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RESEARCH, INNOVATION AND HIGHER EDUCATION IN INDIA: FACTORS INFLUENCING NATIONAL DEVELOPMENT AND WORLDWIDE COMPETITIVENESS

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ABSTRACT

The development of novel concepts in a number of fields, such as defense and other important fields, as well as notable preliminary developments in the upcoming, highly significant research fields, particularly quantum computing, artificial intelligence, and robotics, represents important subjects of current interest. India's economic and intellectual growth will greatly benefit from breakthroughs in these areas, which will put the nation in a strong position to compete on the international scene. Higher education, research, and innovation can be used to address the numerous issues that India, one of the biggest and most populated nations, faces. The present status of higher education, research, and creative ideas entering Indian startups are examined in this study, along with the potential and problems facing these fields and how they support the advancement of society. It also highlights the key areas where creative ideas are making a big difference and examines the function of policies and programs to aid India's advancement in these areas. This essay emphasizes the necessity of modernizing India's aging higher education system and research in order to foster an innovative and sustainable growth culture.

KEY WORDS: *Higher Education, Government Schemes, Innovation, Sustainable Development*

1. INTRODUCTION

Founded on the sustainable development model introduced by the United Nations (UN) on August 4, 1987, the idea of Education for Sustainable Development (ESD) developed between 1990 and 2000 (Acosta-Castellanos et al., 2024). ESD is described as "the process of equipping students with the knowledge, understanding, skills, and necessary attributes to work and live in a way that safeguards environmental, social, and economic wellbeing" (Longhurst et al., 2014). The fundamental goal of ESD is to use education to address the environmental issues brought on by human activity and to encourage a sustainable future for future generations. According to Biasi et al. (2019), the United Nations also announced 17 Sustainable Development Goals (SDGs) in 2014. According to Elmassah et al. (2022), "all students acquire knowledge and skills necessary to promote sustainable development" is the fourth goal of high-quality education. Teachers at higher education institutions (HEIs) now have a primary duty to create new programs and curricula that align with the SDGs. To effectively preserve the natural environment and promote pro-environmental behavior, environmental education is considered crucial. With the majority of people in India not implementing measures for environmental preservation and protection, the concept of environmental sustainability is still in its infancy. According to Siddiqui (2022), India, a rising economy, is one of the top 10 nations most vulnerable to environmental disasters brought on by global warming. India is predicted to produce 20 million tons of solid waste annually, with an annual growth rate of 2.4%. Due to inadequate garbage collection and disposal, most of this debris is burned or left to decompose in dumps, which are usually found in urban areas. The research shows that over 90% of contaminated municipal and industrial trash gets dumped into the ocean. Sometimes, due to bad governance, garbage collection is given precedence on the national agenda, while recycling and environmentally friendly solid waste management are rarely taken into account. Additionally, while economic and industrial development improves human existence in many ways, it also brings about problems like climate change, water pollution, and air pollution. Although research shows that wealthy economies have made tremendous progress in addressing environmental change over the past 20 years, these challenges still have an impact on the environment, society, and economic growth (Nozari et al., 2021). Nonetheless, there is a noticeable and widening gap between environmental concerns and environmental adaptability. This disparity is commonly ascribed to the population's poor comprehension of environmental changes and the HEIs' unwillingness to prioritize environmental degradation concerns in their curricula. Thus, the current study focuses on HEI academicians since they are thought to have a significant impact on students' adoption of green habits by educating them about environmentally

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friendly products that both normalize and safeguard the environment. But previous studies have concentrated too much on how marketers and customers may work together to lessen pollution and environmental damage (Nozari et al., 2021).

The influence of environmental awareness, values, and knowledge on green buying intentions has been examined by others (Chanda et al., 2024). Singh and Singh (2023) looked at the relationship between high school and college students' self-reported behaviors, environmental education, and environmental knowledge and attitudes. Because of their research, teaching, and involvement in the community, academics have a significant impact on public opinion and policy. This study intends to clarify how faculty members can effectively act as advocates for environmental stewardship, consequently having a positive impact on their students and the larger society, by methodically analyzing faculty attitudes toward the environment (ATE). Developing measures that support sustainability and strengthen the role of higher education in solving urgent environmental issues requires this investigation. In India, where understanding of climate change is still in its infancy, the current study aims to bridge this gap in the literature. This is the first study to employ social influence as a moderator between ATE, bio-spheric values, environmental knowledge, and environmental consciousness. While Bertossi and Marangon (2022) add to the scientific literature by emphasizing the critical role that HEIs play in fostering sustainable development by encouraging students to adopt pro-environmental behaviors, this study adds to the body of literature by concentrating on the attitudes of HEI academicians toward the environment. This research will make multiple contributions to the current literature. This will assist developing nations in bringing their educational policies into line with ESD. Second, our study contributes to the expanding body of research on the factors that influence a good attitude toward the environment. This mindset will save trillions of dollars by protecting water supplies and natural landscapes, in addition to assisting us in creating a responsible society. Third, students are likely to implement the principles and values that their professors have taught them, which will assist them in making environmentally responsible choices in their daily lives.

2. THEORY, LITERATURE REVIEW, AND HYPOTHESIS DEVELOPMENT

2.1. Theoretical Underpinning

The value-belief-norm (VBN) theory was created by Stern et al. (1999) to explain how human values influence behavior in an environmentalist context. According to Choi et al. (2015), this theory suggests a causal chain of connections between norms, behaviors, values, and beliefs. Environmental knowledge can strengthen beliefs about environmental issues by acting as a catalyst for the activation of personal norms toward pro-environmental action. By strengthening convictions about the impact on the environment and one's own responsibility, environmental consciousness promotes positive attitudes and, ultimately, pro-environmental action. Crucially, those who hold high bio-spheric values are probably inclined to feel a moral need to protect the environment. Stern et al. (1999) noted that values, particularly biospheric values, influence perceptions of environmental hazards. Individual norms are subsequently triggered by these concepts, leading to environmentally beneficial actions.

2.2. Environmental Knowledge and attitude toward the environment

Singh (2024) emphasized that a person's attitude is a belief, action, or behavior, whether positive or negative, that ultimately shapes their actions or behaviors. People will be more knowledgeable and will have a more positive attitude toward the environment if they understand why they are doing things and how they affect the environment. The most important people in educating tomorrow's leaders to preserve the environment are teachers. In order to develop future leaders with the aptitudes and competencies to address societal challenges, higher education institutions are social entities (Menon and Suresh, 2022). HEIs can play the role of "change agents" and "co-creators for sustainability," which can greatly aid in the achievement of sustainable development. Numerous research have interpreted eco-friendly attitudes and intents using environmental knowledge. There is a connection between environmental knowledge and attitudes regarding environmental products. Barber et al. (2009) highlighted that when environmental knowledge grows, attitudes toward the environment typically change for the better. As consumers learn more about eco-friendly products, their opinions about them may also shift. Furthermore, there is a considerable increase in the positive attitudes toward sustainability among teachers and students who have completed courses on sustainable development.

2.3 Environmental consciousness and attitude toward the environment

An important component of environmental consciousness includes knowledge and concepts about emotional values, attitudes, and beliefs about protecting the environment. People's propensity to address and resolve environmental issues and their awareness of them are explained by environmental consciousness (Alibeli and Johnson, 2009). In India, the topic of environmental consciousness is hardly ever examined in relation to educators and HEIs. But there are a number of research that look at consumers' intentions to make green purchases. According to Singh (2024), environmental awareness is linked to modifications in attitudes, beliefs, and intentions that enhance the environment. People who care deeply about the environment are more likely to want to protect the environment (Dhandra, 2019). Furthermore, it has been demonstrated that environmental consciousness has a favorable impact on attitudes and intentions.

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2.4. Biospheric values and attitude toward the environment

Values are regarded as important factors in predicting and elucidating a variety of variables, including attitudes and behavioral intents. In instance, biospheric values provide a more complex understanding of people's attitudes about the environment (Lee et al., 2013). These ideals promote environmental superiority and enhance personal wellbeing. The inherent worth of the environment and nature is typically given priority by those who have a biospheric value orientation. Furthermore, there is a favorable correlation between green attitudes and biospheric values. The value orientation model points out how attitudes toward the environment are influenced by environmental values, especially biospheric values. The association between eco-friendly behavior and attitudes is also mediated by biospheric values (Figure 1).

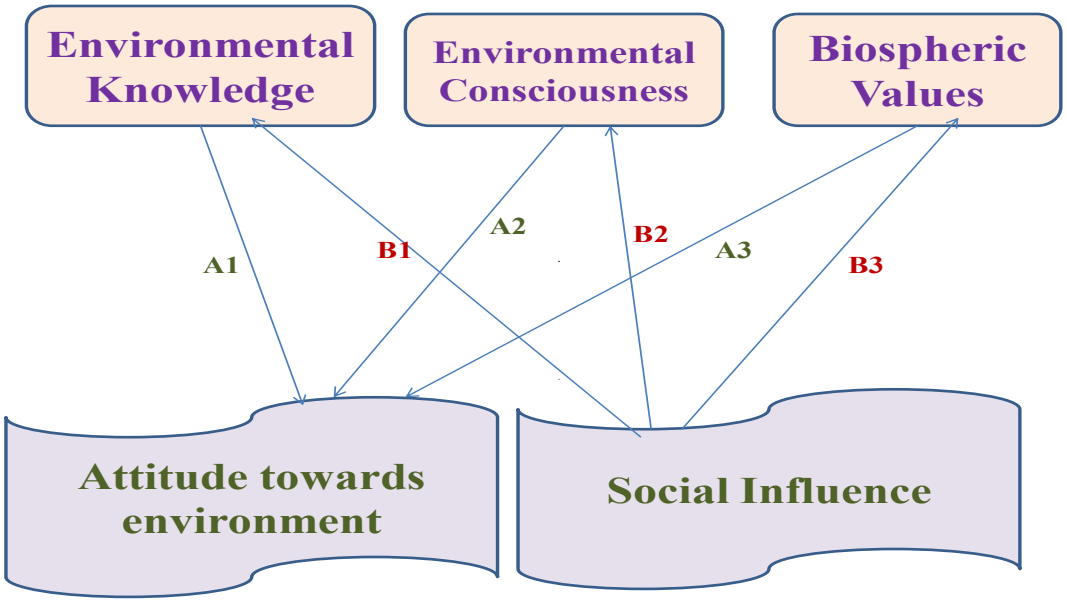


Figure 1: Conceptual Framework

A1: Teachers' EK has a positive impact on their attitude toward the environment
A2: Teachers' environmental consciousness has a positive impact on their attitude toward the environment
A3: Teachers' BV has a positive impact on their attitude toward the environment
B1: Social influence will positively moderate the relationship between teachers' EK and ATE
B2: Social influence will strengthen the relationship between teachers' EC and ATE
B3: Social influence will positively moderate the relationship between teachers' BV and ATE

2.5. Moderating role of social influence

The term "social influence" (SI) describes how the effect of those around oneself can alter a person's attitudes and behaviors (Singh and Singh 2024). SI happens when people change how they think, feel, or behave in reaction to environmental or social forces. To fit in with a larger social group, it modifies attitudes and actions. SI has been found to be a major influence on university students' green behavior and is thought to be an alternative to subjective standards. Individuals frequently modify their attitudes toward the environment in response to societal views. Eco-friendly attitudes, customs, and actions are mostly driven by biospheric values. BV emphasizes the environment's and nature's intrinsic worth. As time passes, so do values, beliefs, attitudes, and norms. According to Nordlund and Garvill (2003), these norms, values, and beliefs have an impact on people's attitudes and behaviors. According to numerous research, values have an impact on motivation, behavior, and attitude. According to Liu and Chen (2020), values have a significant impact on how people feel about the environment. As a result, it is projected that those with greater BV will have a more positive attitude toward the environment. If society and other people share this view, social influence will further enhance this association.

3. THE STATE OF HIGHER EDUCATION IN INDIA

India has a large and diverse higher education system, with over 50,000 institutions serving millions of students annually. One of the biggest educational institutions in the world, the Indian higher education system provides a wide range of undergraduate, graduate, and

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doctorate degrees in humanities, business, engineering, medical, and social sciences. Primarily responsible for overseeing India's higher education system, the University Grants Commission (UGC) is able to improvise the certification and regulation of Indian universities. Though it has expanded quickly, the system still confronts a number of difficulties (Singh 2024).

3.1. Human Capital Development

Higher education is essential to the development of human capital in the context of India's enormous and diverse population advantage. India offers many opportunities despite its large population because half of its people are fewer than 25. As a result, the nation has a great chance of utilizing the potential of a youthful and competent labor force. Reputable universities like the Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs) have produced extremely accomplished engineers, technologists, and managers who have achieved international acclaim. However, many people's potential is limited by a lack of access to high-quality education, particularly in rural areas (Singh and Singh 2023). Reforms are necessary to align curricula with industry expectations since there is also a mismatch between the skills that higher education institutions teach and the demands of the labor market.

3.2 . Quality and Infrastructure Challenges

One further thing to think about is the standard of higher education in India. Poor infrastructure, out-of-date curricula, and a lack of qualified faculty members continue to plague most universities and colleges, despite the fact that some prestigious institutions, such as the Indian Institute of Science (IISc), the Indian Institute of Technology (IIT), and the Indian Institute of Management (IIMs), are internationally recognized. The Times Higher Education Ranking Report 2024 states that India has 91 institutes worldwide, more than India, which has 86 institutes. The lone Indian Institute of Science (IISc) is ranked between 201 and 250. The inability to support innovative research and development is further hampered by India's higher education system's poor infrastructure, which includes antiquated libraries, a lack of research facilities, and restricted access to digital resources.

3.3 . Research Landscape in India

Technological advancement and innovation are mostly driven by research and development (R&D). Numerous government-funded research groups contribute to India's diverse research scene. The Department of Biotechnology (DBT), the Indian Space Research Organization (ISRO), and the Council of Scientific and Industrial Research (CSIR) are a few of these organizations that are pioneering important scientific discoveries in domains like biotechnology, agriculture, and space technology. Universities and commercial research institutes also make significant contributions to knowledge advancement and innovation.

3.4 . Research Output and Collaboration

Recent years have seen a significant increase in India's emphasis on research output. In terms of research production, India ranks third globally and is one of the leading producers of scientific papers and research, according to the Scopus database. Nonetheless, there are still disparities in the caliber of research and its influence on international scientific debate. While many professions, including biotechnology, IT, and space exploration, have seen significant improvements, other fields, like the social sciences and humanities, continue to get inadequate funding and development. In India, research cooperation is expanding, particularly between foreign and Indian colleges. The India-US Science and Technology Cooperation Agreement and other bilateral agreements with European nations to promote cross-border research collaborations are examples of the steps the government has made to collaborate with the world in order to improve the quality of research output.

3.5 . Government Initiatives for Research

The Indian government is working in a number of ways to encourage, support, and concentrate on innovation in the nation. The National Initiative for Developing and Harnessing Innovations (NIDHI) and the Atal Innovation Mission (AIM) are two of the many programs that the Department of Science and Technology (DST) has started. These programs are designed to encourage innovation and entrepreneurship in educational settings. To further entice the brightest brains to pursue doctorate research in India, the Science and Engineering Research Board (SERB) program has introduced the Prime Minister's Research Fellowship (PMRF), additional research grants, and research fellowships. As of 2024, India's Gross Expenditure on Research and Development (GERD) is 2.6% to 0.7% of GDP, significantly lower than the world average of 2.5% and lower than that of Israel (5.4%), the US (3.5%), and India (2.4%). More money must be given to research, particularly in cutting-edge areas like biotechnology, robotics, renewable energy, artificial intelligence, and quantum computing, if India is to become a global leader in innovation.

3.6 . Innovation Ecosystem in India

Addressing the urgent issues of economic growth, societal wellbeing, and sustainable development requires innovation. Government regulations, educational institutions, startups, and sectors all contribute to India's innovation ecosystem. Over the past ten years, the startup environment in India has grown significantly. India is the third-largest startup ecosystem globally, according to DPIIT, with over

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1,50,000 firms registered as of 2024. By providing financial possibilities, incubators, and accelerators to help students and researchers start their own businesses, institutions like IITs and IIMs have promoted an entrepreneurial culture. Through initiatives meant to lessen regulatory burdens, provide tax benefits, and make finance more accessible, the government's Startup India initiative, which was introduced in 2016, has been instrumental in fostering an atmosphere that is supportive of businesses. Particularly in industries like fintech, edtech, and health tech, this program has played a significant role in fostering innovation (Reddy 2023).

3.7 . Challenges in Commercializing Innovation

India has difficulties converting research into marketable goods and services, even with its thriving startup scene. Academic research and business needs can diverge significantly, which slows the rate of commercialization. The innovation ecosystem is further hampered by inadequate patenting and intellectual property protection, as well as by shaky ties between university and business.

3.8. Public – Private Partnerships

In India, public-private partnerships, or PPPs, are crucial for promoting innovation. Research discoveries can be commercialized more quickly when government organizations, academic institutions, and the corporate sector work together, especially in industries like healthcare, clean energy, and agriculture (Banerjee 2022). By encouraging grassroots discoveries and facilitating commercialization through private-sector partnerships, programs such as the National Innovation Foundation (NIF) seek to close the gap between academic research and industry (Nair 2015).

3.9. Challenges and Policy Recommendations

India has achieved great progress in research, innovation, and higher education, but there are still a number of issues that need to be resolved (Figure 2):

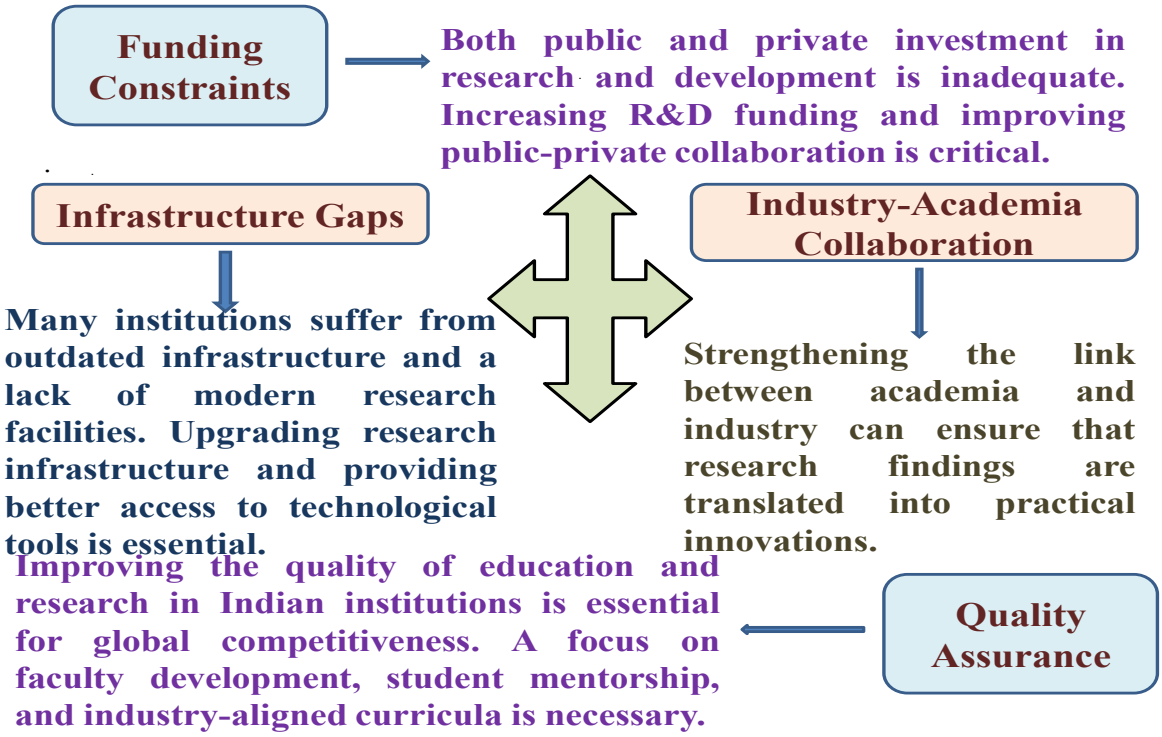


Figure 2: Challenges in higher education, research and innovation

4. CONCLUSION

The ecosystem of higher education, research, and innovation in India has enormous potential to promote social progress, economic expansion, and international competitiveness. India can develop a sustainable, innovation-driven economy by increasing research funding, fostering closer industry-academia cooperation, and implementing reforms to raise educational standards. India has the chance to lead the world in knowledge-based businesses and help address issues like public health, climate change, and sustainable development by tackling the difficulties these sectors face.

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