



Women Scientists As Drivers Of Intellectual Capital And Innovation In Contemporary Society

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ABSTRACT

This article examines the role of women scientists in the formation of intellectual capital and the advancement of innovation in contemporary society. The study argues that women's participation in science, technology, education, and research is not only a matter of gender equality but also a strategic condition for sustainable development, economic competitiveness, and social progress. Drawing on international reports and research by UNESCO, WIPO, UN Women, the World Economic Forum, and other organizations, the article analyzes the contribution of women scientists to knowledge production, STEM development, patenting, digital transformation, and innovation ecosystems. The findings show that despite gradual progress, women remain underrepresented in global research, STEM jobs, technological leadership, and patenting. Therefore, strengthening women's scientific participation requires legal, institutional, educational, and cultural support. The article concludes that women scientists should be regarded as active creators of intellectual capital and strategic actors of innovation-based development.

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Introduction

In the twenty-first century, the development of society is increasingly determined by knowledge, scientific capacity, innovation, and human capital. Natural resources and industrial production remain important, but they are no longer sufficient to ensure sustainable growth and global competitiveness. Modern development depends on the ability of a society to generate new knowledge, transform it into practical solutions, and include the intellectual potential of all social groups.

In this context, the role of women scientists has become especially significant. Women scientists are not only participants in academic life; they are producers of knowledge, creators of new research directions, educators of future generations, and contributors to innovation ecosystems. Their participation in science and technology enriches research culture, broadens the range of scientific problems, and strengthens the social relevance of innovation.

However, global data show that women are still underrepresented in science and innovation. According to UNESCO, women made up 31.7% of researchers worldwide in 2021, compared with 30.0% in the previous UIS reporting period up to 2017. This indicates some progress, but also confirms that gender imbalance in research remains a global issue.

The problem is particularly visible in STEM fields. UNESCO notes that only one in three researchers worldwide is a woman, women account for 35% of STEM graduates, and women hold only 22% of STEM

jobs in G20 countries. These figures show that women's scientific potential is still not fully used in areas that are central to technological modernization and future economic development.

Therefore, the study of women scientists should not be limited to the issue of equal rights. It should also be analyzed through the concepts of intellectual capital, innovation, technological progress, and sustainable development.

Literature Review

International organizations increasingly recognize gender equality in science as a condition for social and economic progress. UNESCO emphasizes that closing the gender gap in science is essential because women remain underrepresented in research, STEM education, STEM jobs, and scientific leadership. UN Women also links gender equality with innovation and technology. Its approach focuses on promoting women as innovators, integrating gender perspectives into innovation processes, and supporting technologies that advance equality. This position is important because it shifts the view of women from passive beneficiaries of technological progress to active creators of innovation.

The World Intellectual Property Organization also provides important evidence on women's participation in innovation. WIPO's study of international patent applications from 1999 to 2020 found that women were involved in only 23% of all applications and represented 13% of listed inventors. More recent WIPO data released in 2024 estimated that women accounted for only 17.7% of inventors named in international patent applications in 2023, and that parity among PCT-listed inventors may be reached only in 2077 if current trends continue.

The World Economic Forum also identifies gender gaps in future-oriented skills. Its Global Gender Gap Report 2024 shows that although the share of women with STEM skills increased from 24.4% to 27.1% between 2016 and 2024, men and women still participate unevenly in skills linked to technological transition. These sources show that women's participation in science and innovation is both a social justice issue and a development issue. When women are excluded from research, invention, and technological leadership, society loses a significant part of its intellectual potential.

Methods

This article uses a qualitative research design based on theoretical analysis, comparative analysis, and document analysis. The theoretical method is used to explain the concepts of intellectual capital, innovation, and women's scientific participation. Comparative analysis is applied to examine international indicators related to women in science, STEM, and patenting. Document analysis is used to study reports and materials published by UNESCO, WIPO, UN Women, and the World Economic Forum.

The article does not present primary statistical data collected by the author. Instead, it relies on secondary data from international organizations and interprets them from the perspective of social development, innovation policy, and gender equality in science.

Results

The analysis shows that women scientists contribute to contemporary society in several major ways.

First, women scientists are important creators of intellectual capital. Intellectual capital includes knowledge, professional competence, scientific experience, creativity, research culture, and the ability to generate new ideas. Through scientific articles, research projects, teaching, academic supervision, and participation in conferences, women scientists expand the intellectual resources of society.

Second, women scientists play an important role in innovation ecosystems. Innovation is not only the creation of new technologies; it is also the ability to identify problems, design solutions, test ideas, and transform knowledge into practical outcomes. Women's participation in innovation brings diversity of experience, social sensitivity, and new research perspectives. UN Women's approach to innovation emphasizes the need to promote women as innovators and to integrate gender perspectives into innovation systems.

Third, women scientists contribute to STEM development. STEM fields are the foundation of digital transformation, artificial intelligence, engineering, biotechnology, green economy, and industrial

modernization. However, UNESCO's data show that women still hold only 22% of STEM jobs in G20 countries and only one in ten STEM leaders is a woman. This means that the participation of women in STEM must be strengthened not only at the level of education but also at the level of career development and leadership.

Fourth, women scientists are connected to patenting and commercialization. In the innovation economy, scientific ideas become especially valuable when they are transformed into patents, technologies, start-ups, or industrial applications. WIPO data show that women remain significantly underrepresented among inventors in international patent applications. This underrepresentation limits women's visibility in technological innovation and reduces their participation in the economic benefits of scientific creativity.

Fifth, women scientists have an important educational and social role. They serve as mentors, role models, and academic leaders for young women and girls. The presence of successful women scientists helps challenge stereotypes that science, engineering, or technology are mainly "male" fields. This is especially important for motivating girls to choose STEM disciplines and research careers.

Discussion

The findings suggest that the role of women scientists should be understood through a broader framework than traditional gender equality. Of course, equal access to education and research is a fundamental right. However, the participation of women in science is also linked to national development, innovation capacity, and long-term social stability.

One of the key challenges is the so-called "leaky pipeline" problem. Many girls and young women enter education successfully, but fewer continue into advanced research, STEM careers, innovation leadership, and patenting. This gap is visible in global data: women's participation in education has improved, but their representation in technological jobs, leadership positions, and invention remains limited. UNESCO's figures on STEM jobs and leadership clearly illustrate this problem.

Another challenge is the structural nature of gender inequality in science. The low number of women inventors does not mean that women lack talent or creativity. Rather, it reflects unequal access to research networks, funding, laboratories, mentorship, leadership positions, and intellectual property systems. WIPO's findings on the gender gap in patenting support this interpretation. Digital transformation also creates both opportunities and risks. On the one hand, digital platforms, online databases, artificial intelligence tools, and remote collaboration can make scientific work more accessible. On the other hand, if women have less access to digital skills, technological infrastructure, or professional networks, digital transformation can reproduce existing inequalities.

For countries seeking innovation-based development, supporting women scientists is a strategic necessity. It is not enough to increase the number of women in higher education. Policy should also focus on research grants, doctoral support, STEM laboratories, patent training, academic mobility, start-up ecosystems, and leadership opportunities for women scientists.

Conclusion

Women scientists are essential actors in the intellectual and innovative development of contemporary society. Their contribution goes beyond academic research: they create intellectual capital, strengthen education, generate new ideas, participate in innovation ecosystems, and inspire future generations.

Global data show that progress has been made, but gender gaps remain in research, STEM employment, scientific leadership, and patenting. UNESCO reports that women represented 31.7% of global researchers in 2021, while WIPO data show that women remain underrepresented among inventors in international patent applications. Thus, supporting women scientists is not only a question of equality. It is a strategic condition for sustainable development, technological modernization, and the effective use of national intellectual potential. A society that fully supports women in science gains broader knowledge, stronger innovation, and a more inclusive future.

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