

An Examination of Africa's Contribution to the World's Scientific Development

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Abstract

This paper examined Africa's contribution to the world's scientific and cultural development. Over time, Africa has played a prominent role in the areas of science, religion, technological and cultural development. Africa has the world's oldest record of human technological achievement: the oldest stone tools have been found in eastern Africa. Cultural Attraction Theory (CAT) was adopted as the theoretical framework. The finding shows that only a limited number of individuals are aware that numerous contemporary high school mathematical principles originated in Africa, including the initial counting methods and Africa's cultural contributions have been significant, varied, and lasting, influencing both the continent's identities and global artistic, literary, musical, and philosophical movements. The paper concluded that science and technology have immensely contributed to development. The paper recommended that **Federal Ministries of Science and Technology across African States** should increase annual budgetary allocations to research and development, **African Union (AU) Department of Education, Science, Technology and Innovation (ESTI)** should coordinate a continent-wide framework for scientific collaboration. **National Ministries of Culture and Tourism** should develop legally binding regulations to strengthen the preservation of artefacts, historical sites, and indigenous knowledge systems.

Key Words: Madrassa, Al-Azhar, epidemiology, agronomy, metallurgy, Nubia, Askum, Timbuktu.

Introduction

Africa's contribution to global scientific and cultural advancement stretches back to the earliest foundations of human civilisation and continues to resonate in contemporary intellectual and creative spheres. Long before modern scientific institutions emerged, African societies generated sophisticated knowledge systems that shaped human understanding of mathematics, medicine, astronomy, engineering, agriculture, and artistic expression. Ancient Egypt, for instance, produced early mathematical principles, including the use of geometry for land measurement and architectural precision, which supported monumental achievements such as the pyramids (Imhausen, 2020). In Ethiopia, the Axumite civilisation developed complex systems of metallurgy and terracing that influenced sustainable agricultural practices across the Horn of Africa. Similarly, the Mali Empire under Mansa Musa became an epicentre of

learning, with the Timbuktu manuscripts illustrating highly developed research traditions in astronomy, pharmacology, theology, and governance (Hunwick, 2020).

Africa's impact on global scientific development is also visible in traditional medicine and ecological knowledge. Indigenous communities across West and Central Africa relied on botanical research that produced effective treatments for malaria, gastrointestinal diseases, and mental health disorders (Sinthumule, 2023). Modern pharmaceuticals have drawn heavily from these discoveries, including the active compounds in *Artemisia annua* and several plant-based antibiotics. The continent's advanced environmental knowledge systems guided water management, pastoralism, and climate adaptation strategies long before modern climate science emerged.

Culturally, Africa has been equally influential. The continent's contributions to music, dance, oral literature, sculpture, textiles, and philosophy have shaped global artistic evolution. African rhythms and instruments provided the foundation for jazz, blues, reggae, Afrobeat, and many contemporary global genres (Allotey-Pappoe, 2024). African philosophies, such as Ubuntu, inspired modern thinking on community, ethics, and restorative justice. Artistic innovations from Nok terracotta to Benin bronzes continue to redefine global art history and challenge Eurocentric narratives about creativity and technical expertise.

Despite these contributions, scholarly recognition of Africa's scientific and cultural impact remains limited. Many colonial-era writings underrepresented African knowledge systems, leading to gaps in global academic discourse. Maqashalala (2025) emphasised the importance of revisiting Africa's intellectual history to correct historical distortions and highlight indigenous innovation. Contemporary African scientists and cultural creators continue to shape global developments in technology, literature, film, and digital arts, reinforcing the continent's enduring relevance. The need for this paper arises from the persistent underrepresentation of Africa's scientific and cultural achievements in mainstream academic and policy discussions, underscoring the need to document, analyse, and amplify Africa's enduring contributions to global development.

Theoretical Framework

The paper adopted Cultural Attraction Theory (CAT) as the theoretical framework. The theory, also referred to as cultural epidemiology, is an evolutionary theory of culture. It provides conceptual tools and a theoretical framework for explaining why and how ideas, practices, artefacts, science, and other cultural items spread and persist within a community and its habitat. It states that cultural phenomena result from psychological or ecological factors of attraction. Cultural attraction theory conceives of cultural phenomena as relatively stable distributions of similar items, either in people's minds or in their habitats: their history, scientific achievements, religious beliefs, patterns of development, or motor skills. Items in the habitat are public productions and can be public expressions of mental contents, such as spoken or written utterances, action patterns, or artefacts (Dehaene & Cohen, 2007).

CAT's main theoretical claim is that the propagation of cultural phenomena results from processes that are repeatedly enacted and transmit similar content or action patterns. Most episodes of transmission will include transformations of the transmitted items. Nonetheless, cultural stability can occur when transformations, rather than being random, converge on or gravitate toward the duplicate content or patterns. The causal factors that determine which transformations are more likely to occur pertain to the processes that construct the items and to the properties of those processes. The processes and the associated causal factors can be cognitive or not, and they can be psychological (occurring in the head) or ecological (occurring

in the body and the environment). The specific loci of the space of possible items towards which actual items gravitate are called cultural attractors. They are statistical types that help describe the distribution of cultural items within a given cultural phenomenon. Importantly, they have no causal power to attract other items. The causal factors are these aspects of the processes that bias transformation towards cultural attractors; they are called factors of attraction. Cultural Attraction Theorists aim to describe the cultural attractors that shape cultural phenomena and identify the factors of attraction that influence the social transmission and production of cultural items, thereby accounting for the observed cultural phenomena (Boyer, 2001).

The specific contributions of cultural attraction theory to understanding culture include:

1. A theoretical analysis of the chain of events that produce cultural phenomena
2. Investigations of the evolved psychological traits at the basis of some cultural phenomena
3. A discussion of the way to model cultural evolution

In practice, this theory seeks to elucidate the cultural evolution of Africa and its role in the stone, medieval, and modern eras of science, technology, cultural development, medicine, agriculture, engineering, etc. This theory focuses on bringing to light the African perspective in the world's scientific and cultural development.

An overview of Africa's Contribution to World Scientific and Cultural Development

Africa has the world's oldest record of human technological achievement: the oldest stone tools have been found in eastern Africa, and later evidence of tool production by our hominin ancestors has been found across Africa. The history of science and technology in Africa since then, however, has received relatively little attention compared to other regions of the world, despite notable African developments in mathematics, architecture, the arts, metallurgy, and other fields (Peter, 2015).

Africa's Contribution to Science and Technology

Math

Only a limited number of individuals are aware that numerous contemporary high school mathematical principles originated in Africa, including the earliest counting methods (Agbata, Obeng-Denteh, Abraham, Asante-Mensa, Kwabi, Okpako, Arivi, 2024). Over 35,000 years ago, Egyptians authored mathematical texts encompassing the division and multiplication of fractions, as well as geometric formulas for calculating the area and volume of objects. Distances and angles were computed, algebraic equations were resolved, and mathematically grounded predictions on the magnitude of Nile floods were formulated. The ancient Egyptians regarded a circle as having 360 degrees and approximated π as 3.16 (Goos, Stillman, Herbert, and Geiger, 2020).

Eight thousand years ago, inhabitants of contemporary Zaire established their own numerical system, as did the Yoruba in present-day Nigeria. The Yoruba numerical system was based on base 20 rather than base 10 and required considerable subtraction to determine various quantities. Scholars have praised this system for necessitating significant abstract reasoning (Usman & Falola, 2019).

Astronomy

Several ancient African cultures made discoveries in astronomy. Many of these are foundations on which we still rely, and some were so advanced that their mode of discovery still cannot be understood. Egyptians charted the movement of the sun and constellations and the cycles of the moon. They divided the year into 12 parts and developed a yearlong calendar system

containing 365 $\frac{1}{4}$ days. Clocks were made with moving water, and sundial-like clocks were used (Goos, Stillman, Herbert, and Geiger, 2020).

A structure known as the African Stonehenge in present-day Kenya (constructed around 300 B.C.) was a remarkably accurate calendar. The Dogon people of Mali amassed a wealth of detailed astronomical observations (Kutsenkov, 2024). Many of their discoveries were so advanced that some modern scholars credit them instead to space aliens or unknown European travellers, even though the Dogon culture is steeped in ceremonial tradition centred on several space events. The Dogon knew of Saturn's rings, Jupiter's moons, the spiral structure of the Milky Way, and the orbit of the Sirius star system (Peter, 2015). Hundreds of years ago, they accurately plotted orbits in this system through 1990. They knew this system contained a primary star and a secondary star (now called Sirius B) of immense density and not visible to the naked eye.

Metallurgy and tools

Many advances in metallurgy and tool-making were made across ancient Africa. These include steam engines, metal chisels and saws, copper and iron tools and weapons, nails, glue, carbon steel and bronze weapons and art (Peter, 2015).

Advances in Tanzania, Rwanda, and Uganda between 1,500 and 2,000 years ago surpassed those of Europeans at the time and were astonishing to Europeans when they learned of them. Ancient Tanzanian furnaces could reach 1,800°C — 200 to 400°C warmer than those of the Romans (Obwona, Shinyekwa, Kiiza and Hisali, 2014).

Architecture and engineering

Various past African societies created sophisticated built environments. Of course, there are the engineering feats of the Egyptians: the bafflingly raised obelisks and the more than 80 pyramids. The largest of the pyramids covers 13 acres and is made of 2.25 million stone blocks (Goos, Stillm, Herber, and Gei, 2020). Later, in the 12th century and much farther south, there were hundreds of great cities in Zimbabwe and Mozambique. There, massive stone complexes served as hubs for cities. One included a 250-meter-long, 15,000-ton curved granite wall. The cities featured huge castlelike compounds with numerous rooms for specific tasks, such as iron-smithing. In the 13th century, the empire of Mali boasted impressive cities, including Timbuktu, with grand palaces, mosques, and universities (Peter, 2015).

Medicine

Several ancient peoples employed many treatments we use today throughout Africa. Before the European invasion of Africa, medicine in what is now Egypt, Nigeria and South Africa, to name just a few places, was more advanced than medicine in Europe. Some of these practices included the use of plants with salicylic acid for pain (as in aspirin), kaolin for diarrhoea (pectate), and extracts confirmed in the 20th century to kill Gram-positive bacteria (Robert & Geiger, 2020). Other plants used had anticancer properties, induced abortion, and treated malaria, and are as effective as many modern Western treatments. Furthermore, Africans discovered ouabain, capsicum, physostigmine and reserpine. Medical procedures performed in ancient Africa before they were performed in Europe include vaccination, autopsy, limb traction, broken bone setting, bullet removal, brain surgery, skin grafting, dental cavity filling, installation of false teeth, what is now known as the Caesarean section, anaesthesia, and tissue cauterisation. In addition, African cultures universally performed surgeries under antiseptic conditions, even as this concept was only emerging in Europe (Goos, Stillman, Herbert, and Geiger, 2020).

Navigation

Bruhns (2024) contended that ancient Africans sailed to South America and Asia hundreds of years before Europeans did. Thousands of miles of waterways across Africa were trade routes. Many ancient societies in Africa built a variety of boats, including small reed-based vessels, sailboats and grander structures with many cabins and even cooking facilities. The Mali and Songhai built boats 100 feet long and 13 feet wide that could carry up to 80 tons. Currents in the Atlantic Ocean flow from this part of West Africa to South America (Denton, 2021). Genetic evidence from plants, along with descriptions and art from societies inhabiting South America at the time, suggests that small numbers of West Africans sailed to the east coast of South America and remained there. Contemporary scientists have reconstructed these ancient vessels and their fishing gear and have completed the transatlantic voyage. Around the same time that they were sailing to South America in the 13th century, these ancient peoples also sailed to China and back, carrying elephants as cargo (Goos, Stillman, Herbert, and Geiger, 2020). People of African descent come from ancient, rich, and elaborate cultures that developed a wealth of technologies across many areas.

Africa's Contribution to Cultural Development

According to Wright and Xiao (2024), Africa's cultural contributions have been significant, varied, and lasting, influencing both the continent's identities and global artistic, literary, musical, and philosophical movements. Over millennia, African communities established intricate systems of meaning, oral traditions, ceremonial performances, visual arts, and social philosophies that sustained communal existence and transmitted knowledge across generations. Akinyemi and Falola (2021) contended that the systems emerged as wellsprings of invention and resilience throughout epochs of trade, empire, colonialism, and post-colonial transition. Oral literature and performance were important to the transmission of African culture. Griots, as storytellers, praise singers, and poets, safeguarded genealogies, legal codes, and moral principles through narrative and music; their methodologies impacted written literature as African authors adapted oral traditions into novels and plays (Howell, 2025). The emergence of contemporary African literature in the twentieth century, exemplified by authors such as Chinua Achebe and Ngũgĩ wa Thiong'o, redefined global perceptions of history, identity, and resistance, contesting colonial narratives and establishing a world literature grounded in African experiences (Mumia, 2022). African music and dance have exerted significant global influence. The African diaspora transmitted rhythmic frameworks, call-and-response patterns, and instrumentation that became essential to blues, jazz, samba, reggae, and, subsequently, popular genres such as hip-hop and Afrobeat. Putiatytska, Ryndenko, Osoka, Putiatytska, and Shchyrytsia (2024) argued that the diasporic dissemination of African musical styles has altered global music industries and cultural perceptions. Modern African artists continue to innovate at the convergence of tradition and modernity, influencing fashion, film, and digital cultures worldwide. African visual and material arts also contest Eurocentric art history. African artists have cultivated intricate techniques and iconographies, as seen in Nok terracottas, Ife bronzes, Benin bronzes, and contemporary African design, which encapsulate religious, political, and social complexities. Förster (2016) emphasised the need to reevaluate provenance, restitution, and the interpretive frameworks employed in museums and galleries worldwide.

These discussions have prompted a comprehensive redefinition of cultural heritage and the ethics surrounding exhibitions. African philosophies and cosmologies provide intellectual resources for discussions on community, ethics, and governance. Akuva and Koko (2025) argued that interdependence and societal peace influenced restorative justice projects and comparative ethics. Indigenous ecological knowledge on land management, crop diversity, and medicinal plants has provided insights into sustainability and public health, and continues to influence scientific research and conservation initiatives (Imhausen, 2020). Colonial and imperial knowledge hierarchies have historically marginalised African cultural contributions.

Contemporary research promoted the decolonisation of curriculum, the repatriation of cultural artefacts, and the elevation of African perspectives within global cultural institutions (Brulon & Witcomb, 2022). A consistent focus on Africa's cultural output rectifies historical neglect and provides essential insights into global cultural diversity and creative advancement.

Challenges to Africa's Contribution to the World's Scientific and Cultural Development

Africa's contribution to global scientific and cultural Development has been shaped by centuries of innovation, creativity, and indigenous knowledge systems. However, several historical and contemporary challenges have constrained the continent's ability to fully project its scientific and cultural achievements onto the global stage. These challenges are deeply rooted in socio-political, economic, and structural realities that continue to shape Africa's participation in global knowledge production (Busia, 2023).

One of the significant constraints is the enduring legacy of colonialism, which disrupted indigenous systems of learning, technology, and cultural expression. Colonial administrations privileged Western epistemologies while suppressing local knowledge systems, thereby marginalising African scientific traditions in fields such as medicine, astronomy, and engineering. Many cultural artefacts were removed from their contexts, taken to European museums, and reinterpreted through Eurocentric lenses, which weakened Africa's ability to control its own cultural narratives and intellectual heritage. This historical displacement continues to shape contemporary debates on repatriation and recognition (Badugela, 2024).

Another significant challenge is inadequate investment in research and development (R&D). Many African countries allocate less than 1 per cent per cent of their GDP to scientific research, well below the global average. This underinvestment limits the development of laboratories, research institutions, and innovation hubs, leading to a reliance on imported technologies and foreign expertise. As a result, African scientists often face constraints in producing globally competitive research, accessing advanced equipment, or participating fully in international scientific networks. The lack of sustained funding also contributes to “brain drain,” where skilled professionals migrate to countries with more supportive research environments (Mumia, 2022).

Additionally, socio-economic instability and weak educational infrastructure hinder Africa's scientific progress. Many educational institutions struggle with inadequate facilities, outdated curricula, and insufficient teaching materials, all of which limit the capacity to train a new generation of scientists and creative scholars. Conflict, political instability, and insecurity in several regions disrupt learning processes and make it challenging to protect cultural sites, archives, and artefacts. These disruptions weaken the structures needed to preserve cultural heritage and sustain scientific innovation (Adewojo, 2024).

The global marginalisation of African cultural expressions also poses a challenge. Although African music, art, and philosophy have shaped world culture, they are often undervalued or appropriated without proper acknowledgement. Hollywood, global fashion industries, and Western academic institutions frequently draw from African cultural motifs while excluding African creators from recognition and economic benefits. This imbalance reinforces global power asymmetries and diminishes Africa's ability to benefit from its own cultural capital. Language barriers further constrain Africa's contributions to global scholarship. With English, French, and Portuguese dominating academic publishing, indigenous African languages are sidelined, limiting the documentation and global circulation of indigenous knowledge. Scholars who publish in African languages often face reduced visibility, fewer citations, and barriers to participation in international debates. This linguistic exclusion perpetuates the invisibility of Africa's intellectual traditions. According to Chirikure (2013), limited cultural policies and weak heritage protection frameworks make it difficult for many African countries to safeguard historical sites, manuscripts, and creative industries. Without strong legal and institutional

protections, valuable cultural resources remain vulnerable to theft, degradation, and commercial exploitation.

Conclusion

Science and technology cannot be denied their immense contribution to development. The evolution of science and development has witnessed so many revolutions from the Neolithic to industrial and now to the present computer age. There have been significant achievements in science and technology across sectors such as medicine, industry, entertainment, education, and infrastructure for development, whose success lies in key elements such as research and global partnerships, as well as new disciplines. Most countries that have exploited this knowledge and technique have seen their socio-economic and financial status improve alongside development. Though science and technology have some detrimental effects on society, the way forward is to promote sustainable development; a strategy to separate the bad from the good technology and promote the good one is presently encouraged worldwide for effective development that will support the sustenance of man and his environment. In addition to the challenges faced in Africa, the advancement of science will only be achieved if Africans change their mindset and place greater emphasis on the key elements and measures that are paramount to development.

Recommendations

- a. **Federal Ministries of Science and Technology across African States** should increase annual budgetary allocations to research and development by establishing dedicated national innovation funds that support indigenous scientific research, laboratory upgrades, and community-based innovation hubs.
- b. **African Union (AU) Department of Education, Science, Technology and Innovation (ESTI)** should coordinate a continent-wide framework for scientific collaboration by creating an African Research Exchange Programme. This programme should support the mobility of researchers across African countries, promote joint publications, and fund multi-country research projects that showcase Africa's scientific achievements on global academic platforms.
- c. **National Ministries of Culture and Tourism** should develop legally binding regulations to strengthen the preservation of artefacts, historical sites, and indigenous knowledge systems. This includes establishing community-based cultural conservation centres, digitising archives such as manuscripts and oral histories, and pursuing diplomatic channels to repatriate stolen cultural artefacts from Western museums.
- d. **National Universities Commissions / Higher Education Accreditation Bodies** should mandate the integration of African philosophies, scientific history, and cultural knowledge into university curricula. They should also fund multidisciplinary research institutes focused on African studies, encourage scholars to publish in African languages, and ensure that indigenous knowledge receives equal academic recognition within global scholarly networks.

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