

Managing University Research Laboratories and Their Contribution to Advancing the Scientific Research Sector in Algeria

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Abstract

search laboratories of university conceded as..... algers depends it in order to develop scientific search sector also to get agreeable from the output of search operation scientific and social problems in all scoop beside this we must guarantee staying of competences inside town ,and don't leave with argument of uncomfortable conditions work , from this serch paper we talk about the dilemma that face project of building university serch laboratories in Algeria and the reality that we leave

.Keywords: search laboratories of university, scientific search , the output of search operation scientific

Axis One: Feminist Discourse in the Context of Digital Transformation

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Introduction

Higher education institutions play a major role in enriching scientific research, which constitutes one of their principal missions through university research laboratories supervised by universities, as they provide an appropriate environment for research and development. In their early stages, higher education institutions primarily focused on teaching and preparing the human resources responsible for managing state affairs, while scientific research had not yet attained a significant position. Their role was largely confined to disseminating knowledge rather than contributing to its advancement. With the growing demand for education since the end of the Second World War and its repercussions, accompanied by a significant expansion in the capacity of higher education institutions worldwide, the nature of these institutions changed from elite institutions into mass institutions. This transformation generated considerable pressure in addressing the various problems associated with such growth and brought about fundamental changes in the structure of higher education institutions.ⁱ

Over time, higher education institutions significantly modified their approach and began to attach greater importance to scientific research. This development initially emerged through the differentiation of higher education systems in response to new challenges. Such differentiation occurred either vertically, through the growth of different types of higher education institutions, including research universities, teaching universities, and community colleges, or horizontally, through the entry of new higher education service providers, such as private universities. In England, the process began with the establishment of the first affiliated laboratories, notably the Clarendon Laboratory at Oxford in 1866. In the United States, attention to scientific research increased following the enactment of the Morrill Act, a law passed by the U.S. Congress that called for the establishment of at least one institution in each state of the Union where scientific and technical studies would have a status equal to that of classical studies, alongside vocational education. Consequently, the third function of the university—scientific research—was added to its two traditional functions, namely, the preparation of scientific personnel and the dissemination of knowledge.ⁱⁱ

Since scientific research is one of the missions entrusted to higher education institutions, these institutions seek to develop and advance knowledge. Scientific research is also an important and vital component of their role as scientific and intellectual institutions and is one of the most significant indicators of their leadership in various scientific fields. Furthermore, the reputation and status of universities are closely linked to the research they produce and publish. Universities are therefore required to conduct high-quality research that benefits society, given that scientific research addresses real and existing problems within society.

The university is considered a fertile environment and an appropriate setting for scientific research. Today, the main driving force behind scientific research in Algeria is represented by the research laboratories established within universities, which in turn undertake research projects and initiatives that benefit society as a whole or specific sectors. Accordingly, universities and their research laboratories constitute a fundamental basis for overcoming the challenges facing societies, fostering their development, and determining their progress and contribution to civilization. Therefore, increasing attention to research laboratories has become

one of the highest priorities, particularly given the human resources and capabilities they possess. Based on the foregoing, the following research problem can be formulated:

What measures are required to advance the scientific research sector in Algeria through university research laboratories?

To answer the research problem, the following hypothesis can be proposed:

University research laboratories have contributed to the advancement of the scientific research sector in Algeria.

Among the previous studies that have addressed this topic, we find the study by Al-Aqab Kamal (2016), a doctoral dissertation in Management Sciences, specializing in Business Administration, at the University of Algiers 3, entitled “The Role of University Research Laboratories in Knowledge Production in Algeria.” The researcher raised the following problem: To what extent do university research laboratories contribute to knowledge production in Algeria, and what are its determinants?

The study aimed to investigate researchers’ opinions in order to diagnose the reality of university research laboratories with regard to knowledge production by conducting a field study on a sample of these laboratories. It also sought to identify the factors influencing the scientific productivity of researchers affiliated with university research laboratories, as well as the problems faced by these laboratories, while providing proposals to enhance their role.

The study concluded that there is no clear strategy in the field of scientific research, particularly within university research laboratories, due to the lack of clarity regarding the objectives for which these laboratories were established and their lack of a clear future vision. Despite the significant increase in the number of research laboratories, the research and studies conducted by these laboratories remain largely a formal aggregation of several projects, without an effective management structure responsible for administering the laboratories and enhancing their role. Furthermore, the laws and regulatory provisions governing the establishment, management, and development of research laboratories do not adequately correspond to the requirements of achieving excellence and quality. This situation has distanced research laboratories from their intended objective of generating local development dynamics.

In this research paper, we will attempt to explore ways of advancing the scientific research sector in Algeria through university research laboratories by addressing the following main themes:

I. Nature of Research Laboratories

II. National Criteria for Evaluating Scientific Research Laboratories and Their Scientific Research Output

III. Problems and Challenges Facing University Research Laboratories in Algeria

IV. Conclusion

I. Nature of Research Laboratories

1. Definition of Research Laboratories

To establish a definition of research laboratories, we will first address the linguistic and terminological definitions, and then examine how the Algerian legislator has defined research laboratories.

A. Linguistically:

The term laboratory is of Latin origin, derived from *laboratorium*, which itself originates from *laborare*, meaning “to work.” The Oxford Dictionary defines a laboratory as a building intended for experiments, scientific research, or training. It may also be used for the preparation of medicines and drugs and for conducting chemical studies.ⁱⁱⁱ The Webster Dictionary further defines it as a place where theories, techniques, and methods are tested, as in education or social studies, and where they are analyzed. It is also a room equipped with specialized materials and equipment for conducting experiments, practical activities, and examinations.

A laboratory is an institution that provides the necessary conditions for conducting scientific experiments, tests, and measurements under standardized and controllable conditions.^{iv}

The plural of laboratory is laboratories. It refers to a place designated for examination, monitoring, and investigation. The Arabic term laboratory is derived from the verb, meaning to know, understand, or inform. The verb means to inform someone of something, while *khabira bil-amr* means to be knowledgeable and experienced in a matter. The term laboratory is derived from the verb, meaning to test or experiment with something.

In general, a laboratory is a place where a number of specialized scientists or researchers work, each having a specific role. For example, a chemistry laboratory may include a specialist whose task is to separate samples from impurities. This does not mean that such a specialist is unable to identify the crystalline properties of a substance; rather, each specialist possesses greater expertise in their particular field.^v

B. Terminologically:

A research laboratory is a research institution composed of researchers who devote themselves to study, research, and the pursuit of knowledge. It constitutes an organizational unit with specific objectives and characteristics and performs a range of scientific functions and roles. In other words, it is an integral part of the educational and research process, within which both formal and informal relationships exist.^{vi}

A laboratory is also a spatial structure devoted to experimentation, research, interpretation, design, planning, the development of methodologies, the proposal of projects, and the formulation of theories. Within the laboratory, researchers find the means necessary to develop knowledge and the capabilities that enable them to investigate, examine, and verify information. It is therefore a specialized scientific body affiliated with an educational and research institution and contributing to the activities of researchers.^{vii}

Research laboratories are considered among the institutions concerned with scientific and technical information within universities, as they represent the organizational structure of scientific research. They play a fundamental role in the dissemination and production of scientific and technical knowledge. The research laboratory constitutes a basic structure for conducting scientific research and achieving technological development across all fields of science and technology, within the framework of the priorities established by development plans and national programs determined by the relevant authorities.

Scientific research laboratories are among the research structures established to carry out scientific research activities. They constitute formal institutions with a set of objectives,

primarily focused on providing the community with scientific and knowledge-based services. They are supervised by researchers, and a research laboratory consists of three sources.^{viii}

Human Resource: This is embodied in the laboratory director and the research teams that constitute it.

Material Resources: These consist of a range of physical spaces, including offices and workshops, in addition to the equipment and resources provided by the laboratory.

Intangible Resource: This refers to the legal status governing these groups of researchers and teams, through the accreditation granted by the supervisory authority for the establishment and accreditation of the laboratory. Research laboratories are generally located within scientific institutions such as institutes, faculties, and universities, as well as hospitals, health centers, research centers, and research institutions. They are institutions dedicated to creating knowledge in its various forms, given the presence of specialized research professors who undertake the study of specific phenomena over a certain period of time, using laboratory methods and a scientific methodology appropriate to the phenomenon under investigation. Such laboratories may also exist within governmental bodies concerned with monitoring and investigation procedures and with providing recommendations. In addition, many specialists in various fields establish private laboratories for scientific research purposes.

C- Definition of a Research Laboratory According to the Algerian Legislator: Algeria has established research laboratories and research units with the aim of promoting scientific research and technological development. To achieve these objectives, the law stipulates that all ministerial departments and private institutions, each within its respective area of responsibility, shall take all necessary measures to promote scientific research within the structures under their authority.

The Algerian legislator defines a research laboratory as “the scientific entity responsible for conducting research within higher education institutions, public bodies, and institutions. A research laboratory is established to carry out research activities included within the framework of a scientific or technological program comprising several research projects.”^{ix}

The idea of establishing research laboratories derives from Executive Decree No. 99-244 of 31 October 1999, which sets out the rules governing the establishment, organization, and operation of research laboratories, pursuant to Article 19 of Law No. 98-11 of 22 October 1998, relating to the Orientation Law on Scientific Research and Technological Development. Research laboratories are established within higher education and training institutions.^x According to Article 5 of the aforementioned decree, a research laboratory is established on the basis of the following criteria:^{xi}

The importance of research activities in relation to the country’s social, economic, cultural, scientific, and technological development needs.

The scope and sustainability of the scientific and technological program within which the research activities are carried out.

The impact of the expected results on the development of scientific and technological knowledge.

The quality and scale of the available scientific and technical capacities.

The available material and financial resources and/or those that need to be acquired.

In addition to the aforementioned criteria, a research laboratory must comprise at least four research teams.

2. Types of University Research Laboratories

University research laboratories can be divided into two types:

A. Technical Research Laboratories: Their research activities focus on technological development (mathematics, medicine, engineering, physics, etc.). Their outputs generally take the form of inventions and solutions to technical problems.

B. Social Research Laboratories: These laboratories focus on studying social phenomena (economics, sociology, psychology, etc.) and work on finding solutions to observed problems and developing methods for improving particular situations.

3. Organization of Work within Scientific Research Laboratories in Algeria

A research laboratory is managed by a laboratory director and is provided with a laboratory council composed of the heads of research teams and research project leaders.^{xii} The director is appointed for a renewable three-year term, based on a proposal by the head of the host institution, from among the two highest-ranking candidates elected by the members of the laboratory council from among themselves.

A research team is composed of at least three researchers and is headed by a qualified researcher. The team is primarily responsible for implementing one or more research projects falling within the laboratory's research program. Each research project is supervised by a project leader.

A. Duties of the Research Laboratory Director

The director of the research laboratory is responsible for the scientific administration and financial management of the laboratory. He or she is the authorizing officer for the appropriations allocated to the laboratory and is also responsible for ensuring its proper functioning. The director exercises hierarchical authority over all research personnel and provides support to the laboratory staff.

Furthermore, with the authorization of the head of the host institution, the director may initiate and conclude contracts and agreements aimed at carrying out research and studies and providing services with national or international institutions whose activities are related to the laboratory's missions, in accordance with the regulations in force.

The director also submits the laboratory's programs and activity reports to the evaluation bodies of the host institution for review. Within the framework of the laboratory's missions, the director may also engage part-time researchers after consulting the laboratory council.^{xiii}

Duties of the Research Laboratory Council

The laboratory council, chaired by the laboratory director, is responsible for the following:^{xiv}

Participating in the preparation of research programs.

Periodically evaluating research activities.

Reviewing and approving research and management reports.

Approving the estimated budgets and expenditures submitted by the director.

Ensuring the rational use of human, financial, and material resources.

Preparing and approving its internal regulations.

4. The Role and Importance of Research Laboratories

Scientific research laboratories have played a major role in advancing the level of scientific research, particularly in postgraduate studies (Master's and doctoral studies under the classical system, and Master's and doctoral studies under the LMD system), by providing educational resources and promoting teaching methods. In many cases, education has shifted from focusing primarily on the theoretical aspect to a form of training that gives greater importance to experimental and field-based training. Moreover, the Ministry of Higher Education and Scientific Research has begun to require the availability of a research laboratory as a prerequisite for opening postgraduate training programs.

The role and importance of research laboratories can be identified through Article 4, pursuant to the provisions of Article 12 of Executive Decree No. 98-11, dated 29 Rabi' al-Thani 1419 AH, corresponding to August 22, 1998, which assigns scientific research laboratories the following responsibilities:^{xv}

Achieving the objectives of scientific research and technological development in a specific scientific field.

Conducting studies and research activities related to its objectives.

Participating in the preparation of research programs related to its activities.

Participating in the acquisition, mastery, and development of new scientific and technological knowledge.

Contributing, at its own level, to the improvement and development of techniques.

Participating in training through research and for the purposes of research.

Promoting and disseminating the results of its research.

Collecting, processing, evaluating, and facilitating access to scientific and technological information related to its objectives.

Participating in the establishment of appropriate research networks.

Research laboratories also perform several other roles, which can be detailed as follows:^{xvi}

Research laboratories organize international and national conferences that bring together specialists in the field.

Research laboratories support their members by providing recommendations for publishing their scientific activities, particularly in the form of research articles. They may also provide professors and researchers with all the information resources they require, thereby contributing to increasing their readiness and willingness to generate scientific knowledge.

Research laboratories support training by organizing regular scientific and technical meetings, as well as short-term training courses.

They publish specialized periodicals and disseminate research findings, benefiting from the capacities and resources available to them.

They facilitate the sharing and exchange of scientific information among professor-researchers and promote informal scientific communication, which takes place through discussions and interactions among researchers and contributes to the development of new knowledge.

Research laboratories indirectly serve as complementary extensions of university libraries through their contributions, such as providing recommendations regarding information sources to be acquired in specific fields of specialization. They also supply university libraries with the

laboratories' specialized journals. Although these journals may not be available in large numbers, they address specialized topics that may not otherwise be found in university libraries.

Research laboratories analyze the citation patterns of a given laboratory according to the number of articles published by each researcher affiliated with that laboratory. This process generates new knowledge by transforming tacit knowledge into explicit knowledge as a result of discussion and intellectual exchange among research professors.

The research laboratory constitutes a fertile, qualified, and specialized environment for supporting scientific research, particularly through addressing the issues prevailing on the national scene. Relying on qualified human resources, material and non-material resources, and the equipment made available to it, the laboratory formulates the issues under consideration and seeks appropriate frameworks for addressing them, given that laboratories are spaces for creating and producing knowledge in its various forms. This is made possible by the presence of specialized research professors who devote themselves to studying specific phenomena over a period of time, using laboratory and scientific methods and adopting a methodology appropriate to the phenomenon under investigation. The actual establishment of research laboratories in Algerian universities dates back to 2000, when 269 laboratories covering various scientific fields were established. The number of laboratories continued to increase steadily, reaching 1,440 laboratories by 2017. University research laboratories accounted for 98% of all research laboratories in Algeria, which represents a significant proportion given the importance of the research competencies available within universities, which can contribute to raising and developing the level of scientific research in Algeria. The following table illustrates this development:

Table No. (6): Evolution of the Number of Research Laboratories in Algerian Universities during the Period (2007–2017)

Year of Establishment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of Laboratories	604	646	729	788	887	1116	1297	1316	1324	1400	1440	1564

Source: Ministry of Higher Education and Scientific Research

Second: National Criteria for Evaluating Scientific Research Laboratories and Their Scientific Production Output

1. Evaluation of Laboratories

Evaluation is a key component of scientific research and is carried out at several levels, including the laboratory council and the institution's scientific council. Accordingly, a set of criteria has been established for evaluating the scientific activities carried out by laboratories over a three-year period. Minimum scientific production requirements have also been

established for these laboratories. Among the responsibilities of the Permanent Sectoral Committee of the Ministry of Higher Education and Scientific Research is to consolidate the results achieved by the evaluation bodies affiliated with the systems responsible for implementing research activities (Executive Decree No. 99-243 of October 30, 1999, Article 2, Paragraph 10).

The scientific activities of research laboratories are evaluated according to the table prepared by the Permanent Sectoral Committee, which takes into consideration the various fields of activity (MPET, SF, ECC, CUH, ATE, ARED, EDS, S). The minimum scientific output takes into account the number of research professors holding the rank of Professor of Higher Education, as well as the number of research teams affiliated with the laboratory. Accordingly, the minimum scientific research output required over the laboratory's three years of activity is determined as follows^{xvii}:

One international publication per researcher holding the rank of Professor of Higher Education (twelve points).

One national publication per researcher holding the rank of Professor of Higher Education (nine points).

One international presentation per research team (four points).

One national contribution per team (three points).

One completed research project per team (two points).

One specialized authored work and other printed lectures (twelve points).

With regard to research-based training (Master's or PhD degree), the minimum required threshold varies from one field to another.

For the different research fields:

Master's training: 4 points per team.

For the different research fields EDS and ECC, the minimum requirement is as follows:

Training for two Master's degrees: 4 points per team.

For the research fields ATE and ARED, the minimum requirement is:

Master's training for two teams (4 points).

For the SANTE research field, the minimum requirement is as follows:

Master's training (4 points).

It should be noted that, for all research fields:

Each completed project entitles the laboratory to 4 additional points.

The defense of a doctoral dissertation for each laboratory and for each assessment period entitles the laboratory to 10 additional points, for all research fields.

Contributing to the preparation of a specialized authored work entitles the laboratory to 4 points.

The number of national publications counted for each laboratory is subject to the following rule: $(7N + 10)$, where N represents the number of international publications.

The number of international contributions counted may not exceed five times the number of international publications plus five (05). This provision is intended to encourage laboratories to increase the number of their international contributions.

Similarly, the number of national contributions counted may not exceed five times the number of international publications plus five (05).

Only Master's and doctoral degrees completed within the laboratory, supervised by professors holding the rank of Professor within the laboratory, and defended at the laboratory's parent institution, are taken into account. This framework aims to obtain the information necessary for the Permanent Sectoral Committee to assess all research activities carried out by the laboratory.

2. Classification of Research Laboratories in Algeria

Research laboratories in Algeria have been classified by the supervising ministry, in cooperation with the Directorate General for Scientific Research and Technological Development, into three categories according to the extent to which these laboratories comply with administrative conformity procedures. Accordingly, these entities have been classified, based on specific criteria, into three categories: red, orange, and green.^{xviii}

A- The Red List:

This list includes laboratories that have not submitted a statement concerning the status of their researchers in accordance with the model established by the Directorate General for Scientific Research and Technological Development. These entities may be dissolved at the discretion of the Permanent Sectoral Committee of the Ministry of Higher Education and Scientific Research.

B- Orange List: This list includes laboratories that submitted statements concerning the status of their researchers, but these statements did not comply with the criteria established previously. Accordingly, these laboratories are required to submit statements that conform to the specified criteria before December 10, 2016.

C- Green List: This list includes laboratories that submitted statements concerning the status of their researchers in accordance with the established requirements. On this basis, these laboratories are considered eligible to receive funding from the National Fund for the Financing of Scientific Research and Technological Development.

Accordingly, this classification focuses on the extent to which research laboratories comply with the standards established by the Directorate General for Scientific Research and Technological Development. Based on this classification, research laboratories placed on the red and orange lists will be deprived of funding until a final decision is issued regarding their closure, given that these laboratories have failed to produce tangible results in the field of scientific research or contribute to the development of the country's economic and social sectors since their establishment, despite having benefited from financial allocations provided by the Ministry of Higher Education.

According to the classification, the red list includes 39 laboratories that failed to submit administrative statements concerning the status of their researchers in accordance with the model established by the Directorate General for Scientific Research and Technological Development. Accordingly, these laboratories may be dissolved at the discretion of the Permanent Sectoral Committee of the supervising ministry. The orange list, meanwhile, includes approximately 410 laboratories located in various university institutions across the country. These laboratories submitted statements concerning the status of their researchers, but

the information provided did not comply with the previously established criteria; therefore, they were granted a period within which to comply with these standards. The Ministry of Higher Education also decided to provisionally grant funding to laboratories classified under the green list, numbering approximately 941 laboratories. These laboratories submitted statements concerning the status of their researchers in accordance with the established requirements and are therefore considered eligible to receive funding from the National Fund for the Financing of Scientific Research and Technological Development.^{xix}

3- Closure of Scientific Laboratories Whose Evaluation Reports Demonstrated Negative Performance:

The Ministry of Higher Education and Scientific Research decided to close research laboratories whose evaluation reports demonstrated negative results. After several years, the supervisory authorities decided to fund only successful research laboratories whose evaluation reports demonstrated positive research outcomes. Out of 1,207 laboratories that were evaluated, more than 300 were found to be scientifically unsuccessful.

These measures were taken after the state decided to allocate an annual budget of 20 billion Algerian dinars for scientific research from 2017 to 2022, amounting to 100 billion Algerian dinars over five years, as part of efforts to enhance the position of scientific research and find solutions to various strategic challenges. Through scientific research laboratories and research institutions, the authorities seek to develop solutions aimed at achieving food security and energy security and improving healthcare services to meet citizens' expectations.

This comes in the context of the completion of the third Scientific Research Law, which was expected to enter into force shortly and included numerous measures and facilities relating to scientific research. Among the most important provisions was the financing of research projects for LMD doctoral students from their first year. Under the new contracts, they would receive a salary of 50,000 Algerian dinars during the first and second years, increasing to 100,000 Algerian dinars in the third year and 150,000 Algerian dinars in the fourth year, provided that the research topic is significant, feasible, and capable of generating added value for the national economy.

The Ministry would also work to encourage the establishment of scientific research centers and units within economic institutions and various other companies, such as Sonatrach, Sonelgaz, and Eni Bel Abbès, which were working on establishing a statutory framework for research personnel within these institutions. This would enable them to contribute to the development of economic institutions and keep pace with various global transformations that have increasingly imposed intense competition that cannot be ignored.

Abdelhafid Aouarak, Director General of Scientific Research and Technological Development at the Ministry of Higher Education, revealed that 70% of the reports concerning the achievements and results of scientific research laboratories were positive, particularly those related to exact sciences. Only 5% of the reports concerning chemistry research laboratories were negative, compared with 16% for life and natural sciences and 13% for physics laboratories. The main issue, however, concerned research laboratories in the humanities, for which the Ministry recorded 54% negative reports.

This situation would lead the Ministry to discontinue their funding, given their inability to provide added value to knowledge, scientific research, and the national economy, despite the considerable amount of time they had been given to adapt and transition toward scientific and knowledge production.

At present, Algeria has 1,440 research laboratories comprising approximately 53,000 researchers, including 34,000 research professors and 18,000 doctoral students. Humanities research laboratories account for 36% of the total. Compared with France, Algeria remains behind, as France has approximately 249,000 researchers, including 148,000 working within institutions, whereas Algerian institutions employ only around 300 researchers.

What distinguishes Algerian research laboratories is that 50% of their researchers hold doctoral degrees, while Algeria has 59,000 registered doctoral students. Research laboratories in the exact sciences have a higher proportion of researchers holding doctoral degrees, exceeding 60%, which reflects their superiority in knowledge production.

With regard to scientific research indicators in relation to population size, Algeria progressed from 105 researchers per million inhabitants in 2000 to 492 researchers per million inhabitants in 2015, whereas the accepted global average is 1,080 researchers per million inhabitants. Switzerland ranks first in this field, with 17 PhD holders per 1,000 inhabitants, compared with 0.22 researchers per 1,000 inhabitants in Algeria, 3 PhD holders per 1,000 inhabitants in France, and 7 PhD holders per 1,000 inhabitants in Germany ^{xx}

4. Centers of Excellence: There is a project involving 750 research projects to be carried out by centers of excellence by 2022. The Ministry of Higher Education and Scientific Research intends to adopt new international standards for scientific research laboratories. Accordingly, there will be ordinary research laboratories and others designated as centers of excellence. The Ministry will deal with the latter according to the principle of funding in return for added value, in order to avoid the proliferation of laboratories without positive results. Thus, increasing scientific research funding from DZD 4 billion annually to DZD 20 billion annually should serve as a factor encouraging quality, patents, international publications, and other factors that would improve Algeria's position among leading countries, enable it to compete in knowledge production, assist the national economy in improving productivity and competitiveness, and improve researchers' working conditions so that they can contribute solutions and alternatives in the struggle for productive capacity.

Scientific research laboratories will be required to implement and develop 750 projects during the next five-year period, at an average of 150 projects per year, with a particular focus on the technological development of 230 projects in order to bridge the digital divide and improve Algeria's ranking in this field. Algeria ranks 113th worldwide out of 128 countries in scientific innovation. To diagnose the causes and assess the current situation, the Ministry of Higher Education and Scientific Research launched a study aimed at determining the extent of technological diffusion and use in Algerian institutions, both technically and in terms of human resources, through a census of the number of engineers and technicians, as well as their presence within institutions.

This transition is part of a new perspective on scientific research, particularly after Algeria succeeded in obtaining 237 patents in 2017. These indicators demonstrated the laboratories'

capacity to develop the knowledge economy. The Ministry of Higher Education and Scientific Research recorded revenues estimated at DZD 100 billion centimes, approximately 80% of which came from research laboratories and less than 20% from the contribution of Algerian universities. This figure could increase in the future if scientific research laboratories are developed and successful ones receive additional support. Statistics indicate that Algeria contributes 0.2% of the world's technological knowledge production and 0.02% of knowledge production in the humanities, whereas the United States dominates 33% of scientific and knowledge production in the humanities and one-quarter of global medical production ^{xxi}

Third: Problems and Difficulties Facing Research Laboratories in Algeria

Despite the efforts made to develop scientific research in Algeria, particularly research laboratories, it remains far from achieving the results attained by scientific research in developed countries, as it continues to face numerous obstacles and constraints.

1. Weak Planning and Management of Scientific Research Activities:

Since independence, scientific research institutions have been placed under the supervision of more than one ministry. This has resulted in delays in the implementation of scientific projects, which have been characterized by the absence of a clear vision and a policy with well-defined objectives for the various research activities. In addition, there has been a problem of instability among the bodies responsible for supervising the scientific research sector. The issue is not merely one of developing a research methodology and enacting laws and regulations; rather, the problem lies in the implementation of research programs and procedures, as well as in evaluation, monitoring, motivation, and follow-up. The main management problems can be summarized as follows:

Bureaucracy within the bodies responsible for supervising research, which has hindered many research activities, particularly since national companies did not cooperate with them. Consequently, scientific activity became concentrated in research centers, while universities did not benefit from the scientific results that had been achieved ^{xxii}

The absence of well-defined timelines for implementing research activities, specifying the stages of implementation, costs, sources of funding, and the human resources required.

The lack of connection between research and the development plans adopted by the state, which has contributed to widening the gap between scientific research at the university level and the provision of services to society ^{xxiii}

The lack of coordination among research institutions, resulting in a significant waste of resources, duplication, and repetition of certain research projects ^{xxiv}

2. Absence of Flexible Laws and Regulations Governing Research Institutions

Scientific research institutions in Algeria have undergone changes on 16 occasions. Since independence, numerous ministries have overseen this sector, and these ministries have also undergone several changes in their names. Such changes in the nature of the administrative authority responsible for higher education and scientific research have inevitably affected the performance and productivity of scientific research.

Despite the need for research institutions to enjoy autonomy, whether in managing research projects or administering their budgets, the regulatory provisions of Executive Decree No. 99-224 dated October 31, 1999, which defines the rules governing the establishment, organization,

and operation of research laboratories, stipulate, for example, that the primary authority responsible for managing the laboratory is the university rector rather than the laboratory director. In addition, the disbursement of funds is required to go through the financial controller legally authorized by the government.^{xxv} Instead, university administrations should refrain from interfering in the affairs of research laboratories and should, rather, introduce procedures and facilitate arrangements that provide researchers with greater flexibility and freedom to move between research institutions. Existing laws should also be adapted to allow professors to establish such institutions or research branches whenever they deem them necessary and appropriate, without requiring them to relinquish their original status as researchers^{xxvi}

3. Absence of a Strategy for Marketing Scientific Research Results

This has resulted in a lack of adequate scientific support and systematic dissemination of outstanding scientific research across various fields through specialized publication outlets. There are many distinguished researchers who produce outstanding and innovative research and studies, yet these works do not receive sufficient attention.^{xxvii} The true success of a research institution lies in the final utilization and marketing of the outputs and outcomes of its research activities. Therefore, the policies and strategies adopted by any administration of scientific research laboratories should be linked to both the internal and external environments of these institutions.

This requires the development of appropriate plans to activate the role of marketing management processes and to invest research findings in various economic and social sectors. Research laboratories should develop their marketing activities by adopting a comprehensive marketing approach and policy at all levels of the organizational units concerned with the laboratories, recruiting professionals, and developing individuals with expertise and strong qualifications in business development. In addition, systems should be established to monitor and control marketing activities and to identify the strengths and weaknesses of the links between the various marketing levels and clients.^{xxviii} Scientific research activities can therefore be regarded as among the most important activities, given that their outcomes have repercussions across a wide range of fields.

4. Absence of an Appropriate Environment for Scientific Research

There are numerous social problems that undermine professors' motivation to engage in scientific research, coupled with the lack of appropriate research resources and a sense that research efforts are marginalized. This situation has led many highly qualified researchers to seek opportunities abroad as a result of the unstable conditions surrounding scientific research in Algeria, despite the establishment of new structures and the provision of material resources for researchers.

– Society's perception of the researcher:

Our society does not generally view researchers with admiration and appreciation. Rather, in the eyes of the majority, the researcher is regarded as a person who occupies one of the lowest positions on the scale of social values. Moreover, the incomes of researchers and university professors rank among the lowest when compared with those of other professional groups, such as military personnel and administrators.^{xxix}

Furthermore, the working conditions experienced by academic researchers, including the lack of benefits in terms of housing, incentives, and rewards, lead to psychological instability and prevent them from fully devoting themselves to scientific research, thereby weakening their scientific productivity.^{xxx} Arab societies, in general, are among the populations with the lowest rates of reading, as reflected in the volume and number of scientific books published annually. Compared with their counterparts in Asian countries, they demonstrate weaker levels of reading and research in terms of the types and diversity of scientific books available.^{xxxi}

Researchers' reluctance to pursue scientific research as a profession, due to this negative societal perception of researchers, as well as their relatively low salaries and the absence of an objective criterion for evaluating serious research, has resulted in researchers abandoning the field and preferring to invest in other areas and pursue liberal professions such as medicine, law, notarial services, and scientific consultancy. Many have also migrated en masse to industrialized countries, where such professions generate incomes several times higher than those provided by higher education. This has ultimately contributed to leaving universities and research centers deprived of their intellectuals, researchers, and thinkers.

5. Insufficient Expenditure on Scientific Research

Expenditure on scientific research laboratories is one of the main indicators used to assess the extent of a government's commitment to scientific research. Expenditure on scientific research refers to the provision of the necessary financial resources, from both governmental and non-governmental sources, to finance studies and research with specific objectives in various scientific fields. Algeria allocates 0.28% of its Gross National Product (GNP) to scientific research. Despite attempts to increase the financial appropriations allocated to this sector, this percentage remains low compared with that of some other countries. This is attributed to the absence of a clear strategic plan and the failure to clearly define the role of scientific research in achieving development.^{xxxii}

A closer examination of the budgets allocated to scientific research by successive Algerian governments indicates a considerable degree of interest in this field. Algeria is classified alongside other countries in the second tier, within the category of medium human development, in terms of expenditure on education and training. This is clearly reflected in the construction of universities, specialized faculties, research and training centers, and in equipping them with the latest devices and equipment. It is also reflected in the continued provision of free university education, the granting of scholarships to students for study inside the country and abroad, and the enactment of numerous laws and regulations aimed at organizing and encouraging scientific research.

6. Undervaluation of Scientific Research

Awareness of the importance of scientific research leads universities and leading intellectuals to become producers of ideas and theories. Conversely, economic institutions and applied schools become workshops for implementing and applying the findings reached by these universities. Nevertheless, some administrations in Algeria still fail to recognize the value of scientific research and therefore do not work to facilitate or support it. Instead, they regard it as an intellectual luxury.^{xxxiii}

This is compounded by the limited confidence placed in research institutions and by the failure to recognize the importance of practical research outcomes for productivity. Consequently, there is a lack of understanding of the direct relationship between research findings and the returns that can be generated from them, as well as their impact on the role of scientific research and development.^{xxxiv}

Furthermore, the lack of seriousness in some research projects submitted for consideration can be observed. Some of these studies are closely linked to theories developed in Western societies and consequently provide solutions to problems that do not actually exist in our society, nor do they correspond to the needs of the local market, as their authors have been influenced by their studies in those countries. There is also a negative attitude among some PhD holders, as some researchers may believe that they have reached the pinnacle of knowledge. As a result, their primary concern becomes pursuing leadership positions and high salaries, while abandoning scientific research and its associated challenges. In addition, some researchers suffer from weak research aptitude, whereas scientific research requires talent that must be developed through knowledge, perseverance, and dedication.^{xxxv}

7. Difficulties in Obtaining Information and Utilizing Research Findings

Researchers often face difficulties in obtaining certain sources of information, particularly within government administrations, which surround official figures and statistics with unjustified secrecy.^{xxxvi} Furthermore, the relevant authorities in the country show little interest in research findings and do not give them adequate attention. This represents a significant contradiction: on the one hand, substantial amounts are spent on education and scientific research, while on the other hand, little attention is subsequently paid to utilizing its findings.^{xxxvii}

In addition, there is a weak relationship between research institutions, research laboratories, and the productive sector. Universities generally perceive that industrial institutions and other organizations have limited confidence in the results of university scientific research and are not convinced of its practical usefulness. At the same time, managers and businesspeople in the industrial sector and other sectors believe that universities do not pay sufficient attention to conducting applied research capable of addressing or solving practical and scientific problems.^{xxxviii}

8. Lack of Sufficient Time to Conduct Research

Universities are relied upon to conduct scientific research because they contain a significant proportion of the intellectual and academic elite. However, the latter primarily focus on teaching, which consumes most of their time and leaves them with limited opportunities to conduct research. In addition, most of them hold administrative positions, which constitute a further obstacle to engaging in scientific research.

Fifth: Conclusion

This study, through addressing the research problem and testing the validity of the hypotheses, demonstrates that university research laboratories do indeed contribute to the advancement of scientific research in Algeria. This is evidenced by the figures and indicators presented in the study, as well as by the increase in patents and international scientific publications, particularly those produced under the supervision of university research laboratories. Scientific research

has also been allocated an independent budget, with a degree of autonomy in its management and expenditure separate from the university's overall budget. Although the laboratory's budget (operating and equipment budgets) is incorporated into the university's accounts and budget, the assessment of needs and the determination of expenditure areas are decided by the laboratory's governing office. Therefore, no one can ignore the importance of funding scientific research, which can mobilize untapped potential, and this has been achieved through the availability of financial appropriations. The Ministry of Higher Education and Scientific Research also seeks to encourage the establishment of new research centers and entities within economic institutions.

Study Recommendations

In order to improve the state of scientific research in Algeria, decision-makers must undertake a series of reforms. The reform policy that has already been initiated through the establishment of research laboratories has transferred scientific research in Algeria into areas that were previously neither feasible nor easily accessible. This policy has focused on the following: Scientific research has been allocated a special budget that is relatively independent in terms of its management and expenditure from the university's budget. Although the laboratory's budget (operating and equipment budgets) is incorporated into the university's accounts and budget, the assessment of needs and the determination of expenditure areas are decided by the laboratory's governing office. Therefore, no one can ignore the importance of funding scientific research, which can mobilize untapped potential, and this has been achieved through the provision of substantial financial appropriations. In order to achieve the objectives of scientific research and technological development established for the five-year period 1998–2002, Article 21 of the Program Law provided for increasing the share of gross national product allocated to scientific research from 0.2% in 1997 to approximately 1% during the period from 1998 to 2002. This contributes to creating the enabling environments necessary for scientific research, since one of the most important foundations for accomplishing any task is to provide the requirements and means necessary for its implementation. Scientific research is among the major priorities for which developed countries compete, as progress and competitiveness have increasingly become dependent on the outputs of scientific research. The more successfully countries provide the necessary requirements for scientific research, the better the results they achieve. These measures include the promotion of fundamental freedoms, from which university administrations should begin, in addition to allocating sustainable financial resources.^{xxxix}

Allocating dedicated scientific facilities to each research laboratory, together with the equipment necessary to conduct scientific research. Despite the availability of human resources in scientific and technical research across various universities, university centers, higher schools, and institutes, insufficient funding and the absence of laboratory equipment—particularly in the experimental and exact sciences—have often constituted obstacles to research and scientific achievement. Within the framework of Law No. 98-11 concerning scientific research and technological development, approximately fifty research laboratories were established in the field of construction. The substantial financial support allocated to

research laboratories made it possible to acquire numerous pieces of equipment, instruments, and machines that had previously been lacking.

Managing scientific research by the laboratory staff in an almost independent manner from the administration, thereby achieving a separation between administration and scientific research. The administrative responsibilities assigned to university administrations have always constituted an obstacle to allocating more time and greater effort to scientific research. Moreover, scientific research encompasses numerous fields and specializations, making it difficult for a single entity to adequately oversee and manage them all.

It is necessary to link scientific research activities to the problems of society and its various sectors, including the industrial, agricultural, service, private, and governmental sectors. This should be achieved through comprehensive surveys of these problems and by identifying the urgent need to address them in a manner that serves comprehensive development and advancement programs. Coordination between universities and external stakeholders plays an important role in this regard by focusing on high-quality research.^{xi}

Accordingly, it has become possible to establish stronger links between universities and scientific research on the one hand, and the economic and social sectors on the other. This process has not been limited to research laboratories engaged in experiments aimed at producing material services; rather, it has also been achieved in laboratories operating in the fields of the humanities and social sciences.^{xli}

Serious efforts should be made to raise awareness among private-sector leaders of the importance of scientific research and its necessity for addressing various problems. This would contribute to improving the productive efficiency of these sectors and, in turn, increase their contribution to financing scientific research activities, rather than relying solely on the government as the only source of funding. It is also necessary to establish a dedicated budget for scientific research, given that it represents one of the most important pillars for achieving the required technological advancement and directing it in accordance with the strategic development plan^{xlii}.

Utilizing knowledge to serve development: The exploitation of the outcomes of scientific research and their deployment for the benefit of humanity is an objective pursued by both companies and universities in their efforts to achieve competitiveness. Therefore, universities and research centers are required to establish sound relationships between the production of goods and services, knowledge, and economic and social development plans, while maintaining continuous links with the needs and practical applications of development in its various dimensions.^{xliii}

In addition, policies should be developed to facilitate the return of highly qualified expatriate researchers by connecting them with research centers and economic institutions within the country, thereby benefiting from their expertise in technology and knowledge transfer. This also requires providing them with professional and social conditions that are at least comparable to those under which they work abroad. In this regard, it is noteworthy that, in 2012, the Directorate General for Scientific Research and Technological Development launched a program aimed at encouraging young researchers and integrating them into national university institutions. It also established the "President of the Republic Award" in specialized

scientific fields, with the aim of attracting highly qualified researchers and enabling them to implement their scientific projects within the country.^{xliv} In particular, the Arab environment, in general, has often been characterized as being unfavorable to scientific competencies, resulting in the migration of Arab professionals and researchers, which accounts for approximately 31% and contributes to the underdevelopment of developing countries. Statistics indicate that this migration continues to increase, particularly among specialists in important scientific, technological, and technical fields.^{xlv}

Scientific research at universities should be linked to the salary system, particularly with regard to scientific output, since scientific production constitutes a fundamental basis for measuring the performance efficiency of the university system and represents one of the main responsibilities of university professors. This requires changing the criteria governing government subsidies, so that scientific output becomes a primary criterion rather than the size of the university or the number of its members. Such measures would foster competition, improve university outputs, and strengthen the role of the economic and social dimensions.^{xlvi}

Specialized scientific research centers should be established according to clear regulations and criteria, with membership based on the researchers' abilities, qualifications, and competencies. The administrative and teaching burdens imposed on faculty members should be reduced in order to provide them with sufficient time to conduct high-quality scientific research.

A university environment conducive to scientific research should be created, encouraging engagement in research activities, consolidating the principle of fair competition, and ensuring decent living conditions for university professors so that they can devote themselves to scientific research.^{xlvii} In light of the developments brought about by globalization and the market economy, Algerian higher education institutions must assume new roles, including developing strategies for building and enhancing human capacities, on the one hand, and adopting specific roles aimed at localizing technology, on the other. Furthermore, technological development should not be viewed solely as a means of advancing scientific research—which, in turn, expands the range of technological options available—but also as a process that generates patents, thereby enriching industry and contributing to its continued development^{xlviii}

In this context, the Minister of Higher Education and Scientific Research, Tahar Hadjar, stated in response to questions from members of Parliament that DZD 200 billion had been allocated to scientific research. He considered this amount insufficient when compared with the ambitions that Algeria seeks to achieve in order to bring the country closer to the ranks of developed nations.

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