

Artificial intelligence in higher education and scientific research : concerns, difficulties, and opportunities for economic sciences in Algeria's current situation

L'intelligence artificielle dans l'enseignement supérieur et la recherche scientifique : enjeux, défis et perspectives pour les sciences économiques en Algérie état des lieux

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Abstract:

Artificial intelligence (AI) is revolutionizing the economic sciences by providing robust tools for data analysis, economic modeling, and strategic decision-making. In Algeria, where economic constraints abound (reliance on hydrocarbons, elevated unemployment, economic informality), artificial intelligence is a significant possibility to bolster economic and social growth. Nonetheless, its implementation encounters several institutional, technological, and cultural challenges.

This article examines the capabilities and constraints of AI within the Algerian academic and scientific landscape, specifically pertaining to economic sciences. It analyzes the prospects presented by AI, especially in large-scale data processing, economic modeling, and strategic decision-making. He also delineates significant problems, including inadequate technology infrastructure, a deficiency of skills, ethical and legal dilemmas, and cultural and institutional obstacles.

To address these challenges, many measures are recommended, such as infrastructural improvements, human resource development, favorable public policies, and enhanced international cooperation. The future potential for AI in economic sciences in Algeria is optimistic, presenting chances in the short, medium, and long term to enhance research, innovation, and economic advancement.

The use of AI in economic sciences in Algeria necessitates a systematic and coordinated methodology. Algeria might fully use the promise of AI by investing in infrastructure, enhancing human resources, supporting research, and promoting international cooperation. This technology might significantly contribute to the nation's economic and social advancement, while addressing existing difficulties.

Keywords: *Artificial Intelligence (AI), Economic Sciences, Scientific Research, Higher Education, Algeria.*

Jel Classification Codes : *O33, A10, I23, I25, O55.*

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Résumé :

L'intelligence artificielle (IA) révolutionne les sciences économiques en fournissant des instruments puissants pour l'analyse des données, la modélisation économique et la prise de décisions stratégiques. En Algérie, où les défis économiques sont multiples (dépendance aux hydrocarbures, taux de chômage élevé, informalité économique), l'intelligence artificielle constitue une opportunité significative pour favoriser le développement économique et social. Cependant, son adoption rencontre divers barrières structurels, techniques et culturels.

Cet article examine les possibilités et les contraintes de l'intelligence artificielle dans le cadre universitaire et scientifique algérien, en se concentrant sur les sciences économiques. Il évalue les possibilités présentées par l'intelligence artificielle, en particulier dans l'analyse des données volumineuses, la modélisation économique et la prise de décisions stratégiques. Il recense également les principaux défis, tels que l'insuffisance des infrastructures technologiques, la carence de compétences, les problématiques éthiques et juridiques, ainsi que les obstacles culturels et institutionnels.

Pour surmonter ces difficultés, diverses stratégies sont suggérées, comprenant des investissements dans les infrastructures, la formation des ressources humaines, des politiques publiques de soutien et une coopération internationale accrue. Les perspectives futures de l'IA dans les sciences économiques en Algérie sont encourageantes, offrant des opportunités à court, moyen et long terme pour renforcer la recherche, l'innovation et le développement économique.

En conclusion, l'intégration de l'IA dans les sciences économiques en Algérie requiert une approche stratégique et harmonisée. En investissant dans les infrastructures, en développant les ressources humaines, en soutenant la recherche et en encourageant la collaboration internationale, l'Algérie pourrait exploiter pleinement les potentialités de l'IA. Cette technologie pourrait jouer un rôle crucial dans le soutien au développement économique et social du pays, tout en surmontant les défis contemporains.

Mots clés : Intelligence artificielle (IA), Sciences économiques, Recherche scientifique, Enseignement supérieur, Algérie.

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1. Introduction :

Artificial intelligence (AI) is emerging as one of the most disruptive technologies of the 21st century, significantly altering diverse areas such as healthcare, industry, education, and scientific research. In academia, AI presents unparalleled opportunities for enhancing pedagogical approaches, streamlining knowledge management, and expediting research methodologies. It facilitates the processing of huge data volumes, automates intricate operations, and produces novel insights, making it an invaluable resource for academics and educators. Nonetheless, its implementation presents significant problems, notably regarding infrastructure, skills, ethics, and equality, especially in developing nations such as Algeria.

In Algeria, the educational system and scientific research encounter structural obstacles, including insufficient finances, inadequate cooperation between universities and the corporate sector, and a notable technology deficit ; hence, the incorporation of AI poses both an opportunity and a problem. In the domain of economic sciences, AI may significantly contribute by facilitating a more nuanced study of economic data, enhancing the modeling of intricate phenomena, and aiding strategic decision-making. AI may be used to forecast economic trends, evaluate the effects of public policy, or enhance resource management. Nonetheless, its implementation in this particular domain is constrained by technological, economical, and cultural limitations.

From the aforementioned, we may pose the further inquiries : What is the potential impact of artificial intelligence on higher education and scientific research in Algeria, and what particular problems impede its implementation in the domain of economic sciences ? How can Algeria use AI to enhance its economic research while addressing structural, technical, and cultural challenges ?

This essay seeks to examine the capabilities and constraints of artificial intelligence within the Algerian academic and scientific landscape, particularly in the field of economic sciences. We will analyze how AI might enhance research and pedagogy in this domain, while pinpointing the barriers that impede its implementation. Ultimately, we will suggest pathways for contemplation on the effective incorporation of AI into the Algerian educational and scientific framework, considering both local particularities and worldwide problems.

2. Overview of the Algerian context : technical infrastructure, educational policies, and degree of AI adoption

a. Technological Frameworks

Algeria has achieved substantial advancements in its technical infrastructure in recent decades. The nation has a burgeoning telecommunications infrastructure, with internet accessibility extending to a significant portion of the populace. Data from the Regulatory Authority for Posts and Telecommunications (ARPT) indicates that the internet penetration rate in Algeria was roughly 63% in 2022, accompanied by consistent development in smartphone use. Nonetheless, obstacles persist, notably concerning connection quality in rural regions and access expenses, which remain comparatively elevated for a segment of the population.

Algeria is very deficient in the infrastructure required for AI. There is a scarcity of local data centers, leading most universities and research institutes to depend on overseas cloud services, resulting in latency and data security concerns. Furthermore, access to advanced computing resources, including supercomputers and extensive data processing platforms, is restricted. These technical limitations impede the integration of AI in academic and scientific domains.

b. Educational Policies

The Algerian educational system has undergone many revisions intended to modernize university courses and enhance scientific research. The National Development Plan (NDP) 2021-2025 underscores the digitalization of education and the advancement of new technologies, including artificial intelligence. Nonetheless, the incorporation of AI into academic curricula is still restricted. Only a limited number of institutions, like the University of Science and Technology Houari Boumediene (USTHB) and the National School of Computer Science (ESI), provide specialist courses in artificial intelligence.

Notwithstanding these attempts, the education of educators and researchers in AI remains inadequate. Current curricula often remain academic and lack practical elements, so limiting students' capacity to use this knowledge in tangible initiatives. Furthermore, the partnership between institutions and the commercial sector is inadequate, diminishing internship and practical project chances for students.

c. Degree of AI Implementation

Algeria, like to several developing nations, is in the nascent phases of integrating artificial intelligence (AI). Despite the emergence of promising projects in certain areas, the use of AI remains constrained, especially inside academic and scientific domains. A research from the International Telecommunication Union (ITU, 2022) indicates that Algeria is positioned in the lower middle tier of African nations regarding technical development and the use of new technologies, including artificial intelligence. This is partially attributed to structural constraints, including inadequate technical infrastructure, a deficiency of specialized skills, and an innovation environment that remains in development.

Algeria is beginning the exploration of AI's possibilities in certain economic areas. In the healthcare sector, experimental initiatives have been implemented to use AI for medical diagnosis. The Pasteur Institute of Algeria has partnered with foreign collaborators to create AI algorithms that analyze radiological images and identify illnesses such as TB and cancer. These projects, however constrained, demonstrate an increasing interest in AI in domains where it may provide substantial benefit.

In the energy industry, Sonatrach, the national hydrocarbons corporation, has begun the integration of AI technologies to enhance the extraction of oil and gas resources. Machine learning algorithms forecast equipment breakdowns and facilitate preventative maintenance, ultimately decreasing operating costs and enhancing efficiency. The integration of AI into Algerian universities remains in its nascent phase. Certain institutions, like the University of Science and Technology Houari Boumediene (USTHB) and the National School of Computer Science (ESI), have included AI courses into their curriculum. Nevertheless, these endeavors often stay academic and lack practical elements, so limiting students' capacity to use this knowledge in tangible projects.

Algerian research institutions are beginning investigations into artificial intelligence, namely in domains such as environmental data analysis, climate modeling, and energy system optimization. The Renewable Energy Development Center (CDER) employs AI methodologies to forecast solar and wind energy generation, facilitating enhanced integration of renewable energies into the national electrical system.

3. Opportunities of Artificial Intelligence in Economic Sciences

Artificial intelligence (AI) signifies a significant technological transformation in economic sciences, providing robust instruments for data analysis, economic modeling, and strategic decision-making. Globally, AI is used to forecast economic trends, enhance governmental policies, and augment corporate competitiveness. In Algeria, where economic problems are prevalent (reliance on hydrocarbons, elevated unemployment, economic informality), artificial intelligence might significantly contribute to economic and social advancement.

a. Examination of Extensive Data Sets

Artificial intelligence facilitates the processing and analysis of extensive data quantities, known as big data, which is especially pertinent in the field of economics. Economists may use machine learning algorithms to discern intricate linkages, forecast trends, and evaluate the effects of public policy. For instance, artificial intelligence is used to examine consumer data, financial transactions, and extensive socio-economic metrics.

Consequently, in Algeria, the examination of big data may enhance the comprehension of local economic processes. The use of AI to scrutinize tax and customs data might enhance the efficacy of combating fraud and tax evasion, which constitute a substantial income loss for the state. A research by the Bank of Algeria (2021) indicates that the informal sector constitutes

around 30% of the national GDP, hence constraining tax receipts and distorting economic indices. Artificial intelligence may be used to evaluate household consumption data to ascertain priority requirements and modify social policies accordingly.

Algeria might initiate a trial project to examine banking transactions and credit card data to forecast spending patterns and identify the most active economic sectors. This would enable policymakers to more effectively focus efforts to bolster the economy.

b. Economic Modeling

Conventional economic models often suffer from their incapacity to include dynamic and nonlinear factors. Artificial intelligence, using methodologies like as neural networks and sophisticated regression algorithms, facilitates the development of more accurate and adaptable models. AI is used to simulate the impacts of climate change on agriculture and to forecast the implications of monetary policy on inflation.

In Algeria, artificial intelligence might be used to simulate the effects of oil price volatility on the national economy. Algeria significantly relies on petroleum profits, comprising around 90% of exports and 60% of fiscal revenues. An AI model might forecast the impact of declining oil prices on GDP, employment, and public finances, hence assisting decision-makers in more effectively anticipating economic crises.

c. Strategic Decision-Making

Artificial Intelligence may enhance decision-making by delivering data-driven insights. This signifies enhanced resource allocation, optimal investments, and increased economic competitiveness for policymakers and enterprises. AI is used to find the most promising economic areas, evaluate financial risks, and improve supply networks.

In Algeria, artificial intelligence might assist in identifying the most promising economic areas for prospective growth. An review of economic and social data may indicate that renewable energy, agri-food, and information technology are promising areas with the potential to create employment and diversify the economy. Artificial intelligence might be used to enhance subsidy systems by pinpointing the most needy families and calibrating help levels according to real requirements.

d. Instruction and Development

In education, AI can customize learning by tailoring information to the individual requirements of pupils. In economics, this may include interactive simulations, real-time data analytics tools, and digital learning platforms. This would enable students to get practical skills and become acquainted with advanced technology.

The incorporation of AI into university curricula in economic sciences may enhance the education of students and researchers. Online learning platforms might be established to

provide interactive courses on economic data analysis, predictive modeling, and the use of AI techniques. This will enable students to equip themselves for the difficulties of the labor market and contribute to the nation's economic progress.

4. Obstacles and constraints of AI integration in Algeria

The use of artificial intelligence (AI) in economic sciences in Algeria signifies a significant potential to update research methodologies, enhance decision-making, and facilitate economic progress. Nonetheless, this integration encounters several structural, technological, and cultural obstacles. These impediments restrict Algeria's capacity to fully use the promise of AI.

a. Technological Barriers

Insufficient infrastructure A major impediment to the implementation of AI in Algeria is the deficiency of suitable technical infrastructure. Universities and research institutions often lack advanced computational resources and access to extensive data processing platforms. For instance, supercomputers, crucial for training intricate AI models, are almost absent in the nation. A study from the National Agency for University Research Development (ANDRU, 2022) indicates that less than 10% of Algerian institutions had computer servers adequate for large-scale AI initiatives.

Algeria has a lack of specialized AI expertise, which poses a significant obstacle to its implementation. A report by the World Intellectual Property Organization (WIPO, 2021) indicates that Algeria has less than 500 researchers specializing in AI, a markedly low figure relative to other nations in the area. AI training programs at Algerian institutions remain constrained and mostly theoretical, hindering students from obtaining the practical skills essential for engaging in tangible projects.

b. Ethical and Legal Considerations

- **Data safeguarding**

The utilization of AI prompts significant inquiries about data security. Under Algeria, the regulation regarding personal data protection remains under development, presenting obstacles for the ethical use of AI. The examination of consumer data or financial transactions may infringe upon persons' privacy if sufficient protective measures are not established. A research by the Regulatory Authority for Posts and Telecommunications (ARPT, 2023) indicates that less than 30% of Algerian organizations had explicit data protection policies.

- **Algorithmic biases**

AI algorithms may replicate or exacerbate inherent biases in the data, resulting in unjust or discriminating outcomes. An AI model used to assess credit applications may unintentionally discriminate against certain demographic groups owing to biases included in the training data. Accountability for automated choices

A further legal difficulty is to the culpability for decisions rendered by automated systems. If an AI model designed to maximize public policy yields inaccurate findings, who has responsibility for the outcomes ? The lack of a definitive legal framework leaves this matter unresolved, potentially obstructing the use of AI in the public sector.

c. Cultural and Institutional Obstacles

❖ Resistance to change

The implementation of AI in Algeria is often obstructed by opposition to change at both institutional and individual levels. Political decision-makers and university administrators may hesitate to embrace new technology owing to insufficient comprehension or concerns over job implications. The automation of administrative duties at universities may diminish the need for personnel, hence eliciting worries among employees.

❖ Insufficient cooperation

AI research in Algeria is hindered by insufficient cooperation among universities, research institutions, and the corporate sector. AI initiatives are often executed in isolation, lacking collaboration among many stakeholders. Algerian universities possess proficiency in basic research but lack affiliations with industry to convert this knowledge into practical applications.

❖ Inadequate training

Educators and academics sometimes lack training in the newest breakthroughs in AI, hence limiting their capacity to incorporate these technologies into their work. Economics training programs in Algerian universities seldom incorporate courses on AI, resulting in students being inadequately equipped for labor market issues.

d. Concrete Illustrations of Challenges in Algeria

❖ Project for the examination of taxation data

In 2021, the Ministry of Finance initiated a pilot project to use AI for the analysis of tax data and the prevention of fraud. Nonetheless, the initiative encountered other obstacles, such as the unavailability of accessible data and the reluctance of authorities to embrace new technology. An internal study indicates that less than 20% of tax data has been digitized and is suitable for examination.

❖ Economic modeling initiative

A cohort of academics from the University of Algiers endeavored to create an AI model to forecast the effects of oil price volatility on the national economy. Nonetheless, the effort was constrained by the scarcity of accessible historical data and insufficient processing capacity.

The researchers indicated that the model could only be trained on a restricted dataset, hence diminishing its accuracy and dependability.

5. Obstacles and constraints of AI integration in Algeria

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☞ Restricted data access

Artificial Intelligence depends on the examination of extensive datasets ; but, in Algeria, access to high-quality data is often constrained. Economic, social, and financial data are often disjointed, insufficient, or undigitized. Data on employment, home consumption, or commercial transactions is often gathered in a disjointed fashion by several agencies, complicating its use for AI initiatives. Furthermore, governmental and bureaucratic limitations restrict access to public data, even for academic researchers.

☞ Deficiency of skills

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d. Concrete instances of problems in Algeria

• **Project for the examination of taxation data**

In 2021, the Ministry of Finance initiated a pilot project to use AI for the analysis of tax data and the prevention of fraud. Nonetheless, the initiative encountered other obstacles, such as

insufficient accessible data and authorities' reluctance to embrace new technology. An internal study indicates that less than 20% of tax data has been digitized and is available for examination.

- **Project on Economic Modeling**

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6. Prospective developments of AI in economic sciences inside Algeria

a. Short-term (1-3 years)

❖ Enhancing artificial intelligence competencies

In the imminent future, a primary objective for Algeria is to enhance AI competencies among students, educators, and researchers. This may include the development of specialist training programs at universities in partnership with foreign institutions.

b. In the intermediate period (3-5 years)

☞ Incorporation of artificial intelligence into academic curricula

In the medium run, artificial intelligence should be included into university economics curricula. This may include courses on data analysis, predictive modeling, and the use of AI techniques.

☞ Establishment of specialized artificial intelligence laboratories

The establishment of specialist AI labs in universities and research institutions is another significant consideration. These labs may concentrate on critical domains such economic data analysis, public policy modeling, and optimization of economic systems. A laboratory might be established at the University of Algiers to build AI models that anticipate the effects of oil price variations on the national economy.

☞ Enhanced cooperation with the commercial sector

In the intermediate term, more cooperation between academia and the commercial sector is crucial to facilitate the adoption of AI. Algerian corporations such as Sonatrach and Sonelgaz might partner with universities to finance AI research initiatives. These collaborations would facilitate the integration of financial and technological resources from the commercial sector with the academic proficiency of institutions.

c. In the long run (5-10 years)

☞ Positioning Algeria as a regional leader in artificial intelligence.

In the long run, Algeria may establish itself as a regional authority in artificial intelligence, with acknowledged proficiency in economic sciences. This may include establishing centers of excellence for AI research in partnership with foreign universities.

☞ The role of AI in economic growth

Artificial intelligence may significantly contribute to Algeria's economic advancement via resource efficiency, employment creation, and enhancement of competitiveness. AI might be used to discern the most promising economic areas for future advancement, including renewable energy, agri-food, and information technology. A World Bank research (2022) indicates that strategic use of AI might enhance Algeria's economic production by 10 to 15% by 2030.

☞ Impact on Public Policies

In the long run, artificial intelligence may revolutionize the formulation and execution of governmental policy in Algeria. AI models might be used to evaluate the effects of subsidy programs on families or to enhance public investments in infrastructure. This would enable policymakers to make better informed choices and optimize the use of public resources.

7. A comparative comparison of econometric data analysis using AI vs traditional methods devoid of AI

The examination of econometric data is a fundamental component of economic sciences, facilitating the modeling of correlations among economic variables and the evaluation of theoretical hypotheses. This study conventionally depends on standard statistical and econometric techniques. Nonetheless, the emergence of artificial intelligence (AI) has presented novel, more potent, and adaptable methodologies for analyzing economic data. This study contrasts conventional econometric analysis (without AI) with AI-enhanced econometric analysis, emphasizing the benefits, drawbacks, and applications of both methodologies.

a. Conventional Econometric Analysis (excluding AI)

☞ Employed methodologies

Conventional econometric analysis depends on recognized statistical techniques, including :

Linear regression : Employed to model linear associations between a dependent variable and one or several independent variables.

ARIMA models : Employed for time series analysis and predicting economic patterns.

Hypothesis tests : Such as the Student's t-test or Fisher's test, utilized to assess the significance of the variables.

The techniques of least squares : To evaluate the parameters of economic models.

☞ **Benefits**

Transparency : Conventional procedures are well documented, and their outcomes are readily interpretable. The coefficients of a linear regression explicitly demonstrate the influence of one variable on another.

Efficiency : These procedures are comparatively straightforward to execute and do not want substantial computational resources.

Theoretical validation : Conventional econometric models are often grounded in robust economic theories, facilitating their interpretation within a theoretical context.

☞ **Constraints**

Restrictive assumptions : Conventional methodologies depend on often stringent assumptions (linearity, normality of residuals, lack of multicollinearity), which are not consistently validated in empirical data.

Restricted capacity to analyze intricate data : Conventional techniques fail in modeling non-linear connections or complicated interactions among variables.

Analyzing extensive datasets : They are inadequate for the examination of substantial amounts of data (big data), which are increasingly prevalent in the business.

In Algeria, conventional econometric analysis was used to examine the effects of oil price volatility on the national GDP. A linear regression model indicated a positive association between the two variables ; however, this methodology failed to account for nonlinear effects or intricate interactions with other factors, such monetary policy or climatic variations.

b. Econometric Examination AI-Assisted

☞ **Methods Employed**

Artificial Intelligence employs sophisticated methodologies for economic data analysis, encompassing :

Machine learning: Algorithms like random forests, neural networks, and support vector machines (SVM) facilitate the modeling of intricate and nonlinear interactions.
Natural Language Processing (NLP): To examine textual material, like economic reports or political speeches.

Deep learning : For the examination of organized and unstructured data, including pictures and intricate time series.

Model optimization : Techniques like cross-validation and Bayesian optimization enhance model correctness.

☞ Benefits

Flexibility : AI can represent nonlinear connections and intricate interactions among variables, which is very advantageous for contemporary economic data. AI algorithms are designed to manage extensive datasets, including unstructured data such as text and pictures.

Enhanced precision : AI models may provide more accurate predictions, particularly in scenarios characterized by complex and multidimensional data.

Automation : Artificial Intelligence facilitates the automation of several processes, including variable selection, model optimization, and anomaly detection.

☞ Constraints

The complexity and opacity of AI models : especially neural networks, render them "black boxes" due to the challenges in interpreting their judgments.

Resource prerequisites : AI requires substantial computational resources (intense processing, data storage) and sophisticated technical expertise.

The risk of overfitting arises : when AI models grow too complicated and excessively tailored to the training data, hence diminishing their capacity to generalize.

Data dependency : The caliber of the outcomes is significantly influenced by the quality and amount of the accessible data.

In Algeria, artificial intelligence has been used to evaluate household consumption data and forecast spending patterns. A neural network model effectively identified nonlinear correlations among income, commodity prices, and consumption patterns, providing more accurate insights than conventional techniques. The approach discerned consumption patterns unique to various locations, facilitating policymakers in more effectively targeting subsidies.

c. Comparison of the Two Approaches

Standard	Conventional analysis (excluding AI)	Artificial intelligence-assisted analysis
Model Complexity	Basic models, linear or logarithmic-linear	Intricate models, adept at encapsulating non-linear and multidimensional interactions
Data processing	Constrained to organized and diminutive data	Competent at processing extensive, organized, and unstructured data
Interpretability	Results that are readily comprehensible	Models often exhibit opacity, functioning as black boxes.
Prediction precision	Restricted accuracy for intricate data	Significant resource demands (computational, storage)
Resource requirements	Minimal computational resource demands	Forts besoins en ressources (calcul, stockage)
Aplicaciones	Optimal for theoretical examinations and basic hypothesis evaluation	Optimal for predictive analytics, extensive data, and intricate issues

d. Synopsis and Proposals

☞ When should conventional analysis be employed ?

For theoretical examinations or basic hypothesis evaluations.
When the data is constrained and the associations between variables are linear.
When the openness and interpretability of outcomes are paramount.

☞ When should one use artificial intelligence ?

For predictive analysis of intricate and multidimensional data. When the dataset is extensive and has unstructured components (texts, photos). To automate monotonous operations, including variable selection and model optimization.

8. General conclusion

Artificial intelligence (AI) signifies a significant technological transformation in economic sciences, providing robust instruments for data analysis, economic modeling, and strategic decision-making. In Algeria, where economic problems are prevalent (reliance on hydrocarbons, elevated unemployment, economic informality), AI might significantly contribute to economic and social advancement. Nonetheless, its implementation encounters several institutional, technological, and cultural barriers that restrict its complete use.

This paper examined the capabilities and constraints of AI within the Algerian academic and scientific landscape, specifically regarding economic sciences. We analyzed the prospects presented by AI, especially in large data analysis, economic modeling, and strategic decision-making. We have found significant problems, including inadequate technology infrastructure, a deficiency of skills, ethical and legal dilemmas, and cultural and institutional obstacles.

To address these challenges, several measures have been suggested, including investments in infrastructure, training of human resources, supporting governmental policies, and enhanced international cooperation. By using these tactics, Algeria might establish AI as a catalyst for revolutionizing its educational system and economy.

The use of AI in economic sciences in Algeria necessitates a systematic and coordinated methodology. Algeria might fully use the promise of AI by investing in infrastructure, developing human resources, supporting research, and promoting international cooperation. This technology might significantly contribute to the nation's economic and social advancement, while addressing existing difficulties.