



Student University and Mechanisms for the Success of Academic Teaching in Light of the Requirements of the Fourth Generation University Project (4.0) in Algeria

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Abstract:

This study aimed to examine the nature of the relationship between the requirements of the Fourth Generation University and the mechanisms for the success of university teaching and the university student within the Algerian academic environment. This was achieved through the construction of a structural model explaining the direct and indirect effects among these variables. The study adopted the Structural Equation Modeling (SEM) approach using Amos software, based on data collected through a questionnaire designed for this purpose and distributed to a sample of university faculty members in Algerian universities consisting of (167) male and female professors. The research instrument satisfied the required validity and reliability criteria necessary to achieve the objectives of the study.

The results of the study revealed a direct and positive effect of the requirements of the Fourth Generation University on the mechanisms of successful university teaching. The findings also indicated a direct effect of the mechanisms of successful university teaching on the university student. Furthermore, the study demonstrated an indirect effect of the requirements of the Fourth Generation University on the university student through the mediating variable represented by the mechanisms of successful university teaching, which confirms the central role of university teaching in transmitting the effects of the transformation toward the Fourth Generation University to the student.

These findings highlight that the success of the Fourth Generation University project is not solely associated with the provision of organizational, technological, and cognitive requirements, but also largely depends on the university's capacity to develop teaching mechanisms aligned with the demands of the digital environment and the knowledge economy. This, in turn, contributes positively to enhancing the psychological readiness, pedagogical preparedness, and self-efficacy of the university student.

Keywords: Fourth Generation University, mechanisms of successful university teaching, university student.



Abstract:

Este estudo teve por objectivo examinar a natureza da relação entre os requisitos da Universidade de quarta geração e os mecanismos para o sucesso do ensino universitário e do estudante universitário no ambiente académico Argelino. Isto foi conseguido através da construção de um modelo estrutural que explica os efeitos directos e indirectos destas variáveis. O estudo adotou a abordagem de Modelagem de Equações Estruturais (MEE) utilizando o software Amos, com base em dados coletados por meio de um questionário elaborado para esse fim e distribuído a uma amostra de membros do corpo docente universitário em universidades argelinas composta por (167) professores do sexo masculino e feminino. O instrumento de investigação satisfaz os critérios de validade e fiabilidade necessários para atingir os objectivos do estudo.

Os resultados do estudo revelaram um efeito directo e positivo dos requisitos da Universidade de quarta geração sobre os mecanismos de ensino universitário bem sucedido. Os resultados também indicaram um efeito directo dos mecanismos de ensino universitário bem sucedido sobre o estudante universitário. Além disso, o estudo demonstrou um efeito indirecto dos requisitos da Universidade de quarta geração sobre o estudante universitário através da variável mediadora representada pelos mecanismos de ensino universitário bem-sucedido, o que confirma o papel central do ensino universitário na transmissão dos efeitos da transformação para a Universidade de quarta geração para o aluno.

Estes resultados sublinham que o sucesso do projecto Universitário de quarta geração não está apenas associado ao fornecimento de requisitos organizacionais, tecnológicos e cognitivos, mas também depende em grande parte da capacidade da Universidade de desenvolver mecanismos de ensino alinhados com as exigências do ambiente digital e da economia do conhecimento. Isso, por sua vez, contribui positivamente para aumentar a prontidão psicológica, a preparação pedagógica e a autoeficácia do estudante universitário.

Palavras-chave: Universidade de quarta geração, mecanismos de ensino universitário bem-sucedido, estudante universitário.

1. Study Problem:

The Algerian university is progressively moving toward the adoption of modern and strategic orientations in administration, education, research, and training. The characteristics of the twenty-first century have introduced new requirements marked by the strong integration of technology, the adoption of development strategies based on artificial intelligence, and the reliance on innovative solutions to contemporary issues that are often complex and, in many cases, critical in nature. This transformation has also imposed on the university the necessity of forming a generation of competent and highly qualified specialists and researchers, not only in terms of specialization, skills, and professional competence, but also in terms of self-development, problem-solving capacity, critical and deep thinking, and the effective use of communication and linguistic skills in



an era characterized by rapid and continuous change. This evolution has shifted universities across successive generations, environments, and challenges in a manner that has often been abrupt and unprecedented.

The Algerian university has become increasingly aware of these challenges and has begun to establish the foundations for adopting the requirements of the Fourth Generation (4.0), aiming to reduce the gap and disparity between itself and global universities. This orientation is based on the recognition of the necessity of openness to the external environment and the adoption of scientific, objective, and realistic approaches that ensure development, competitiveness, and quality of outputs, while guaranteeing their direct impact on the social and economic context of Algeria.

Within this developmental framework, researchers emphasize that the challenges of the Fourth Industrial Revolution require the integration of technical knowledge with personal and social skills, with greater emphasis on communication, personality development, leadership, teamwork, innovation, problem-solving, and critical thinking, in addition to the ability to utilize computing technologies, big data, the Internet of Things, and ICT-based learning platforms and self-directed learning systems. (Satpathy, Dash, & Mohapatra, 2020)

From this perspective, Academic Teaching 4.0, as a conceptual and practical framework, has undergone a fundamental transformation in the understanding of education, as it now aims to harness technological advancement to create an engaging learning experience that ensures a high level of interactivity and practical engagement for students, while integrating emerging technologies such as artificial intelligence into traditional educational systems (Dhivya, Hariharasudan, & Nawaz, 2023).

University curriculum design is implemented in a manner that enhances students' preparedness and responds to the requirements of the Fourth Industrial Revolution, in which humans and machines interact collaboratively to improve project outcomes and develop solutions to various problems through innovations that contribute to societal advancement. Classroom environments are progressively transitioning toward virtual learning platforms that primarily emphasize personal competencies such as problem-solving, critical thinking, leadership, effective communication, and innovative learning approaches. Concurrently, learning content is increasingly oriented toward digital literacy, the development of life skills, leadership, accountability, productivity, and academic responsibility. The latter enables learners to become individuals capable of learning and unlearning when necessary in order to acquire new and more relevant forms of knowledge acquisition. (Dhivya, Hariharasudan, & Nawaz, 2023)

Unlike traditional face-to-face instruction and e-learning models, Education 4.0 ensures flexibility and accessible educational resources. Consequently, technological competence represents a fundamental pillar within a global perspective and continuous evaluation framework. It prepares students to become responsible global citizens capable of adapting and performing effectively within a rapidly evolving labor market. Overall, Education 4.0 constitutes a significant



qualitative transformation that enables learners to acquire knowledge, skills, and attitudes that support lifelong learning and success in addressing the challenges of the twenty-first century (Udvaros, Gubán, Gubán, & Sándor, 2023).

Experts are nearly unanimous that the Education 4.0 system should be structured around four core components: competencies, learning methodologies, information and communication technologies, and infrastructure. Regarding competencies, academic institutions and organizations have identified critical thinking, collaboration, communication, and creativity as the most essential. In relation to learning methodologies, task-based learning is among the most prominent approaches, with emphasis placed on learning activities and tools that support the development of these competencies. In terms of technology integration, reliance is placed on digital platforms such as virtual reality environments, flipped classrooms, and similar learning systems. Finally, institutions are required to ensure the availability of appropriate infrastructure to implement the Education 4.0 framework among students, thereby strengthening knowledge acquisition, deep understanding of academic content, and improving employability prospects. (Udvaros, Gubán, Gubán, & Sándor, 2023)

Investment in teacher training within the educational context enables educators to confidently use digital platforms and integrate modern resources into curricula. This contributes to the development of a more dynamic and interactive learning environment and represents a strategic step toward equipping both teachers and learners with the competencies and knowledge required to succeed in future educational contexts. In general, teaching 4.0 reflects a fundamental shift in the conceptualization of education, aiming to harness technological advancements to create a more engaging learning experience.

A number of scholars and stakeholders engaged in Teaching 4.0 indicate that its practical implementation still requires further theoretical consolidation and empirical investigation. The challenges remain significant, particularly those related to curriculum design, the development of its components, and the selection of appropriate pedagogical strategies, while ensuring alignment between teaching outcomes and the competencies required by the Fourth Industrial Revolution. There is also a need to establish practical mechanisms that make digital literacy, technical training, and soft skills development mandatory for all university graduates in accordance with Fourth Industrial Revolution standards (Satpathy, Dash, & Mohapatra, 2020).

Regarding students and graduates, the World Bank graduate employability survey indicated that 80% of companies consider that university graduates require additional training upon completion of their studies, while more than 81% of companies emphasized the importance of language proficiency and communication skills as essential graduate competencies. In this context, the Joint Information Systems Committee (JISC), a non-profit organization supporting post-secondary education, higher education, and scientific research in addressing challenges associated



with modern technologies, has positioned the student experience at the core of the challenges facing Education 4.0 (Bonfield, Salter, Longmuir, Benson, & Adachi, 2020).

Therefore, the effectiveness of academic teaching mechanisms within the framework of the Fourth Generation University (4.0) project remains closely associated with the level of student interaction and the extent of their engagement in the evolving teaching process, whether in terms of psychological readiness, pedagogical preparedness, or self-efficacy. These determinants indicate that the effectiveness of academic teaching mechanisms in Algerian universities, from this perspective, depends on the degree of fulfillment of the requirements of the Fourth Generation University, as well as on the level of student engagement with this transformation process.

Accordingly, this study seeks to address a central question: what is the proposed model that explains the relationship between the requirements of the Fourth Generation University project (4.0) and the university student, in the presence of the teaching variable as a mediating factor that may significantly shape the nature of the relationship between the requirements of the Fourth Generation University project on one side and the university student on the other side?

2. Study Objectives

The study aims to analyze the causal relationships between the requirements of the Fourth Generation University and the mechanisms of successful academic teaching on one hand, as well as the causal relationship between the university student, as a fundamental component of the teaching process, and the requirements of the Fourth Generation University project within the Algerian university context. It also aims to examine this causal relationship within more specific frameworks reflected in the dimensions of traditional mechanisms of successful academic teaching, particularly those related to educational programs, teaching methods and strategies, and instructional tools, and their relationship with the requirements of the Fourth Generation University project.

Furthermore, the study seeks to examine the relationship between the developed and contemporary dimensions of university teaching related to creative thinking, innovative research, service to emerging economic and social institutions, community engagement, and teaching quality standards, and the requirements of the Fourth Generation University project in Algeria. It also aims to investigate the relationship between the psychological, pedagogical, and self-efficacy characteristics of the twenty-first-century university student and the requirements of the Fourth Generation University project in Algeria. Finally, the study aims to identify the requirements of the Fourth Generation University project within the Algerian context, particularly following the adoption of this project and the initial efforts undertaken to establish its foundations in several Algerian universities that have embraced this initiative.

3. Study Importance

The importance of this study is reflected in the following aspects:



_ The importance of this study lies in the significance of the Fourth Generation University project in Algeria, which has been adopted by the Ministry of Higher Education and Scientific Research within the framework of a policy aimed at developing the Algerian university system and strengthening its openness to both Algerian society and the global academic environment, as part of the comprehensive development strategy currently pursued by the Algerian state.

_ The importance of the study also stems from the value of the student as a central actor in the effectiveness of teaching mechanisms on one hand, and as an essential component within the requirements for the success of the Fourth Generation University project on the other hand.

_ The importance of the study is further reinforced by the significance of the teaching process itself in light of the rapid digital transformations embodied in the Fourth Generation University project.

_ The study gains its importance from its reliance on the perspectives of university professors, considered experts and practitioners of the educational process, which enhances the credibility of the findings and reflects the actual reality of academic teaching under current transformations.

_ It also derives importance from the methodological approach adopted in this study, based on structural equation modeling, characterized by its strong capacity for controlling, reducing, organizing, and structuring variables.

4. Definition of Study Concepts

_ **Fourth Generation University:** It refers to an advanced model of higher education institutions that extends beyond the traditional roles of teaching and research toward strategic functions based on knowledge production, utilization, and reconfiguration within an open and interconnected digital environment. This model is characterized by its capacity to integrate effectively within its social and economic context through the adoption of open innovation principles and by orienting scientific research toward the resolution of real-world problems and the support of a knowledge-based economy. It also relies on digital transformation and advanced technologies to enhance the efficiency of academic and administrative processes and to activate flexible and participatory learning models, thereby contributing to the development of human capital and generating sustainable social and economic impact in accordance with the requirements of the Fourth Industrial Revolution.

_ **Academic Teaching:** It is a structured and purposeful educational process implemented within higher education institutions, aimed at constructing specialized scientific knowledge and developing students' critical and research-oriented thinking through an organized interaction between professor and student, based on pedagogical and scientific foundations. Academic teaching is no longer limited to the transmission of



knowledge; it extends to guiding learners toward knowledge production and application, as well as fostering analytical skills, inquiry, and problem-solving abilities in alignment with disciplinary requirements and contemporary cognitive and technological transformations.

– **University Student:** It refers to an active cognitive agent within a digital and participatory learning environment, contributing to the construction and dissemination of knowledge, utilizing modern technologies to develop research and innovative skills, and responding to the demands of the knowledge-based economy through continuous learning and adaptation to technological and social transformations.

5. Previous Studies

It is important to note that the previous studies reviewed by the researchers, which addressed the variables of the Fourth Generation University, mechanisms of successful university teaching, and the university student, remain relatively limited, particularly those that examined these variables within an integrated structural model explaining the direct and indirect causal relationships among them.

Most previous studies focused on a single aspect of the Fourth Generation University, such as digital education, pedagogical innovation, or students' readiness for digital transformation, while other studies addressed specific indicators of university teaching or student characteristics in modern learning environments in a fragmented manner. In contrast, the present study sought to construct an integrative framework that combines the requirements of the Fourth Generation University, mechanisms of successful university teaching, and the university student within a unified structural model, allowing for a deeper understanding of the direct and indirect effects among these variables in the Algerian university context.

In this context, the study conducted by Jugembayeva, Murzagaliyeva & Revalde (2022) aimed to propose a pedagogical model for developing students' readiness for the transition to the Fourth Generation University and to analyze the impact of using modern technologies and pedagogical innovations based on the 4.0 university model in improving the effectiveness of the educational process, as well as in developing students' professional competencies and intellectual skills. It also sought to measure their level of readiness and motivation toward transitioning to the Fourth Generation University. The study adopted an experimental methodology and was conducted on a sample of (464) university students from different specializations and academic levels at Al-Farabi Kazakh National University. The participants were divided into two groups: a control group that followed a traditional academic program, and an experimental group that studied according to an educational program based on the 4.0 university model using modern technologies and pedagogical innovations.

The results of the study indicated that students in the experimental group achieved higher levels across all measured indicators compared to those in the control group, including the development of abstract logical reasoning, critical thinking, strategic thinking, imagination,



creativity, and learning motivation, in addition to a higher level of readiness for transitioning toward the Fourth Generation University. The study concluded that the integration of modern technologies and innovative pedagogical practices effectively contributes to preparing students for adaptation to the requirements of the contemporary digital university and enhances both the outcomes and efficiency of the educational process.

Salehi et al. (2021) also focused on examining the transition toward Fourth Generation Universities through a comprehensive systematic review of educational and administrative strategies. The study aimed to identify the most significant educational and administrative strategies required for this transition. It adopted a systematic literature review approach based on scientific publications indexed in several international databases. The findings demonstrated that the transition toward a Fourth Generation University necessitates the development of soft skills, the strengthening of creativity and innovation, the updating of faculty training programs, the adoption of multidisciplinary education, and the internationalization of higher education.

It also requires empowering both students and faculty members with the competencies needed to respond to the demands of national development and the knowledge-based economy. The study concluded that the success of Fourth Generation Universities is closely associated with their ability to develop modern educational strategies that contribute to preparing students with the skills and competencies required to face the challenges of contemporary society.

The study conducted by Sein-Echaluce et al. (2022) examined the Flipped Learning 4.0 model as an expanded version of the flipped classroom within the framework of Education 4.0 and the associated organizational learning processes. Accordingly, the study developed an educational model that integrates the philosophy of Education 4.0 with the flipped classroom approach through the use of knowledge creation processes and collaborative learning within the university environment.

The proposed model was applied across different educational modalities, including distance learning, blended learning, and face-to-face instruction. The results revealed that student participation in collaborative knowledge production contributed to improving academic performance and deepening learning outcomes. It also supported the development of collaborative skills and the capacity to create and manage knowledge in a way that enhances the learning process. The study concluded that the adoption of educational practices aligned with the requirements of Education 4.0 leads to improved learning quality and strengthens student effectiveness within the university environment.

The study by El Moutchoua & Touatea (2024) investigated pedagogical innovation within the context of Higher Education 4.0 and analyzed its reality in light of the transformations imposed by this paradigm. It adopted a systematic review of studies published between 2013 and 2023 according to the PRISMA protocol. The study included the analysis of (30) scientific papers addressing the relationship between digital transformation and innovation in university education.



The results showed that Higher Education 4.0 has contributed to strengthening innovative pedagogical practices and improving educational quality through the use of modern digital technologies, the development of creative thinking, the enhancement of flexibility and adaptability to change, as well as the development of digital skills and competencies required by the Fourth Industrial Revolution. The study also confirmed that the success of the transition toward Higher Education 4.0 is closely associated with the capacity of universities to adopt pedagogical innovation as a fundamental approach to improving the teaching and learning process.

6. Study Methodology:

6.1 Study Approach:

The descriptive-analytical approach was adopted due to its relevance to the nature and objectives of the study. It is aimed at describing and analyzing the reality of university students and university teaching mechanisms in light of the requirements of the Fourth Generation University. This approach also sought to examine the perspectives of university professors regarding the extent to which current teaching practices align with the transformations imposed by contemporary higher education environments, particularly in relation to the requirements of digitalization, pedagogical innovation, and the enhancement of the student's role as an active participant in the educational process.

6.2 Study Sample:

The study sample consisted of (167) male and female professors distributed across different specializations in several universities in eastern Algeria, particularly the University of Jijel, the University of Sétif, and the University of Constantine.

6.3 Study Instrument:

The study instrument was developed in the form of a questionnaire, structured into four main sections in accordance with the study objectives and variables. The first section included the personal data of the study sample. The second section focused on the mechanisms of successful university teaching in terms of educational programs, teaching methods and strategies, instructional tools, the role of university teaching in supporting creative thinking and innovative research, its contribution to serving emerging economic and social institutions, its role in community service, and the quality of university teaching through faculty training.

The third section included five dimensions of the Fourth Generation University project requirements, namely human requirements, digital and technological infrastructure, organizational and university governance requirements, pedagogical requirements, and innovation and research requirements. The fourth section addressed three dimensions measuring the characteristics of the university student in terms of psychological readiness, pedagogical readiness, and self-efficacy within the framework of the Fourth Generation University requirements.

The questionnaire items were developed based on theoretical literature and relevant previous studies. They were then submitted to a panel of specialized reviewers to ensure their scientific and



linguistic validity. Necessary modifications were introduced in accordance with their feedback to ensure measurement accuracy and clarity of the items.

6.4 Statistical Methods Used:

The Statistical Package for the Social Sciences (SPSS V26) was used, along with the Analysis of Moment Structures software (AMOS V22). From the range of functionalities provided by both programs, the following techniques were applied:

- _ The Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity were used to assess sampling adequacy and the identity matrix condition.
- _ Confirmatory Factor Analysis (CFA) was employed to examine the construct validity of the hypothesized model.
- _ The integrated AMOS structural model was utilized.

Table 1 presents the set of statistical indices used by AMOS software

Indicator		Good values	Acceptable values
Absolute indices	χ^2 (Chi-square) or CMIN	$df \geq \chi^2 \geq 0$	$df \geq \chi^2 \geq df$
	p	$0.01 \geq p \geq 0.05$	$0.01 \geq p \geq 0.05$
	df	$2 \geq df \geq 0$	$3 \geq df \geq 2$
	cmin/df	$df \geq cmin/df \geq 0$	$3 \geq cmin/df \geq 2$
	GFI	$1.00 \geq GFI \geq 0.90$	$0.90 \geq GFI \geq 0.80$
	AGFI	$1.00 \geq AGFI \geq 0.90$	$0.85 \geq AGFI \geq 0.85$
	RMSEA	$0.08 \geq RMSEA \geq 0$	$1.0 \geq RMSEA \geq 0.09$
	SRMR	0.00to 0.05	0.05to 0.08
Incremental Indices	TLI	$1.00 \geq TLI \geq 0.95$	$0.95 \geq TLI \geq 0.90$
	NFI	$1.00 \geq NFI \geq 0.95$	$0.95 \geq NFI \geq 0.90$
	CFI	$1.00 \geq CFI \geq 0.95$	$0.95 \geq CFI \geq 0.90$

Source: Prepared by the researchers based on AMOS V22 outputs and according to benchmark values adopted from (Schermellah-Engel & Moosbrugger, 2003, p. 52) (Tetik, 2016, p. 231)

6.5 Validation of Data Suitability for Study Variables.

The validity of the collected data was verified through several tests, which fall under two main analyses: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).



6.5.1 Exploratory Factor Analysis of Study Variables:

In order to validate the factorial structure encompassing the items and dimensions of the study variables, it is necessary to verify sample adequacy and ensure the absence of an identity matrix condition, in order to avoid multicollinearity issues among the study variables.

Table 2: KMO and Bartlett's Test for Study Variables

Test	Data			
	Study variables	University Teaching	Fourth Generation University	University Student
Kaiser–Meyer–Olkin (KMO) Test	Calculated Value	0.95	0.96	0.94
Bartlett's Test of Sphericity	χ^2 (Chi-square)	5593.544	3942.070	2219.693
	Degrees of Freedom (df)	210	105	36
	Significance Value (Sig.)	0.000	0.000	0.000

Source: Prepared by the researchers based on SPSS V26 outputs.

- **Verification of sample adequacy:**

After the distribution of the questionnaire and confirmation of the absence of missing values, the study sample was reduced to (167) respondents. To assess sample adequacy as a prerequisite for conducting Exploratory Factor Analysis, the Kaiser-Meyer-Olkin (KMO) test was applied. The results indicated KMO values of 0.95 for the university teaching mechanisms matrix, 0.96 for the Fourth Generation University project matrix, and 0.94 for the university student matrix. These values are considered strong, as they exceed 0.60 and remain below 1 according to Kaiser's criteria, indicating adequate sampling and a high level of shared variance. This interpretation is consistent with Mahesh & Nanjundeswaraswamy. (Mahesh & Nanjundeswaraswamy, 2020, p. 5) Accordingly, the condition of sample adequacy was satisfied, confirming the suitability of the data for Exploratory Factor Analysis in this study.

- **Verification that the correlation matrix differs from the identity matrix:**

To examine this condition, Bartlett's Test of Sphericity was employed. The results revealed a statistically significant value at the 0.001 level, which is lower than the study's significance threshold of 0.05. This outcome was confirmed across the three study variables, where the Chi-square value for the university teaching variable was 5593.544 with 210 degrees of freedom, the Fourth Generation University variable recorded 3942.070 with 105 degrees of freedom, and the



university student variable recorded 2219.693 with 36 degrees of freedom. These findings indicate that the correlation matrix is not an identity matrix, demonstrating that the data are appropriate for factor analysis and exhibit a sufficient level of intercorrelation. Consequently, the null hypothesis is rejected. Therefore, the condition confirming that the correlation matrix differs from the identity matrix (i.e., all correlation coefficients equal to one) is satisfied (Asraoui, Ouad, & Alaoui, 2020, p. 885).

6.5.2 Confirmatory Factor Analysis (CFA) of the Study Variables

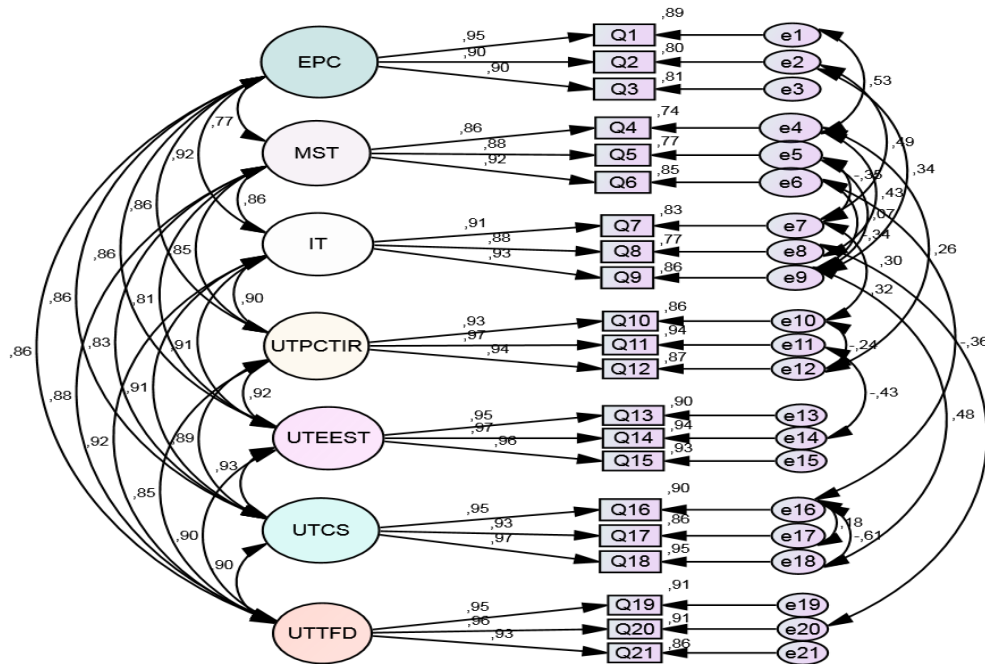
Following Exploratory Factor Analysis, the factorial structure of the study variables was further validated by examining the degree of fit between the hypothetical model and the empirical (observed) model. This involved testing the factorial structure of the study variables, namely: the mechanisms of successful academic teaching, the requirements of the Fourth Generation University (4.0) project, and the university student. This procedure was conducted by determining whether the first-order multidimensional model, which includes the dimensions of the variables, provides a better fit than a unidimensional model. The evaluation was based on standard goodness-of-fit indices. In addition, necessary modifications and adjustments were introduced to the measurement models whenever required by the research context.

The factorial structure of the variables—mechanisms of successful academic teaching, requirements of the Fourth Generation University, and the university student—was subsequently examined. As an initial step in evaluating model quality, the adequacy of goodness-of-fit indices was assessed. The results of the confirmatory model for the three variables indicated that some of the adopted fit indices (predictive and incremental indices) did not meet the required acceptance thresholds used in Structural Equation Modeling (SEM). Accordingly, the measurement models did not fully satisfy their structural conditions, and the hypothesized models of the present study—which assume that the three variables are defined through interrelated dimensions—did not initially demonstrate an adequate fit.

This necessitated the implementation of model modifications aimed at improving model fit, particularly through the correlation of high measurement error terms in order to reduce unexplained variance between them. These adjustments were carried out based on modification indices provided by the AMOS software and statistical considerations, while ensuring conceptual consistency with the content of the items and the dimensions of the mechanisms of successful academic teaching, the requirements of the Fourth Generation University, and the university student. The following presents the multi-factor confirmatory (measurement) models.



Figure 1: Multi-factor Confirmatory (Measurement) Model for the Variable “Mechanisms of Successful Academic Teaching”



Source: Prepared by the researchers based on AMOS V22 outputs

Confirmatory Factor Analysis (CFA) was conducted using Structural Equation Modeling (SEM). The results indicated that all goodness-of-fit indices after model refinement met or exceeded the accepted threshold values. The seven dimensions of the MSUT (Mechanisms of Successful University Teaching) model were tested for validity, with factor loadings (FL) ranging between (0.86 and 0.95), which are high values indicating strong convergent validity and statistically significant internal consistency at the significance level $\alpha = 0.05$.

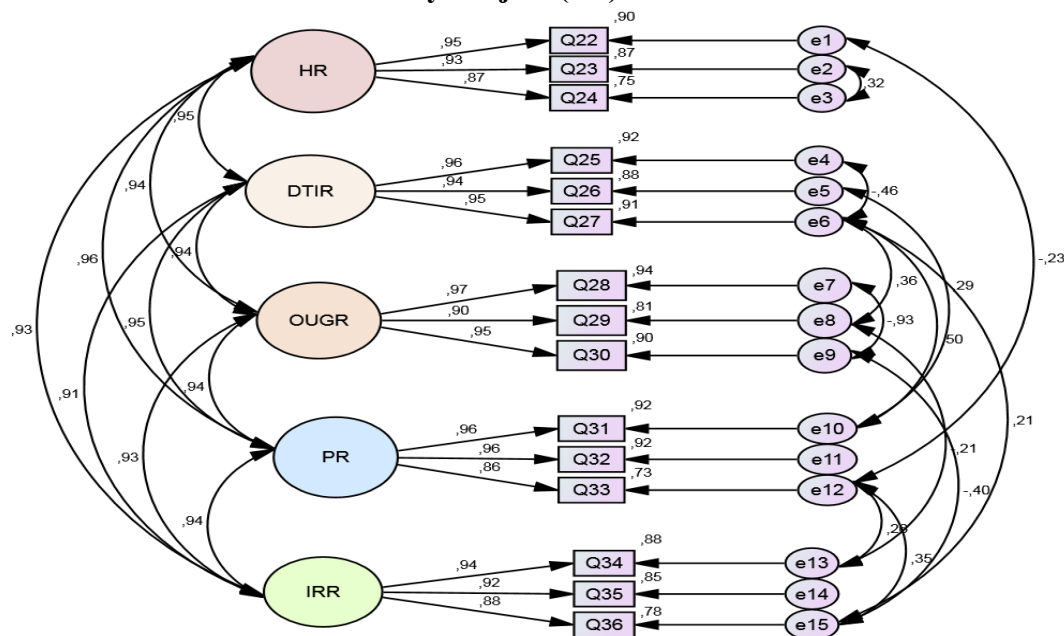
Regarding predictive goodness-of-fit indices, all values satisfied the acceptance criteria except for the Chi-square statistic, which was 322.937 with 152 degrees of freedom. Given the sensitivity of this index to sample size, the Chi-square divided by degrees of freedom ratio (cmin/df) was adopted as a more stable indicator. Its value was 2.125, which is considered acceptable as it remains below the threshold of 3, indicating that the MSUT model demonstrates a good level of fit with the data.

The main predictive fit index, the Root Mean Square Error of Approximation (RMSEA), recorded a value of 0.082, which falls within the acceptable range as it is approximately equal to 0.08, indicating an acceptable model fit. The Root Mean Square Residual (RMR) was 0.027, also indicating a good level of fit. The Goodness of Fit Index (GFI) was 0.860, which is within the acceptable range, reflecting an acceptable level of model fit. Accordingly, the absolute (predictive) fit indices for the MSUT variable are considered satisfactory.



Regarding incremental (comparative) fit indices, the Tucker-Lewis Index (TLI) recorded a value of 0.957, the Comparative Fit Index (CFI) was 0.969, and the Normed Fit Index (NFI) was 0.944. All values fall within acceptable ranges, indicating a good incremental model fit for the MSUT variable and confirming the validity and suitability of the model for the observed data.

Figure 2: Multi-factor Confirmatory (Measurement) Model for the Fourth Generation University Project (4.0) Variable



Source: Prepared by the researchers based on AMOS V22 outputs

Confirmatory Factor Analysis (CFA) was also conducted using Structural Equation Modeling (SEM). The results showed that all goodness-of-fit indices after model refinement did not fall below the accepted threshold values. The five dimensions of the Fourth Generation University Project (FGUP 4.0) were tested for validity, with factor loadings (FL) ranging between (0.88 and 0.97), which are high values indicating strong convergent validity and statistically significant results at $\alpha = 0.05$.

Regarding predictive goodness-of-fit indices, all values met the acceptance criteria except for the Chi-square value, which was 135.681 with 68 degrees of freedom. Given the sensitivity of this index to sample size, the Chi-square to degrees of freedom ratio (cmin/df) was used as a more stable indicator, with a value of 2.00, which is considered good as it remains below 3, indicating that the FGUP 4.0 model demonstrates a good fit with the data.

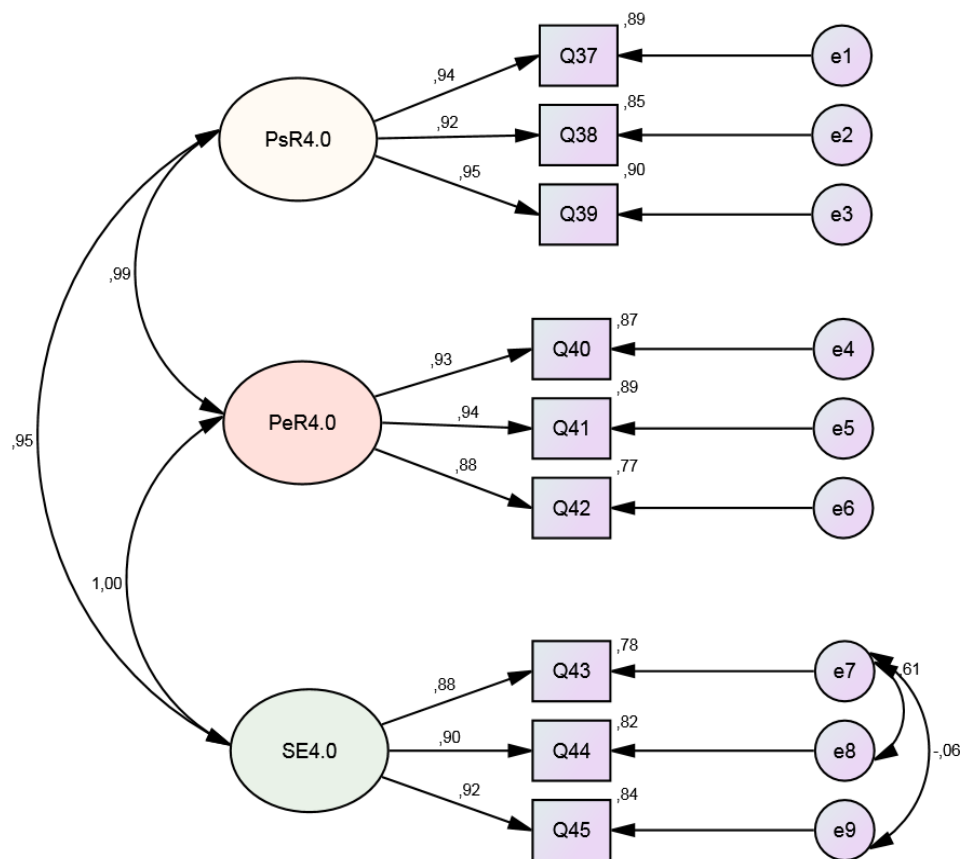
The most important predictive fit index, RMSEA, was 0.078, which is relatively good as it is below 0.08, indicating an acceptable model fit. The RMR value was 0.018, reflecting a very good level of fit. The GFI value was 0.913, which falls within the good range and indicates an adequate



level of model fit. Accordingly, the predictive (absolute) fit indices for the FGUP 4.0 variable are considered satisfactory.

Regarding the incremental (comparative) fit indices, the TLI value was 0.974, the CFI was 0.983, and the NFI was 0.967. All three indices indicate acceptable and strong model fit, confirming high-quality incremental fit for the Fourth Generation University Project (4.0) variable, which in turn supports the validity and suitability of the model for the observed data.

Figure 3: Multi-factor Confirmatory (Measurement) Model for the University Student Variable



Source: Prepared by the researchers based on AMOS V22 outputs

Confirmatory Factor Analysis (CFA) was conducted using Structural Equation Modeling (SEM). The results indicated that all goodness-of-fit indices after model refinement met or exceeded the accepted threshold values. The three dimensions of the University Student (US) model were tested for validity, with factor loadings (FL) ranging between (0.88 and 0.95), which are high values indicating strong convergent validity and statistically significant internal consistency at the significance level $\alpha = 0.05$.



Regarding predictive goodness-of-fit indices, all values met the acceptance criteria except for the Chi-square statistic, which was 53.681 with 22 degrees of freedom. Given the sensitivity of this index to sample size, the Chi-square to degrees of freedom ratio (χ^2/df) was adopted as a more stable indicator. Its value was 2.44, which is considered acceptable as it remains below the threshold value of 3, indicating that the student model demonstrates a good level of fit with the data.

The most important predictive fit index, the Root Mean Square Error of Approximation (RMSEA), recorded a value of 0.093, which falls within the acceptable range, indicating an adequate model fit. The Root Mean Square Residual (RMR) was 0.016, reflecting a good level of fit. The Goodness of Fit Index (GFI) was 0.936, which falls within the good range and indicates a satisfactory level of model fit. Accordingly, the predictive (absolute) goodness-of-fit indices for the University Student variable are considered satisfactory.

Regarding incremental (comparative) fit indices, the Tucker-Lewis Index (TLI) recorded a value of 0.977, the Comparative Fit Index (CFI) was 0.986, and the Normed Fit Index (NFI) was 0.976. All three indices indicate acceptable and strong model fit, confirming good incremental fit for the University Student variable and supporting the validity and suitability of the model for the data.

6.5.3 Verification of the Factorial Structure of the Study Variables (Reliability)

The validity and reliability of the study instrument were assessed using data from the main sample, based on the outputs of SPSS V26 and AMOS V22. The following table presents the results:

Table 3: Factorial Structure of the Study Instrument

Construct	Composite Reliability (CR)	Cronbach's Alpha (α)	McDonald's Omega (ω)
Standard Value	> 0.70	> 0.70	> 0.70
Academic Teaching Success Mechanisms	0.973	0.986	0.986
Fourth Generation University (4.0) Project	0.990	0.985	0.986
University Student	0.980	0.979	0.979
Result	Achieved	Achieved	Achieved



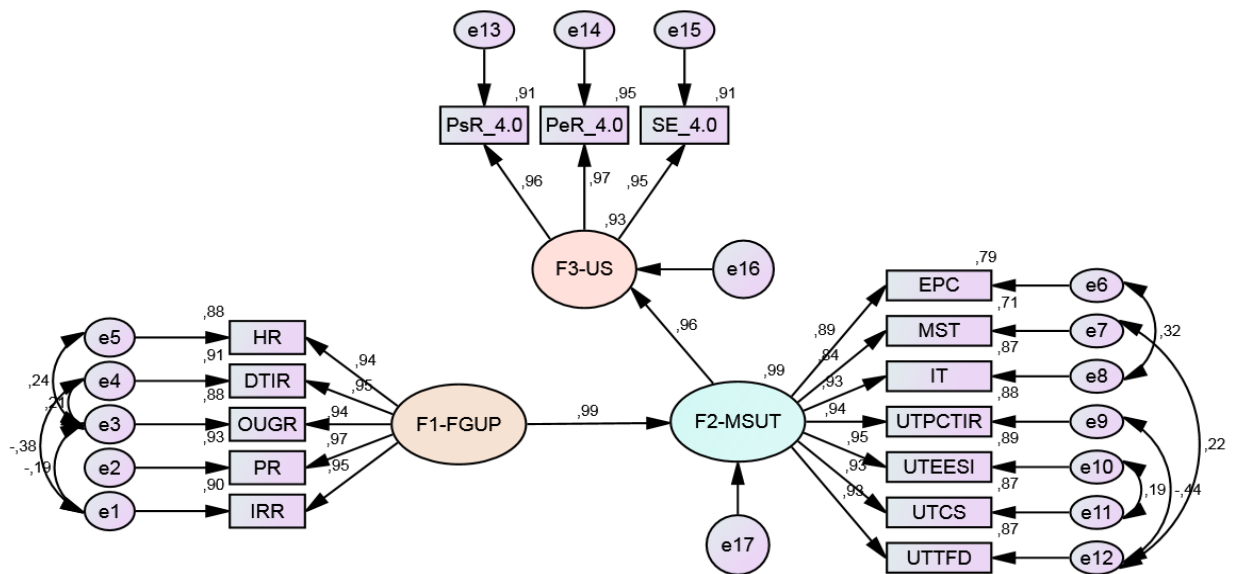
Source: Prepared by the researchers based on AMOS V22 outputs

The obtained results indicate that the study instruments demonstrate a high level of validity and reliability, as all values exceeded the commonly accepted thresholds in quantitative research. This reflects their suitability for measuring the study variables. These indicators provide strong support for the adoption of the hypothesized model in the structural analysis, thereby reinforcing the reliability of the results derived from examining the causal relationships among the variables.

7. Integrated AMOS Model:

An integrated structural model was developed using AMOS software to represent the relationships among the study variables. This model constitutes the applied framework used to address the research question through Structural Equation Modeling, as presented below.

Figure No. (04): Integrated AMOS Model for the Causal Relationships among Study Variables



Source: Prepared by the researchers based on AMOS V22 outputs

Through the integrated AMOS model, the direct relationships between the Fourth Generation University Project requirements (F1–FGUP) and the mechanisms of successful academic teaching (F2–MSUT) are clearly identified on one hand, and between these mechanisms and the university student (F3–US) on the other hand. These relationships are statistically significant at the level $\alpha = 0.05$. The standardized loadings also indicate high values across all study variables, ranging between (0.71 and 0.97).

The model further reveals a very strong direct effect of the Fourth Generation University requirements on the mechanisms of successful academic teaching, with a coefficient value of (0.99). It also indicates a direct effect of the mechanisms of university teaching on the student, with



a coefficient value of (0.96). These values represent strong structural weights, reflecting the strength and robustness of the relationships among the study variables.

The results of the structural model further show that all goodness-of-fit indices met or exceeded the minimum acceptable thresholds for each indicator. The predictive goodness-of-fit measures confirmed an acceptable level of fit between the model and the empirical data. The Chi-square (χ^2) value reached 337.013 with 80 degrees of freedom. Although statistically significant, this index is sensitive to sample size and model complexity; therefore, greater reliance was placed on the Chi-square to degrees of freedom ratio (CMIN/DF), considered a more stable indicator. This ratio was 4.213, a value deemed acceptable as it remains below the maximum threshold of 5, indicating an acceptable level of model fit.

The Root Mean Square Error of Approximation (RMSEA) reached 0.139. Although this value exceeds the ideal threshold for model fit, it may be interpreted in light of the complexity of the model and the large number of dimensions and indicators included in the study. The Root Mean Square Residual (RMR) was 0.018, a low value indicating good model fit. The Goodness of Fit Index (GFI) reached 0.809, reflecting a relatively acceptable level of model fit.

Regarding the incremental (comparative) fit indices, the Tucker-Lewis Index (TLI) recorded 0.928, the Comparative Fit Index (CFI) reached 0.946, and the Normed Fit Index (NFI) recorded 0.930. All values exceed the minimum acceptable threshold of 0.90, indicating a satisfactory level of incremental model fit for the proposed structural model.

Based on these findings, it can be concluded that the proposed structural model demonstrates an acceptable level of fit with the empirical data. It also shows adequate explanatory power regarding the relationships among the study variables. This confirms the validity of the model and its suitability for explaining the relationship between the requirements of the Fourth Generation University and the mechanisms of successful university teaching on one hand, and between these mechanisms and the university student within the Algerian academic context on the other hand.

Given that the model reflects the presence of indirect effects mediated by the mechanisms of successful teaching between the requirements of the Fourth Generation University and the university student, and considering that the student is an active and central actor in teaching processes that have evolved in alignment with the requirements of the fourth generation, the model further presents estimates of indirect effect pathways. These were examined using the Bootstrap method available in AMOS software. The results indicated a mediating relationship within the structural model, where the indirect effect was estimated at (0.95), reflecting a very strong mediating influence of the Fourth Generation University requirements on the university student through the mechanisms of university teaching.



8. Discussion of Study Results:

The study results confirmed that the proposed structural model is integrated and demonstrates a satisfactory level of statistical fit, which explains the strong relationship between the requirements of the Fourth Generation University, the mechanisms of successful university teaching, and the university student within the Algerian academic context. The findings also revealed a direct and positive effect of the Fourth Generation University requirements on the mechanisms of successful university teaching, as well as a direct effect of teaching mechanisms on the university student.

Based on these results derived from the perspectives of university professors, it becomes evident that the success of the Fourth Generation University project within Algerian universities is not solely dependent on the provision of human, organizational, and technological requirements. Rather, it fundamentally depends on the capacity of universities to develop teaching practices and transform them into a modern instructional model based on digitalization, innovation, and interaction. This transformation contributes to preparing a university student capable of adapting to the requirements of the fourth generation and contemporary cognitive and technological changes.

The findings obtained through the integrated structural model indicate that the requirements of the Fourth Generation University project represent a decisive factor in reshaping the mechanisms of successful university teaching within Algerian universities. This is supported by the high direct effect value of (0.99), which reflects the strength of the structural relationship between the two variables. It also indicates that the transition toward the Fourth Generation University in Algeria is no longer merely an organizational or technological adjustment; rather, it has become a transformation that affects the core of the educational process, particularly the function of university teaching as the most closely connected domain to the production and formation of human capital, primarily represented by the university student.

This finding gains particular relevance in light of global transformations driven by the Fourth Industrial Revolution, which has redefined the functions and traditional roles of universities. Universities have become spaces for knowledge production and utilization, closely linked to the digital economy, innovation, artificial intelligence, and entrepreneurship. In this context, the concept of the Fourth Generation University has emerged as a new institutional model based on comprehensive digitalization, smart governance, openness to the economic and social environment, valorization of scientific research, enhancement of innovation, and the development of human capital capable of adapting to rapid technological transformations.

It also emphasizes creativity and innovation, multidisciplinary training, and the development of competencies aligned with the knowledge economy (Salehi, Ahmadian, & Khanalarzadeh, 2021). These foundations exert both direct and indirect influences on the trajectory of university teaching, as well as on its implementation methods and strategies depending on available conditions and resources.



The opportunities offered by the Fourth Generation University contribute to the development of applied knowledge in a way that supports the resolution of contemporary problems, particularly those related to fundamental human issues such as quality of life, sustainability, and openness to more appropriate scientific, economic, and cultural alternatives for addressing current societal challenges. University teaching has therefore moved beyond traditional frameworks centered on selecting, organizing, transmitting, and disseminating knowledge. Instead, it is increasingly grounded in continuous development, renewal, adaptability, clarity of argumentation, practical applicability of ideas, integration of multiple disciplines, and the practical use of curricula, alongside more flexible, creative, and digitally enabled pedagogical practices (Kaoutar & Touate, 2024). In this context, economic institutions increasingly prioritize competence and graduates' ability to interact with knowledge and solve problems rather than relying solely on academic degrees and completed coursework.

In this context, the critical importance of establishing a robust connection between the digital orientation introduced by the Fourth Generation University and technology-enhanced teaching becomes evident. Modern technologies have effectively contributed to the development of teaching mechanisms grounded in artificial intelligence, cloud computing, immersive learning environments, and augmented reality. This represents an emerging practice within Algerian universities, particularly in technical and medical fields. Digital transformation has also introduced pedagogical approaches that are jointly engaged by both learners and instructors. Numerous initiatives have been developed to implement the flipped learning model as an effective mechanism for redirecting human effort toward the utilization of available digital knowledge and its reintegration within university classrooms. According to the perspectives of Algerian professors, these initiatives constitute a direct outcome of the transition toward the Fourth Generation University.

The study results also demonstrate a strong and direct effect of university teaching mechanisms on the university student, with a standardized coefficient value of (0.96). This represents a very high value, indicating that the nature of university teaching has become one of the primary determinants in shaping the characteristics of the university student under the requirements of the Fourth Generation University. This finding suggests that the transformations affecting Algerian university teaching are no longer confined to the development of educational content alone; rather, they extend to reshaping the student's psychological, pedagogical, cognitive, and personal profile.

As previously indicated, the features and indicators of university teaching within the framework of the Fourth Generation University play a central role in shaping the profile of the university student. The student is increasingly positioned as an active agent in knowledge construction, relying on research, interaction, autonomous learning, and continuous engagement with technology for both knowledge production and acquisition. Consequently, university teaching



has become a decisive factor in shaping the student's psychological readiness, pedagogical preparedness, and self-efficacy within the context of Fourth Generation University requirements.

At the level of psychological readiness, contemporary university teaching mechanisms have contributed to the development of psycho-pedagogical adaptation among students in response to the transformations imposed by the digital university environment. Teaching based on digital interaction, self-directed learning, collaborative work, and continuous assessment has fostered psychological readiness among students to accept and engage with technological transformation. Moreover, the shift from a closed traditional classroom environment to open and interactive learning spaces has generated new forms of academic interaction grounded in participation, trust, and autonomy. This transformation has strengthened psychological adjustment to the modern university context, particularly as students increasingly perceive technology as a means of academic achievement and self-realization rather than merely a technical intermediary.

At the level of pedagogical readiness, the strength of the effect identified by the study reflects the effectiveness of university teaching in reshaping the student's cognitive and methodological framework in accordance with the requirements of the Fourth Generation University. Contemporary teaching practices are no longer centered on the reproduction of content; rather, they are founded on active learning, competency-based approaches, critical thinking, problem-based learning, and the use of digital environments for knowledge construction. This pedagogical transformation has made students more capable of managing their own learning processes and better prepared to engage with the flexible and evolving educational systems characteristic of the digital university.

Furthermore, the use of online platforms, open educational resources, collaborative research, and project-based learning has contributed to strengthening students' pedagogical readiness, enabling them to adapt more effectively to multimodal and multi-source learning environments. This represents one of the fundamental characteristics of the student profile within the Fourth Generation University.

With regard to self-efficacy, contemporary university teaching has played a central role in enhancing students' sense of academic and cognitive effectiveness within the emerging university environment. The greater students' engagement in teaching activities based on achievement, interaction, research, and the practical application of knowledge, the stronger their perceived capacity to succeed and adapt to academic and technological challenges becomes. The integration of digital tools, intelligent applications, and continuous assessment has enabled students to experience learning environments characterized by initiative, autonomy, and decision-making. This has contributed to strengthening self-confidence, perceptions of competence, and the ability to manage their educational pathways. Consequently, student self-efficacy has become closely associated with the quality of the teaching environment provided by the university.



This finding acquires particular importance in light of the ongoing transformations within Algerian universities, especially the shift toward the digitalization of higher education, the integration of start-up ecosystems, the development of e-learning systems, and the promotion of a culture of innovation and entrepreneurship within the university environment. These transformations have not merely sought to modernize university structures but have also aimed to produce a new model of the university student: the digital student who is capable of engaging with intelligent knowledge, continuous learning, adaptation to virtual environments, and the use of technology for research, innovation, and problem-solving.

Accordingly, university teaching has become the most influential mechanism in shaping this new student model, as it constitutes the channel through which the various objectives of the Fourth Generation University are translated from conceptual and reform-oriented frameworks into tangible effects on the student's personality and psychological, pedagogical, and cognitive development.

Regarding the findings that revealed a very strong indirect effect of the requirements of the Fourth Generation University on the university student through the mechanisms of successful university teaching, the indirect effect value reached (0.95). This is a high value that reflects the strength of the structural pathway linking the requirements of the Fourth Generation University to the university student through the mediating variable represented by university teaching mechanisms. This finding indicates that the influence of the Fourth Generation University does not reach the student directly; rather, it is primarily realized through the transformations that these requirements introduce into the nature, methods, and functions of university teaching.

This result provides a profound insight into the Fourth Generation University project within Algerian higher education, demonstrating that it is not merely concerned with modernizing technological infrastructure or introducing digitalization into the university environment. Rather, it fundamentally seeks to restructure the educational process itself in a manner that supports the development of a university student capable of adapting to the demands of the digital society and the knowledge-based economy. However, such transformation cannot be achieved solely through the availability of technology or digital systems, as the university student is not directly shaped by technological infrastructure itself, but by the way these capabilities are integrated and utilized within the teaching and learning process.

From this perspective, university teaching emerges as the central mechanism through which the philosophy of the Fourth Generation University is transmitted to the student. It represents the domain in which digital, organizational, and pedagogical reforms are translated into concrete educational practices experienced by students within the academic environment. The transformations associated with the Fourth Industrial Revolution—including smart learning, digital platforms, e-learning, innovation, and artificial intelligence—have fundamentally reshaped the nature of university teaching. It has evolved into an interactive form of instruction centered on the



development of critical thinking, self-directed learning, research, creativity, and the intelligent integration of technology into the educational process.

University teaching mechanisms have therefore become the principal mediating factor through which the requirements of the Fourth Generation University are transformed from structural and digital reforms into tangible outcomes affecting the formation of the university student. The more universities succeed in developing curricula, modernizing teaching strategies, integrating digital tools, and linking teaching with scientific research, innovation, and the socio-economic environment, the more these efforts are reflected in the characteristics of the university student, particularly with regard to psychological readiness, pedagogical preparedness, and self-efficacy.

This result also reflects the ongoing transition toward what is increasingly described as the digital student, characterized by the ability to interact effectively with digital environments, engage in self-directed learning, utilize technology in learning processes, and adapt to virtual and intelligent educational settings. The digital student is a direct outcome of the transformations that have influenced university teaching within the framework of the Fourth Generation University. This emerging student profile is primarily shaped within a teaching environment based on interactive learning, blended education, digital platforms, research, and innovation, rather than within a traditional educational context centered on memorization and rote learning.

In light of the transformations experienced by the Algerian higher education sector in recent years—particularly the digitalization of universities, the adoption of e-learning systems, the establishment of university incubators and innovation centers, and the strengthening of university linkages with start-up enterprises—these reforms have not been limited to technological modernization. Rather, they have sought to reshape the university student in a manner consistent with the requirements of the Fourth Industrial Revolution. This is especially significant given that elements of the technological knowledge infrastructure are already partially embedded in students' daily practices both at home and in public life.

Nevertheless, achieving this objective remains dependent on the capacity of university teaching to harness these transformations and convert them into meaningful learning experiences that influence how students learn, think, and interact with knowledge. It also depends on their ability to consciously distinguish between purposeful digital use aligned with the objectives of the Fourth Generation University and random, unstructured use of digital technologies, which has become one of the principal obstacles to achieving these educational goals.

Accordingly, the strength of the indirect effect, as reflected in the responses of university professors, confirms that the success of the Fourth Generation University project within Algerian higher education does not depend solely on the availability of digital infrastructure or technological resources. Rather, it is fundamentally associated with the ability of university teaching to embody these transformations within the educational process, thereby contributing to the development of a digital student characterized by self-efficacy, cognitive flexibility, and the capacity to innovate and



adapt to the rapid transformations imposed by the contemporary knowledge society and digital economy.

9. Conclusion:

The relationship between the requirements of the Fourth Generation University, the mechanisms of successful university teaching, and the university student constitutes a fundamental framework for understanding the transformations currently shaping contemporary higher education. The requirements of the Fourth Generation University serve as the reference framework guiding the processes of modernization and transformation within the university system. University teaching mechanisms represent the practical means through which these requirements are translated into effective pedagogical and instructional practices. The university student, meanwhile, constitutes the ultimate objective of these transformations and the primary beneficiary of their outcomes. Through this interconnected relationship, the importance of building an integrated university system becomes evident, one that is capable of mobilizing technological, cognitive, and organizational resources to advance the educational process and meet the requirements of the modern university.

The findings of the study confirm that the success of the Fourth Generation University project, as a comprehensive and far-reaching reform initiative, extends beyond the mere provision of organizational, technological, and digital requirements. It encompasses a broader challenge, namely directing university teaching toward intelligent integration with the digital, social, economic, and cognitive demands that underpin this transformation. The achievement of effective University 4.0 teaching will be directly reflected in the student, who represents the central component of this profound transition. The study findings further indicate that contemporary university teaching has become a decisive factor in shaping and enhancing the psychological readiness, pedagogical preparedness, and self-efficacy of university students from the perspective of university professors. These findings suggest that the rapid transformations driven by the Fourth Industrial Revolution, artificial intelligence, and advanced digital technologies require a redefinition of learning processes and learning practices in order to enable students to integrate effectively into this continuously evolving environment.

10. Proposals and Recommendations:

At the conclusion of this study, the following proposals and recommendations are presented:

- _ The adoption of a comprehensive institutional vision that integrates digitalization, artificial intelligence, innovation, and entrepreneurship across the educational, research, and societal functions of the university.
- _ The redesign of the university teaching system in accordance with the philosophy of the Fourth Generation University, emphasizing the production, utilization, and dissemination of knowledge directed toward addressing real-world and developmental challenges.



_ The continuous development of pedagogical training programs for university professors, with particular emphasis on digital teaching strategies and the integration of artificial intelligence applications in higher education.

_ Strengthening the self-efficacy of university students through greater involvement in educational activities, research processes, and innovation-driven projects.

_ Enhancing integration between the university and its socio-economic environment by orienting university teaching toward addressing real societal challenges and aligning academic training with labor market needs and the requirements of the knowledge economy.

_ Establishing periodic evaluation mechanisms to assess the degree of alignment between educational programs and teaching strategies and the requirements of the Fourth Generation University, thereby ensuring continuous improvement in the quality and outcomes of higher education.

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