DEVELOPMENT OF SCIENCE IN THE ANGOLAN PERSPECTIVE: PROBLEMS AND SOLUTIONS

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Abstract. The paper contains an overview of the process of the development of science with the emphasis on local science. General models proposed by Imre Lakatos and Thomas Kuhn are described, compared and applied to the sphere of research and development in Angola. The authors analyze the statistics focused on science and its development in Angola, discuss the problems faced by Angolan science and propose the possible solutions.The authors claim that there are key conditions which can provide the global competitiveness of Angola in terms of scientific productivity. The conditions include construction of a benchmarking table for the webometric university ranking indicator and selection of the best university systems in Sub-Saharan African countries; calculations of imitations (simulators) according to variation (increasing) in the webometric rankings of private Angolan Universities in order to increase the webometric university ranking of Angola; construction of a benchmarking table for four webometric indicators for all of the private Universities in Angola.

Key words: scientific paradigm; development of science; Angolan science

РАЗВИТИЕ НАУКИ В АНГОЛЕ: ПРОБЛЕМЫ И ПУТИ ИХ РЕШЕНИЯ

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Аннотация. Статья содержит обзор глобальных процессов развития науки и их отображение в научной жизни Анголы. Описаны и сопоставлены общие модели, предложенные Имре Лакатосом и Томасом Куном. Данные модели науки последовательно применены к анализу научно-исследовательской сферы деятельности в Анголе. Авторы анализируют статистические данные, отображающие многочисленные параметры научной деятельности в Анголе, обсуждают проблемы, возникающие на пути ее развития, и предлагают возможные пути их решения. Авторы отмечают наличие ключевых решений обозначенных ранее проблем, преодоление которых может привести к повышению конкурентоспособности Анголы с точки зрения развития ее науки. К таким факторам относится проведение сравнительного анализа научной деятельности государственных университетов Тропической Африки; вычисление вебометрического рейтинга университетов Анголы; проведение анализа научной деятельности частных университетов. Сбор статистических данных о научной деятельности в высших учебных заведениях Анголы, их сопоставительный анализ, проведение оценочных испытаний и установление контрольных точек позволят выявить векторы ускорения научно-исследовательской деятельности и сформировать предпосылки для развития науки в Анголе.

Ключевые слова: научная парадигма, развитие науки, наука в Анголе.

Introduction

The history of classical science unified in philosophy has a peculiar cognitive form, which consists in the specification of spiritual observance and the systematic organization of social institutions. This form gave rise to the so-called form of *natural science*, which in turn developed in a relatively independent manner.

The development of science, in general, brings together four (4) points of reference, namely: Ancient Cultures, which includes Science in the ancient Middle East, Science in Ancient Egypt, Science in the Greco-Roman world, Science in India and Science in China; Science in the Middle Ages, which includes Science in the Islamic world and Science in Medieval Europe; Science in the Renaissance and Modern Science [Vlasov, 2012]. These four (4) axes of science, represented in different cultures and knowledge, are the main pillars of science in current times, since science is in a very accelerated development, in which new knowledge is being introduced, refuting or improving old knowledge, as well as the premises and theories that are undergoing some corrections. When taking into account these relevant factors, the occurrence of quantitative and qualitative changes in knowledge are visible, that is, the gradual accumulation of new facts, observations, and experimental data within the framework of existing concepts.

With this precise evolution of science, it is quite common, in modern times, the responsibility of each country to develop its local science, according to the tendencies of the reflections of its people, that is, the result of a development system that produces minds capable of creating new knowledge, based on the experiences acquired during training or during the exchange of experiences and ideas with different experts and studies on different subjects, related to the enclosing world.

Many countries have achieved great success in the development of *Local Science*, through the creation of Science Academies, as well as National Centers for Advanced Research and other related institutions.

Academic culture is one of the main components for achieving positive results at various levels of science. Brazil, for example, has developed its science on the basis of the development of a safe and strong academic culture. Today, in the Community of Portuguese-Speaking Countries (CPLP), Brazil is regarded as a great reference in terms of availability and introduction of highly relevant scientific results.

According to the authors of the paper [Zimba et al., 2008], with the analysis carried out on the evaluation of the degree of coverage of the ISI Web of Science and SCOPUS databases in relation to research produced and published by authors who carry out their research activities in the PALOP, it was verified that Mozambique, around the time of the research, notably leads with 61.6% of documents produced from the total of publications, carried out by the countries of the community. The second place was occupied by Guinea Bissau (17.3%), and in the third place – Angola (16.1%), according to Scimago.

Many visions for the development of science and technology in Angola are presented, in many cases, through surely ambitious and innovative projects, such as, for example, FUNDECIT – National Foundation for Scientific and Technological Development, created by Presidential Decree in May of 2021, is under the tutelage of the Ministry of Higher Education, Science, Technology and Innovation, as the

overseeing body, which is responsible for creating conditions for its operation, based on the priorities defined in the National Policy on Science, Technology and Innovation, which has the mission to implement science, technology and innovation policies, with financial means from the General State Budget and from donations aimed at scientific research and development [Site oficial da Angop…, 2022].

The most recent study on the competitive level and development of the Angolan scientific system was prepared by the authors of the paper [Casimiro et al., 2021a]. The results of the study show that Angola has a weak scientific system, which significantly influences its level of scientific productivity and, consequently, its competitiveness. In conclusion, the authors of the referenced paper focus their thinking on the essential vision of giving more relevance to scientific knowledge produced by Angolan scientists and treating it as an indispensable ally for social growth and development, making it an indispensable tool for solving economic, social and even cultural problems.

Science development models

From the 20th century onwards, science began to take an evolutionary path, due to the systematic organization of accumulated scientific facts and the multi-variety of theories. The revolution follows the evolution of science, that is, ideological problems, crises, collapses, conceptual restructuring and other contradictory cases are frequent in the world of science, which give rise to new horizons of scientific consciousness within it.

The contradictions faced by science culminated in the development of models, which became guidelines in the 20th century. The models that have reached a considerable level of notoriety are the models of the American scientist **Thomas Kuhn** and the British scientist **Imre Lakatos**.

Thomas' model analyzes the development of science based on scientific paradigms[1]*that*are susceptible to change. The great scientists of the past such as **Aristotle**, **Ptolemy**, **Copernicus**, **Galileo** and **Newton**, presented paradigms that lasted many years. Inrecent past, the scientist **Einstein** presented to the world of science the paradigm of relativity, according to which the Universe has no center, beyond borders, or rather, any point can be considered its center, it will only be a conditional, relative center [Gusev, 2022].

The sustainability of **Thomas'** dialectical discussion of the development of science as such concerns the comparison of the symmetrical growth of a tree with the predictability of its branches, which he claims is not convincing enough to be called development. But if it is a type of tree, whose growth is asymmetrical, showing unpredictability, then it can be said that there is development. In other words, the development of science must obey the principle of revealing unpredictability, making scientific knowledge assert itself as such, giving rise to paradigms.

The model proposed by **Imre Lakatos** for the development of science does not differ much from **Thomas Kuhn's** model, but it presents a vision considered

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[1]A paradigm, in the broadest sense of the word, is a collection of any ideas, visions, positions, etc. A scientific paradigm is a system of more general and broader scientific ideas about the world around us.

fundamental. **Imre Lakatos** used an expression, considered synonymous with the word paradigm – research program, which must not obey the principle of unpredictability, that is, scientific introductions must be categorical and considerably rational, respecting the rigor of logical and scientific criteria. This program is based on the cognitive view of the basic ideas, on the *negative heuristic* and on the *positive heuristic*.

Positive heuristics help scientists, who work with research programs, pay more attention to their scientific inquiries, not giving too much weight to the comments of refutors. But this does not define infinite positive results, since the cognitive view of the basic ideas can show deficiencies over time, due to the fact that it becomes outdated. Therefore, there will be an urgent need to reconstruct new ideas, changing the research programs that in many cases are considered a scientific revolution. As **Imre Lakatos** himself stated: "A program is considered progressive when its theoretical growth anticipates its empirical growth, that is, when it manages to predict new facts with some success..." [Lakatos, s.a.].

Thus, from **Thomas Kuhn's** point of view, the development of science is a successive shift of scientific paradigms, which occurs mainly irrationally; and according to **Imre Lakatos**, the development of science is in the change of research programs, occurring in a rational way. Furthermore, according to the two scientists, this change finds its expression in the scientific revolutions that, therefore, play an important role in the development of science, and represent some key and remarkable moments in its history.

Development of science in Angola: main problems and solutions

Many modern analysts claim that the major problem of the slow development of science in Angola is precisely the insignificant investment for the development of scientific projects of great relevance and the visions of Angolan scientists in solving social problems outside the Angolan context.

Science in Angola, that is, the results of scientific production, linked to specific issues in Angola, still does not have the necessary sway power for decision-making related to political implementations that can substantially develop the social and economic life of Angolans.

One of the major problems of reducing the relevance of the development of local science lies in the small group of national scientists, who have the necessary qualifications in terms of carrying out scientific investigations, as well as the low responses of scientific achievements in the technical-scientific environment and low productivity, which would help in quickly introducing inventions and mass producing new knowledge.

According to Scimago, from 1996 to 2020 Angola produced 1489 scientific documents officially published in scientific journals, of which there were 19,590 citations. In 2014, Angola made more documents available for open access, compared to other years, according to figure 1 [Site oficial da Scimago…, 2022].
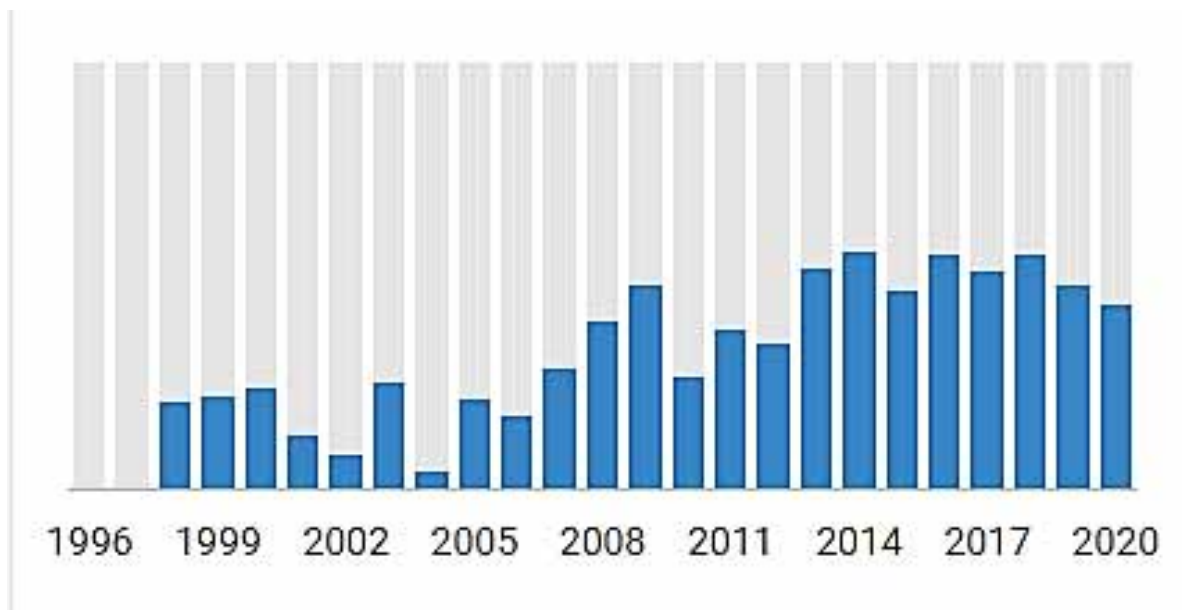
Figure 1. *Documents produced by Angola from 1996 to 2020 available in open access (%)*

Compared to the top 5 (five) on the list (Africa leaders), according to source data [Gusev, 2022], Angola'sdata has no impact. In the 2020 ranking, Angola occupies the 38thposition, a difference of 6 documents with Guinea, which occupies the 37th position. In 2019, Angola occupied the 41st position in the data presented from 1996 to 2017, having produced 1,005 scientific documents [Casimiro, 2019a], which, compared to the current ranking, shows a certain improvement, as it leaves the 41st position (in 2017) to reach the 38th position (in 2020) in three years.

We should work to perform better than we did during the three years of improvement, as Figure 2 shows the considerable dominance of the countries that occupy the first 5 places compared to Angola, as a reason to continue to work hard, as it is believed that Angola can be among the top 20 on the list until at 2026 at least.
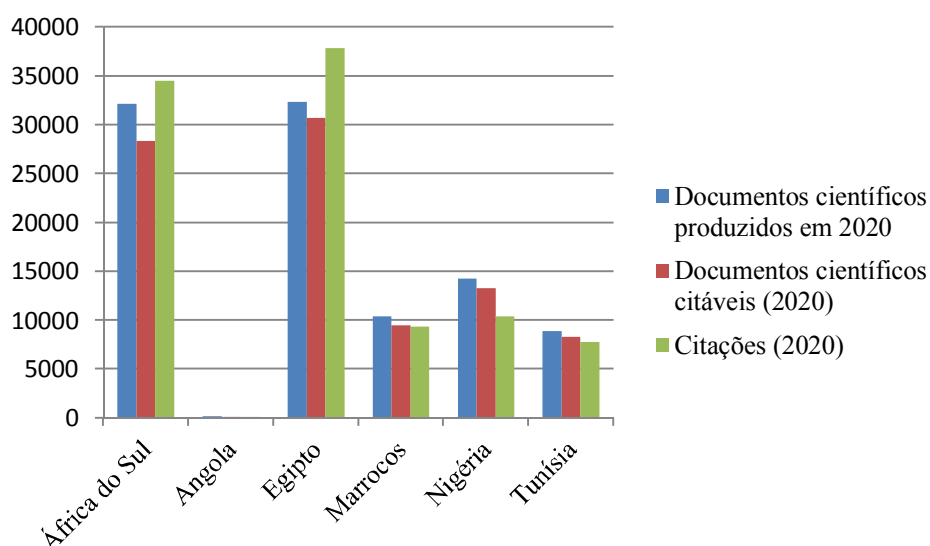

Figure 2. *Data from the 5 leading countries compared to Angola (2020)*

As we can see, the first place is occupied by Egypt with 32,323 scientific documents produced, of which 30,697 are citable. In second place is South Africa with 32,174 documents produced, of which 28,365 are citable. Next, we have

Morocco with 10,403 documents, of which 9,463 can be cited, and finally Tunisia which occupies fifth place with 8,890 scientific documents produced, of which 8,338 are citable.

From the data presented, we can have a clearer view of Angola's great challenges for the development of local science. The leading countries have a highly developed scientific system, in which the main bases for solidifying knowledge consist of the creation of indexed and high-impact journals (SCOPUS). The existence of journals with this category, not excluding the factor of dominance of the English language, makes these and other countries obtain satisfactory results.

Thus, we can categorically state that Angola's main problem not being in acceptable positions is the lack of high impact journals (SCOPUS), as well as national policies to encourage Open Access.

In the motivation, presented in 2021 by the authors of the study [9], it was analyzed that Sub-Saharan African countries generate less than one percent of the world's scientific publications. This is largely due to the small number of scientific journals in these countries. The high-status journals in these countries (Scopus – journals) are distributed as follows (93 journals in total):

1. South Africa – fifty (50) journals, of which sixteen (16) are medical journals;

2. Nigeria – twenty (20) journals, of which twelve (12) are medical, four (4) are pharmaceutical sciences journals, one (1) isa library and information sciences journal, one (1) of agriculture and one (1) of socio-economic sciences and philosophy;

3. Kenya – six (6) journals, three (3) medical, two (2) agricultural and one (1) of ornithology;

4. Ethiopia – four (4) journals, three (3) of medicine, one (1) of chemistry;

5. Ghana – three (3) journals, one (1) of medicine, one (1) of ecology and one (1) of physics;

6. Uganda – 2 medical journals;

7. Zimbabwe – 2 social science journals;

8. Senegal – 2 social science journals;

9. Malawi – one (1) medical journal;

10. Mali – one (1) medical journal;

11. Rwanda – one (1) medical journal;

12. Tanzania – one (1) medical journal.

These data were collected in October 2020 on the Scimago platform. From them, we see that of about 50 countries in Sub-Saharan Africa, only 12 countries have Scopus Journals, mainly with a health sciences profile. As we can see, there are no high status journals in Angola, i.e. Scopus Magazines. The relevance of Open Access and webometric research in the world, and especially for African countries, as we have already shown above, makes it urgent to create a journal of this nature in Angola. For this to be a reality, there must be funding for a period of 3-4 years, until it is included in Scopus. After inclusion, the journal can become self-sufficient due to APC (Article Processing Charges), which introduce most AL – Journals (OA-journals). In the initial stage of creating the magazine,

For a better expansion of the work of Angolan researchers, which will culminate in the development of science from the Angolan perspective, Angolan scientific journals must be registered in the Directory of Open Access Journals (DOAJ). In addition, they must be registered with the African Journal online (AJON), where 526 journals from 32 African countries are registered (as of 3/11/20). On this platform, the largest number of registered journals are from Nigeria – 222, and many of them claim to have purely African status, because their nomenclatures begin with the word "African".

In order for us to have significant results for Angola, it is advisable to create journals in two languages, publishing articles in English and Portuguese in them. The publication of articles in Portuguese will attract authors from Portugal and Brazil, who work on Open Access issues in African countries or share their experiences with African researchers.

As if that were not enough, there is a need to develop a set of measures to boost the global competitiveness of IESs. The author of the work [Casimiro et al., 2021b], in 2019, stated that if we want to achieve a satisfactory classification, it is necessary to carry out a University Webometric Benchmarking Procedure. His algorithm consists in the following [Casimiro, 2019b]:

1. Construction of a benchmarking table for the webometric university ranking indicator for Sub-Saharan African countries on a biannual basis (University webometric rankings are calculated twice a year).

2. Selection of the best university systems in Sub-Saharan African countries and their target indicators, with the aim of their continuous implementation in the Angolan university system.

3. Calculations of imitations (simulators) according to variation (increasing) in the webometric rankings of private Angolan Universities in order to increase the webometric university ranking of Angola and achieve the rankings of the selected leading countries. As a result, we will obtain a series of scenarios from the leading countries for the achievement of Angola's target indicators.

4. The scenarios obtained will be the basis of the webometric university benchmarking carried out for the Universities of Angola. Construction of a benchmarking table for four webometric indicators for all of the private Universities in Angola, on a biannual basis.

Taking these key conditions into account, one can guarantee the global competitiveness of Angola, in terms of scientific productivity of great relevance to the world of science. Because a large part of Higher Education Institutions in Angola do not have policies to encourage effective scientific and technological innovation, which are the main levers for demonstrating to the world what HEIs in Angola are producing and innovating. With that, everything we produce in Angolan territory "is only in Angola". To solve this problem, as we said earlier, we must create safe conditions for the development of open access, which directly depends on the existence of Scientific Platforms for the coordination of scientific productions, which are carried out in the national territory –*creation of repositories and high impact indexed scientific journals*.

Conclusion

With the approaches presented above, we can see that science develops in the dynamics of scientific introductions by several scientists from different fields of activity.

From the analysis carried out, it became clear that the steps carried out by Angola for the development of local science and technology are not based on scientific structures geared towards cognitive sustainability, which are the main pillars of development.

To guarantee the non-infringement of scientific principles and the stability of the academic-scientific culture, which will provide significant results, the Angolan scientific system must undergo a systematic restructuring, based on the models proposed by **Lakatos** and **Thomas**, as both scientists have ideas with logical visions, necessary to guarantee the stability and adequate development of science in a country with characteristics similar to Angola.

More boldness and assurance of convictions by Angolan scientists is needed, which must be supported by modern policies for the development of science from the Angolan perspective. The creation of executable and updateable research programs, as a result of a set of scientific problems, which reflect the main problematic issues that Angolan society presents over time is recommended.

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