectiveness of digital training is not solely dependent on technological infrastructure, but also on the human capability to leverage it effectively (Claned, 2024; Sanusi et al., 2022; ,Pandey et al., 2023; Hashim et al., 2022; Halagatti et al., 2023; Sari & Lubis, 2021; Walker, 2024; Dooley, 2022; Alwi, 2021; Aljehani et al., 2021; Orlando et al., 2019). Given the prior literature and discussed arguments, the researcher asserts that:

H₃: AI have a positive and significant impact on digital training competencies and skills of trainers

As mentioned earlier, several studies have asserted that the application of artificial intelligence (AI) in digital training environments has emerged as a key driver in enhancing training effectiveness (Claned, 2024). Unlike traditional training , digital learning allows for instant feedback, personalized learning paths, and flexible access to content, all of which contribute to better engagement and retention (Chen et al., 2020 ; Rodrigues et al., 2019; Alwi, 2021).Furthermore, AI can reduce the time and resources needed for course development and delivery, thereby increasing the overall efficiency and impact of digital training programs (Holmes et al., 2019).

Moreover, digital platforms facilitate data collection that supports continuous improvement through analytics, allowing instructors and institutions to adapt content and delivery methods in response to learner needs (Martin et al., 2020; Sanusi et al., 2022). Additionally, It is also influenced by the alignment between training objectives

and the technologies used, as well as the digital readiness of both learners and instructors. It is found to be more effective compared to traditional training (face to face training) when it is well designed, implemented and integrated with interactive elements and learner centered approaches (Zhang et al., 2004; Dooley, 2022).These competencies suggest that AI technology significantly contribute to the perceived and actual effectiveness of digital learning processes.

Building upon the preceding discussion and existing studies, the researcher posited that:

H_4: **AI have a positive and significant impact on digital training effectiveness.**

3. Research problem:

The Egyptian banking sector is experiencing rapid digital transformation, driven by the increasing demand for efficiency, innovation, and improved customer service. In the light of this digitalization, employee training remains crucial in maintaining competitive advantage and operational effectiveness (Omar, A. M., 2023; Elsayed & Abdelaziz, 2023). However, traditional training methods fail to meet personalized, scalable, and adaptive learning needs of banking professionals (Popenici & Kerr, 2017; VanLehn,2011). With the emergence of artificial intelligence (AI) technologies, new opportunities have emerged to enhance digital training through incorporating intelligent systems capable of immediate feedback and adaptive learning methods (Zawacki-Richter et al., 2019).

Despite the growing interest that AI has received in revolutionizing education and professional development, there remains limited empirical research on its specific impact within Egypt's banking institutions (Hassanien, K. B. E.-D. A., 2024). Questions remain regarding how effectively AI applications such as chatbots are being utilized to improve learning outcomes, engagement, and training efficiency in this sector (Abdel Wahab, H., 2023; El-Shihy et al., 2023). Given the strategic importance of banking in Egypt's economic development as being one of its basic drivers, it becomes essential to

investigate the influence of AI technology in training systems on the employees' competence and institutional capacity building (Central Bank of Egypt, 2024; Egyptian Banking Institute, 2023).

Accordingly, this research seeks to fill this gap by assessing the role of AI in optimizing digital training strategies in Egyptian banking institutions.

4. R**esearch objectives:**

To acquire a deep understanding of the issue under investigation, this research

aims to:

- Identify AI technologies currently applied into digital training in Egyptian banks .
- Explore digital training and examine how they differ from traditional training in terms of structure and outcomes.

- Assess the impact of AI on digital training in general and its process in specific.

- Propose recommendations for enhancing digital training in banking using AI, based on findings from the Egyptian context.

5. Research importance:

By analyzing the impact of artificial intelligence on digital training, this research expected to possess valuable contributions on both theoretical and practical levels.

<u>**On the theoretical level,**</u> the research will :

- Focus on bridging a knowledge gap: as this research contributes in expanding the existing literature related to artificial intelligence and its impact on digital training (specifically applied in the Egyptian banking sector), which is considered a relatively new area which captures the attentions of most scholars nowadays for its promising outcomes.

- Interdisciplinary insights: As this research combines concepts from different areas including computer science, education, Human Resources management and

organizational behavior, offering a multidisciplinary perspectives that enriches the academic understanding and offers many opportunities for different fields.

On the practical level, the research will:

- By practically identifying how AI supports digital training, which is considered one of the most practices that enhance human capital. This study can help all benefited parties , where:

  - *From the trainers perspective*: It helps to adopt new tools that facilitate tailoring content to individuals different learning styles , improve their instructional design, implementation and feedback which in turn will support their organization's capabilities to achieve its goals effectively.

  - *From the employee perspective :* It can facilitate the process of learning resulting in increasing adaptability , performance and competitiveness in the working environment .

- Additionally, the research will provide practical recommendations and action plan that can help in adopting AI in different sectors , guiding policy and decision makers in their applicability and investments in training technologies.

6. Configuration of the theoretical research model:

In the light of the previously mentioned literature review and developed hypotheses, the researcher developed the following theoretical model that aims to illustrate the relationship between artificial intelligence (as independent variable) and digital training (as dependent variable) as indicated in figure (1).

Figure (1): The Suggested Research Model Source: Prepared by the researcher.
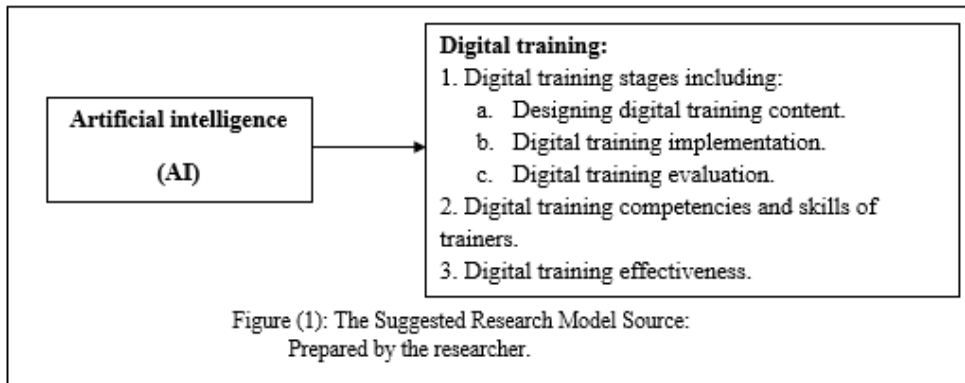
7. Empirical investigation

This section is dedicated to the analysis of the empirical investigation as well as testing the hypothesis.

7.1 Population and sampling

Banking sector is considered one of the most important sectors that acts as a catalyst for fostering economic development and Gross domestic product (GDP). According to the online database of central bank of Egypt , the total number of supervisors and middle managers employed were is approximately 12400 employees.

Based on this population which is over 10,000 , a cross sectional simple random sample (384 participants) was drawn from the Egyptian banking sector in Egypt at a 95% confidence level with a 5% margin of error (Sekaran & Bougie, 2016). Out of the total sample, 366 responses were received resulting in a response rate of 95 %. In this respect, survey participation was voluntarily and participants were ensured completed confidentiality and anonymity of the responses .

7.2 Measurement Instruments

All research variables were assessed using validated measurement tools that adopted a 5-point Likert scale, where the responses range from '1' indicating Strongly Disagree to '5' indicating Strongly Agree, allowing the study sample to express their level of

agreement with the questionnaire items .Finally, all research variables were examined through the use of validated measurement instruments as follows:

1. AI in Digital Training: The scale consists of 12 items . Sample statements include " AI-powered Chabot's resolved 90% of learner queries instantly", ""Personalized learning paths improved completion rates by 25%." . adapted from (Folcuț et al., 2024; Al-Emran et al., 2023; Pandey et al. , 2023).

2. Digital training: The dependent variable, digital training, with its three dimensions, comprising a total of 40 items distributed across the following dimensions:

2.1 Digital Training Stages: This part focuses on tracking learner progression through phases of digital competency. It consists of three main domains of total 18 items distributed as follows :

2.1.1 Designing Digital Training Content: It focuses on evaluating the course design standards. It includes 8 items. Sample statements include " Multimedia (videos, info graphics) align with learning outcomes", ""Interactive quizzes reinforce key concepts effectively". Adopted from (Quality matters, 2023).

2.1.2 Implementing digital training : It focuses on assessing organizational readiness and execution for AI technologies. It includes 8 items. Sample statements include "Technical support was available 24/7 during implementation", "The organization provided adequate technical infrastructure" adopted from (Venkatesh et al., 2003).

2.1.3 Evaluating digital training : It focuses on the process (e.g., user experience, immediate learning). It includes 8 items . Sample statements include "The multimedia elements like videos enhanced my understanding", "the platform provided actionable feedback on my progress". Adopted from (Wang et.al, 2007)

2.2 Digital competencies & Skills of Trainers: it focuses on assessing trainers' proficiency in designing and delivering digital content. it includes 8 items. Sample statements include "Trainers use interactive tools (e.g. simulations, polls) to enhance engagement". Adopted from (Redecker & Punie, 2017).

2.3 Digital training effectiveness of: It focuses on measuring effectiveness using Kirkpatrick's Four Levels namely reaction, learning, behavior and results. It focuses on learner's satisfaction, knowledge retention and behavioral changes. It includes 8 items . Sample statements include " I apply the skills learned in the training in my daily tasks", "there has been a noticeable improvement in productivity since the training". Adopted from (Kirkpatrick & Kirkpatrick, 2006).

7.3 Testing Reliability and Validity:

Assessing the measurement tool is crucial to determine its reliability and effectiveness. The results of these analyses are presented in Table 1.

Variables	Mean	SD	Reliability α	Validity
Artificial intelligence (AI)	3.998	0.655	0.905	0.949
Digital training stages	4.049	0.662	0.963	0.980
Designing digital training content	4.122	0.664	0.897	0.947
Digital training implementation	4.042	0.727	0.926	0.958
Digital training evaluation	3.983	0.691	0.891	0.940
Digital training competencies and skills of trainers	4.044	0.676	0.923	0.960
Effectiveness of digital training	4.096	0.818	0.909	0.950
Digital training	4.056	0.662	0.973	0.985

- Results in table (1) shows that all the measurement scales used in the study are both reliable and valid. Specifically, Cronbach's Alpha coefficients ranged from 0.891 to 0.973, showing that all latent constructs met the minimum threshold of 0.70 for (α) indicating acceptable reliability. Likewise, the validity evaluation results demonstrated that all latent constructs met the minimum standard for extracted variance which is 0.60 (Sekaran et al., 2016; Hair Jr et al., 2010). These findings confirm that all the scales meet the essential criteria required for conducting the research.

- Additionally it was noted that the mean scores for all variables exceed 3, reflecting the central anchor point of the utilized measurement scales.

7.4 Hypothesis testing

The researcher presents the results of testing the field study hypotheses, which were statistically analyzed using the SPSS software package (version 30.0.0(127)).

As revealed in table (2), Pearson Correlation method was employed to show the correlation coefficient between artificial intelligence (as the independent variable) and digital training (as the dependent variable) and valuable insight were provided.

Table (2) Pearson Correlation Coefficients (r)								
Variable	1	2	3	4	5	6	7	8
Digital training stages	1.000							
Designing digital training content	0.822***	1.000						
Digital training implementation	0.834***	0.806***	1.000					
Evaluation of digital training	0.830***	0.825***	0.863***	1.000				
Digital training competencies and skills of trainers	0.848***	0.699***	0.777***	0.812***	1.000			
Effectiveness of digital training	0.730***	0.597***	0.699***	0.829***	0.755***	1.000		
Digital training	0.918	0.782***	0.895***	0.921***	0.928*	0.870***	1.000	
Artificial Intelligence	0.958***	0.852***	0.918***	0.944**	0.871**	0.784**	0.962***	1.000

(*** = P < 0.001,   ** = P < 0.01,   * = P < 0.05)

1: Digital training stages, 2: Designing digital training content, 3: Digital training implementation, 4: Evaluation of digital training, 5: Digital training competencies and skills of trainers, 6: Effectiveness of digital training, 7: Digital training, 8: Artificial Intelligence.

The results presented in Table 3 indicate the following key findings:

- It is evident that there is positive, strong and statistically significant relationship between AI and digital training (where r = 0.962, p-value<0.001). Consequently, the main **hypothesis $H_1$was verified.**

- Similarly, results indicated a strong, positive and statistically significant relationship between AI and digital training stages (where r = 0.958, p-value<0.001). Consequently, the **hypothesis $H_2$was justified.**

- Following the same pattern, results revealed a positive, strong and statistically significant relationship between AI and digital training design, digital training implementation and digital training evaluation respectively (where r = 0.852; r= 0.918; r= 0.944, p-value<0.001). Consequently, **H_2a, H_2b, H_2c were verified.**

- Finally, results showed a positive, strong and statistically significant relationship between AI and digital training competencies and skills of trainers and digital training effectiveness (where r= 0.871, r= 0.784, p-value<0.001). Consequently, **H_3 and H_4 were justified.**

After verifying the presence of positive and statistically significant correlation between the variables, the coefficient of determination, denoted as R^2, is used to evaluate the goodness of fit of a regression model. It was used to determine the predictive power of the independent variable on the dependent variable , exploring how well AI could influence outcomes related to digital training. The results of this analysis are presented in Table 3.

Table (3) Coefficient of determination (R^2) for AI and digital training

Variables	R^2	Sign. Level
Digital training	0.926	0.001
Digital training stages	0.918	0.001
Designing digital training content	0.726	0.001
Digital training implementation	0.843	0.001
Evaluation of digital training	0.891	0.001
Digital training competencies and skills of trainers	0.758	0.001
Effectiveness of digital training	0.614	0.001

The results in table (3) showed that:

- AI operate jointly and explain 92.6 % of the variance in digital training, since (R^2) was equal 0.926 and P < 0.001.
- Furthermore , results revealed that AI is strongly and significantly impact Digital training, where:

  - Digital training stages (R^2 =**0.918** at **sign 0.001**)
  - Designing digital training content (R^2 =**0.726 at sign. 0.001**)
  - Digital training implementation (R^2 =**0.843 at sign.0.001**)
  - Digital training evaluation (R^2 =**0.891 at sign. 0.001**)
  - Digital training competencies and skills of trainers (R^2 =**0.758 at sign.0.001**)
  - Digital training effectiveness (R^2 =**0.614 at sign.0.001**)
- These findings highlight the significant explanatory power of the AI in relation to digital training.

8. Research discussion and conclusion

This research was conducted with the aim of exploring the impact of artificial intelligence (AI) on digital training within the Egyptian banking sector. This is consistent with the government's initiative toward digital transformation of all its operations and services, given the significant importance of these technologies and applications as tools that align with the nature of their work and assist in achieving their training objectives efficiently and effectively.

The research findings affirmed a positive, strong and statistically significant

impact of AI on digital training including the aforementioned variables. Also, AI operate jointly and explain 92.6 % of the variance in digital training. The delivered results are consistent with the findings of (Carvalhais & Azevedo, 2024; Halagatti et al., 2023; Olaruposiar, 2022; Gegenfurtner et al., 2020; Farouk, 2022; Zawacki-Richter et al., 2019; Rodrigues et al., 2019; Popenici & Kerr, 2017 ; Pandey et al., 2023). Accordingly, the researcher has confirmed the validity of all the study's hypotheses.

As for the relationship between AI and designing digital training content, where

r = 0.852, p-value<0.001, showing a positive, strong and significant relationship . These findings are consistent with (Clark & Mayer, 2016; Holmes et al., 2019; Azevedo & Carvalhais, 2024) as AI technologies have been integrated into instructional design models like ADDIE (Analysis, Design, Development, Implementation, Evaluation). This integration facilitates the creation of personalized learning experiences by automating content and tailoring instructional materials to individual learner needs. Such applications enhance the efficiency and effectiveness of the design process, leading to more engaging and relevant training programs (Chai, D. et al., 2025).

Also, the relationship between AI and digital training implementation, where r = 0.918 , p-value<0.001, presents strong, positive and significant relationship. The result is aligned with the studies of (Al-Fraihat et al., 2020; Dooley, 2022; Zawacki-Richter et al., 2019) as the researcher argue that the adoption of AI technologies in digital training platforms has modified implementation strategies. As AI offer adaptive learning paths, immediate feedback, and personalized support, which contribute to improved learner engagement and performance . Also, It facilitate the development of critical thinking and problem solving skills by providing interactive and tailored learning experiences (Alotaibi, N. S., 2024, Heffernan & Heffernan, 2024).

Furthermore, the correlation between AI and digital training evaluation , where r = 0.944 , p-value<0.001, confirmed a positive, strong and significant relationship. This result is consistent with the findings of (Kirkpatrick & Kirkpatrick, 2006; Chen et al., 2020; Alwi, 2021;Al-Emran et al., 2023; Baker, 2014) as the researcher believes that AI enhances the evaluation process by enabling synchronized assessment and feedback. Intelligent Tutoring Systems utilize AI to monitor learner progress, identify struggling areas , and provide immediate and personalized feedback. This continuous evaluation approach supports learners experience in developing reflective thinking skills and self-regulated learning behaviors (Saritepeci, M. et al., 2024).

Additionally, the results of this research are consistent with the researchers findings on the strong, positive impact of AI-based training programs in providing learners with new skills and competencies (Gegenfurtner et al., 2020; Fraij et al., 2024; Claned, 2024; Sanusi et al., 2022; ,Pandey et al., 2023; Hashim et al., 2022; Halagatti et al., 2023; Sari & Lubis, 2021; Walker, 2024; Dooley, 2022; Alwi, 2021; Aljehani et al., 2021) where (r= 0.871, p-value<0.001). As AI technologies support the development of learner competencies by providing adaptive learning systems that fits different learning styles. These tailored systems enhance self-learning, critical thinking, and problem-solving skills. Additionally, AI can assist learners with disabilities by offering customized support, thereby optimizing the learning process (Yusuf, S. O. et al., 2024; OECD, 2016). Moreover , the research results showed a positive, strong and significant relationship between AI and digital training effectiveness, where r = 0.784, p-value<0.001. Delivered results are consistent with the findings of (Claned, 2024; Chen et al., 2020 ; Rodrigues et al., 2019; Alwi, 2021; Holmes et al., 2019; Martin et al., 2020; Sanusi et al., 2022; Zhang et al., 2004; Dooley, 2022) . The researcher noted that the effectiveness of digital training programs is significantly improved through AI integration. AI driven platforms can analyze learner data to identify skill gaps and adapt content accordingly, leading to enhanced learning outcomes. Studies have shown that such personalized approaches

result in increased learner satisfaction, motivation, and knowledge retention (McGehee, N. , 2024; Heffernan& Heffernan, 2024; Rodrigues et al., 2019).

Finally, The integration of AI technologies into digital training has a presented positive impact across various dimensions. By enhancing content design, implementation, evaluation tools, learner competencies and overall effectiveness, AI serves as a catalyst for more efficient and comprehensive training programs.

9. Research recommendations

In light of the research findings and from the researcher perspective, the researcher proposes a set of general recommendations supported with an action plan comprises the necessary steps needed for implementation as indicated below in table (4). Proposed recommendations :

- Emphasize the importance of collaboration with universities and research institutions to develop specialized AI applications for digital training to be applied in all Egyptian sectors.

- Equip qualified trainers to use AI effectively through ongoing training and professional development programs to enhance their digital training knowledge and skills.

- Promote the use of AI technologies in other human resources functions, such as recruitment, selection, performance appraisal and specifying training needs. This will improve process efficiency , flexibility and enable more accurate and objective decision-making.

- Encourage different training institutions to increase reliance on AI in digital training at all stages while adopting clear policies and regulations to minimize

legal and ethical risks, achieve training goals efficiently and effectively and to enhance learning experiences.

● Proactively adapt to emerging technologies that may contribute to the future development of digital training and allocate budgets to facilitate their acquisition and use.

For the optimal application of the previously mentioned recommendations, a proposed action plan with the necessary steps needed for implementation is presented in the following table :

Table (4) Proposed action plan with the necessary steps needed for implementation

Proposed recommendation	Implementation mechanism	Responsible body for implementation
Prepare a strategic guide for the use of AI in digital training in specific sectors .	1. Establish a committee to prepare a strategic guide for the use of AI in digital training in specific sectors. 2. Prepare the strategic guide in its initial version. 3. Present the draft to relevant departments for review and feedback. 4. Make necessary revisions based on feedback received. 5. Finalize the guide and approve it. 6. Adopt the final version in official format and distribute it across all target entities.	○ CEO of the required sector. ○ General administration of human resource department. ○ Training and development department
Focus on using AI applications to achieve effective digital training	1. Conduct a field study to identify the most important AI applications that can be used in digital training to fulfill the training needs. 2. Identify AI applications that achieve training effectiveness.	○ General administration of human resource department.

Proposed recommendation	Implementation mechanism	Responsible body for implementation
	3. Publish the results and recommendations in an official report and circulate them to relevant institutions. 4. Monitor the use of these applications and evaluate the outcomes.	○ Training and development department
Enhance the use of AI technology in all stages of digital training	1. Provide AI tools, and data analysis platforms for all training institutions. 2. Train all employees in different training institutions on using these tools. 3. Ensure the use of AI technology in all stages of the training process. 4. Evaluate training programs that use AI.	○ General administration of human resource department. ○ Training and development department
Train and qualify trainers to use AI technologies	1. Train and qualify trainers on using AI technologies in digital training. 2. Provide motivational incentives for trainers who apply AI in their training programs.	○ Training and development department
Focus on the outcomes of digital training	1. Measure the impact and the outcomes of digital training. 2. Identify areas for improvement in digital training outcomes. 3. Take corrective measures to enhance the effectiveness of digital training.	○ Training and development department

Source: Prepared by the researcher.

10. Research limitation

Although this research presented many valuable insights, but it has its limitations. The most notable limitations include:

1. **Cross-Sectional Design**: The research utilized a snapshot survey design, which provides a limited view of the phenomena under study. As a result, the

interpretation of the findings is constrained by the inability to draw causal inferences, as the design does not capture changes over time.

2. **Reliance on Self-Report Measures**: The research employed self-report questionnaires to assess the key variables. Accordingly, relying exclusively on self-report measures introduces several conceptual and methodological challenges that might affect its generalizability including response biasness, lack of objectivity as it is known for being subjective by nature, mood state biasness and interpretation variability.

3. **Field related limitation:** The uncertainty about the extent to which the study population actually uses AI technologies in digital training (which was resolved earlier by conducting a pilot study to ensure the applicability) and the reluctance of some training professionals to participate in the study .

11. Future research

Based on the findings and recommendations of this study, and given the importance of exploring the impact of artificial intelligence (AI) on digital training in general, the researcher proposes a set of topics that can serve as the foundation for future studies and research in this field:

- Studying the ethical challenges associated with AI in digital training.

- Conduct additional studies on the impact of AI on other human resources management functions, such as recruitment, selection, and performance appraisal

- Conduct further studies on the subject using different models and variables, such as examining the impact of AI applications on digital training while including the variable of identifying digital training needs, alongside the current study's variables.

- Studying the effect of AI on various HR functions using alternative methods such as interviews and case studies.

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