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# Emerging trends in Social innovation and Inclusive development in the perspective of IKS

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## Abstract:

*This research paper attempts to review the role of IKS in social innovation and inclusive development, to find out the list of emerging trends in aforesaid terms and also to uncover the sector of contribution of Indian knowledge system. The study is solely based on secondary data. The information was gathered from various related books, journals, internet, newspapers, articles and personal collection. Data was collected according to the requirement of fulfilment of objectives. The research found that there was mass implications of IKS in social innovation and inclusive development. Besides, IKS plays prominent role in conserving holistic development, environmental consciousness, inclusive- accessibility, sustainable practices, Indian language proficiency and digital literacy which might be revitalize and reverted for the sustainable global growth and also allows Indian Ethos, Value System and Dharmic principles to establish and propagate the thought of Vasudhaiv Kutumbakam, Moto of G 20 Summit, which conveys the message of the growth, prosperity, happiness and interconnectivity of the whole world together.*

**Keywords:** Sustainability, Pluriversal futures, brand credibility, macro thinking, Orders of Design

## Introduction:

**General Background of the Study:** India has always been recognised globally as a prosperous and culturally rich nation with a long history of knowledge, systems and intellectual achievements. However, for the last two centuries, the Western perception has been leading, influencing factor in our education. The British rule and their policies even had a detrimental impact on India's education system and led to a decline in its prosperity. Due to this colonial thought process the Indian origin knowledge is either been rejected or ignored in mainstream education for many decades. The Bhartiya world view is entirely lacking in the society. Living with all kinds of materialistic things or having all those, has become the lone objective of current education. Whereas, living life for meaningful purpose always

been the aim of Indian education system, so that, one can change his perspectives towards life and think innovatively and impactful to make the society better place to live in. Nowadays, IKS or Indian knowledge system become the flavour of the season as this euphoria begin with the mention of IKS in National Education Policy 2020, where it is mandated to have IKS based education in schools, colleges and higher education institutes and have been largely discussed in the academic and administrative circles. This paper aims to understand how Indigenous cultures and their knowledge systems can contribute to global challenges.

In order to do so, this paper will attempt first to understand the concept of IKS; then to explore the relationship between social development and IKS. After that, how this relationship can be helpful in inclusive development.

**Conceptual Understanding of IKS:** IKS is a short acronym of Indian Knowledge System which means indigenous source of knowledge generated by the ancient Indian society from the wisdom and insights arising out of deep experiences, observations, experimentations and analysis of various concepts. It is a legacy, woven from Jyan, Vigyan and Jeewan darshan. These are not just abstract concepts; Indeed, they have evolved from centuries of experience and rigorous analysis. IKS has a very long history that has continued unbroken like the Ganges river. From the Vedas to the country's native and tribal folklore knowledge has been the focus of all research. Since In Ancient Indian Education, knowledge has always been prominent. As Lord Krishna guides Arjuna in Bhagavad Gita. 4.38 that knowledge is the greatest means of self purification and liberation. Na hi gyanen sadrisham pavitramih vidyatevidyate'. There is a vast repository of knowledge available not only in Sanskrit, Pali, Prakrit, but also in all native Indian languages. However, One of the key pillars of India's ancient knowledge system is the Vedic literature. These texts contain a vast repository of knowledge encompassing various disciplines such as philosophy, science, mathematics, language & linguistic, astronomy. Moreover, Ayurveda, Yoga Metallurgy, Rasashastra, Public administration, War Technology management, Science Technology and many more. Today, this insightful knowledge is much needed for Knowledge diplomacy which is going to rule the international relations in future world, Since India has such a literary repository that will enrich the Indian civilization for millennia.

**Social innovation & inclusive development in the light of IKS:** In the perspective of IKS, social innovation and inclusive development of country might be revitalize and reverted for sustainable growth with Indian ethos. As IKS places a premium on practical application, emphasizing hands on learning, having problem solving skills. This practice bridges

the gap between theory and practice, preparing citizens for the dynamic challenges of the professional landscape. Indeed, it insists mind-set where theoretical concepts find tangible expression, fostering a generation of learners capable of addressing real world problems with creativity and practical insight.

### Objectives of the Study

- To uncover the sector of contribution of IKS.
- To review the role of IKS in social innovation and inclusive development.
- To find out the list of emerging trends in present scenario.

**Methodology:** Methodology deserves a very careful consideration. Methodology and procedures are the important factors in conducting a research. Appropriate methodology used in research helps to collect valid and reliable data and analyse the information purposively to arrive at correct decision. The study was solely based on secondary data. The information was gathered from various related books, journals, Internet, newspapers, articles and personal collection. Data was collected according to the requirement of fulfilment of objectives. There has lot of related data in websites But the most important data was only incorporated here. Gathered experience and knowledge, also incorporated in this paper.

### Findings

#### Significant Role of IKS in various sectors:

**IKS in Entrepreneurial mind-set:** In the words of PM Narendra Modi, 'start-ups are more than commercial success stories. They are powerful examples of social innovation' The IKS instils and entrepreneurial mind-set by encouraging learners to embrace risk taking and innovation. The approach cultivates an entrepreneurial spirit, inspiring them to become creators rather than jobseeker. As said by Ancient scholar, Chanakya, in his neeti that 'once you start

working on something, don't be afraid of failure and don't be abandoned it. People who work sincerely are the happiest.' This entrepreneurial system powers to contribute actively to economic growth by fostering an environment that values innovation and risk. In ancient times 64 kalas ( skills) are mentioned which are basically the foundation of startups .Various skills are mentioned in early times such as; the art of producing vessels out of bamboo, knowledge of processes of milking and making ghee from milk, the art of preparing tambul i.e beetal nuts, the science of manufacturing vessels and other articles out of glass, the art of cooking various dishes and so on ,encourage Entrepreneurial mind-set, prepare person for dynamic career parts. It nurtures a culture of self reliance, creativity and problem solving essential for navigating the challenges of a rapidly evolving global economy.

**IKS in Environmental Consciousness:** The IKS underscores environmental consciousness, integrating education that promote sustainable practices. There are numerous examples mentioned in ancient text. Vedic sages had great declaration that Earth is the mother of all and all creatures are her children. Tree conservation, prohibition of killing animals, water conservation in the form of developing wells, bawadi, lake, ponds etc., pollution free environment and so on. This approach equipped with an awareness of environmental issues. And instil a sense of responsibility towards the ecosystem. By incorporating ecological consideration into the curriculum. Theoretical understanding of environmental challenges and are motivated to adopt ecofriendly behaviour. This emphasis on ecological consciousness ensures that learners graduate with a heightened awareness of their impact on the planet, contributing to an environmentally responsible generation. And it end actively engaged in building a sustainable future.

**IKS in Global Competence:** The IKS actively promotes global competence among students. Exposure to international

perspectives within the curriculum ensures they are well prepared for a globalised job market. This exposure. broadens their horizons and enhances cross cultural understanding, cultivating adaptability and collaboration skills by fostering a global outlook. Radha kumad mookerji wrote in his book that in ancient times there was the provision of completing education in foreign or students after graduation can undertook an extensive foreign travel to give a practical turn to their theoretical studies at the colleges, and qualify themselves for the life in the world by broadening the range of their experience and deepening their insight into human affairs. So, the system equips to navigate diverse professional environments and contribute meaningfully internationally. This emphasise on international competence, position students to thrive in an interconnected world where cultural fluency and collaborations are integrated to success.

**IKS in Inclusivity and Accessibility:** The IKS prioritises inclusivity and accessibility, ensuring that education transcends socio economic barriers. Special provisions are in place to guarantee that every students, regardless of their background, has access to quality education. A.S Altekar mentioned in his book that at early stages of history, the principle of hereditary professions was accepted by society. However, specially gifted children could change their family professions. Hindu society tried to make a fairly efficient arrangements for the proper education of the rising generation. Additionally, the system embraces inclusive practices, offering support tailor to the diverse learning needs of learners by fostering and environment where education is accessible to all irrespective of socio-economic disparities. The IKS plays a pivotal role in creating a more equitable and inclusive society, empowering students from various backgrounds to pursue an excel in their education endeavours.

**IKS in Language Proficiency:** The IKS priorities language proficiency by promoting regional language, preserving linguistic diversity and enriching students with a deep appreciation for their cultural heritage. Bilingual education further enhances communication skills, recognising their crucial role. In a global context, this approach facilitates effective cross cultural communication and equips students with a valuable asset in an interconnected world. Keeping this view in mind, government is also building database through Bhasini an AI tech language translation system that creating open source data sets in local languages. The emphasis on language proficiency ensures that they are not only academically adapt but also proficient communicators capable of navigating diverse linguistic landscapes with confidence and understanding.

**IKS in Digital literacy:** The IKS significantly emphasises digital literacy equipping students with essential skills for the digital era. Education for all wherever, whenever is also ancient education concept where every student can access knowledge content at his own space. As Hiuen Tsang's time education was free for students . This focus ensures that students gain technological proficiency, allowing them to navigate and contribute effectively in a digitally driven. By incorporating digital literacy into the curriculum, the education system prepares students to acquire the power of technology for communication, problem solving and innovation. This emphasis on digital skills enhances their academic journey and positions them to excel in a technological evolving global landscape, fostering a generation adapt at leveraging digital tools for success.

**IKS in Continues learning:** Incorporating a culture of continuous learning. The IKS equips students for lifetime of education. In ancient times , under the scheme of pnamahayagya every householder was daily required to spend some time over

Swadhayaya. So that youth may not go back or slip into ignorance Emphasising adaptability as a core skill, it recognises the importance of navigating And ever evolving professional landscapes by installing a mindset of virtual growth and learning, Students are academically prepared and develop the resilience needed to thrive in dynamic and challenging environment. This commitment to continuous learning and assures that graduates are well positioned to embrace new opportunities, stay relevant in their careers and contribute meaningfully to the process of society.

**IKS in Holistic Development:** The IKS strongly emphasises holistic development, incorporating arts, sports and extracurricular activities into the educational fabric. This integration ensures students cultivator well rounded skill set beyond academic excellence. The system focuses on creativity and critical thinking equipped students with the tools to navigate diverse challenge fostering a mind-set beyond rote learning by nurturing these aspects students are academically proficient and processes the creativity and analytical skills necessary for success in an every evolving world. In ancient education system also rote learning was not been promoted in one of Sanskrit verse, in Nirukt it is mentioned that, 'Saraswati Or the Goddess of learning reveals her full charm only to him who understand what he recites. Other are merely beasts of burden'.

**Role of IKS in social innovation and inclusive development:** The terms social innovation and inclusive development both are interconnected to each other. Indeed, social innovations are the solutions for inclusive development of human being, society, country and world respectively. As the process inclusion engages each individual and makes people feel valued, respected, empowered which is essential for the growth



of both individual and society. Basically, the concept of inclusion derives from the Sanskrit phrase - Vasudhaiv Kutumbakam ( world is one family) which encompasses a broader relationship & togetherness among people, across the society . In the words of Amartya Sen, ‘Human development is about creating an environment in which people can develop their full potential and lead productive, creative lives in accord with their needs and interest. People are the wealth of nations. Development is, thus, about expanding the choices people have to lead lives that they value. And it is, thus, about much more than economic growth, which is only means if a very important one of enlarging people’s choices.’ To meet the goals of inclusive development, social innovation might be the impactful solutions to make individuals empowered, self respected, implies new types of collaboration. These innovations may be in the form of either products, services or models that address community's unmet needs effectively, thus improving people lives. Many world societal challenges can be see through the lens of Indian knowledge system to get better solutions in various social or environmental issues such as health, Education, climate change, energy, water conservation, sanitation livelihood and so on.

**List of Emerging trends in Social innovations in the perspective of IKS (Economic Diplomacy Division, Ministry of External Affairs, Govt. of India)**

- Rooftop Organic fertilizer Maker
- Meghshala: Encouraging learning through technology
- Connecting Rural Artisans to the Global Market
- River: Re-engaging Teachers and the taught

- Third Eye
- Water Purifier that beats the RO
- Swarna pragati : Revolutionizing Rural Housing Finance.
- Mushrooms from coffee waste.
- Holistic Solution to rural sanitation

Here are some more examples of social innovations which are quite impactful in present scenario of society

1. Agnisumukh – Inspired by the traditional Indian method of cooking on charcoal. Agnisumukh manufacturers commercial kitchen equipment driven by innovative, energy efficient radiant heat gas burners, and these ultra – efficient cooking stoves save 30c/o on gas. Their vision is to transform lives by providing clean green, energy efficient heating solutions across gas fuels.
2. Project listen up – inspired by the thought of sarve bhavantu sukhina, paropkaraya idam sharirram, Sohum Innovation labs India Pvt limited is providing low cost hardware cum software solutions which screens and diagnoses infants with hearing impairment at early age.
3. Sakha consulting wings: yatra naryaastu pujiyante, ramante tatra devta. Based on this thought to protect and empower women Sakha Consulting Wings are playing prominent role in providing safe transport solution for women in four Indian cities.
4. AYZH – inspired by the simple idea of developing affordable, appropriate health technologies produced by women for women in rural India.
5. Aditya – India ‘s first solar ferry, mode of transport by solar energy in India. It is also the first ferry in the world to have more than 80c/o of its energy requirements met through solar.

## Conclusion

Eventually, we can conclude that IKS is not merely knowing about some ancestral knowledge, ancient texts, Vedic culture, rituals and so on. Indeed, it is vital to protect received wisdom, because economic security and national pride had been propounded in these ancient scripts and knowledge. Besides, we need IKS for variety of reasons which is mainly useful for Inclusive development of human beings living respectful, empowered life which ensures their rights and participation in social, political and economic development in the society. IKS is mainly bridging the gap between ancient wisdom and the modern world. It offers valuable insights not just for Indian people but for the entire world. It's about shaping behaviour and propelling future on a global scale. It is not just a vision but a tangible force steering the country towards significant change. The principles embedded in the IKS offer a timeless wisdom applicable to contemporary social challenges which can play the significant role in impactful social innovations. Last but not least, IKS is a living legacy offering insights that can shape our choices, policies and innovations in the dynamic landscape of today's interconnected world.

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## Spiritual Ecology In The Light Of Upanishads

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### Abstract:

*The relationship between the mankind and the environment has always been a matter of dispute as the development of the former is draining the other. The constant degradation of the environment has major consequences in not just the human lives but all the living beings in the world. The rising ecological concerns has been a wake-up call for us to take action to protect not just the human life but the whole world. It is time to change our view of the world as a 'means of survival' to that of 'a sacred place, a Sanctuary'. This is the ecological view which we find in the Upanishads, our sacred scriptures. Upanishads preach that all living and non-living entities are sacred and one. This view of oneness promotes a harmonious and holistic relation between man and nature. Our ancient scriptures speak the divine relation between material and spiritual. This is not just an abstract ideology but can be practiced in physical form. Upanishads have shown many environmental conservation-oriented practices. "annaṁ brahmeti vyajānāt ...", "annaṁ na nindyāt | tad vratam |....", "annaṁ na paricakṣīta | tad vratam |....", these verses of Taittiriya Upanishad remind us the importance of food and seek not to exploit it. There are many instances in Upanishads where all plants and animals are treated as divine and are to be respected and protected. Most of the Upanishads emphasize on the interconnectedness between all beings through the five elements which create and sustain all forms of life and absorb everything after death or decay. This eco-philosophy aims at the avoidance of exploitation of the universe by humans.*

**Keywords:** *Eco-philosophy, Ecological view in Upanishads, Spiritual ecology, Oneness, Interconnectedness of all beings.*

### Introduction:

Currently humans are facing ecological crisis. Environmental issues like climate change, global warming, plastic pollution, biodiversity loss are the effects of mankind's urge for development at the cost of nature. The constant degradation of the environment has major consequences in not just the human lives but all the living beings in the world. This has become a major global challenge that needs to be addressed as soon as possible. As a result, efforts are being made to find solution through conferences like UN Climate Change Conference (COP summits), UN Biodiversity conference, World Conference on Sustainability, Energy & Environment.

But scientific solutions are not enough to tackle the problem at hand. It is time to change our view of the world as a 'means of survival' to that of 'a sacred place, a Sanctuary'. We must find the connection between spirituality and ecology for the betterment of the universe. This spiritual ecology presents the significance of interconnectedness of all beings. This is the ecological view found in ancient Indian scriptures, Upanishads.

Upanishads emphasize the oneness of all living and non-living beings. "Sarvam Khalvidam Brahma"<sup>1</sup> in Chandogya Upanishad presents the world as the one Brahman. In Isha Upanishad – "yastu sarvāṇi



bhūtāni ātmanyevānupaśyati | sarvabhūteṣu chātmanāṃ tato na vijugupsate ||” 2 verse perceives the oneness of all beings. This view of oneness promotes a harmonious relation between man and nature. The various practices found in Upanishads help to resolve the ecological crisis.

### Methodology

The present ecological crisis is related to the lack of awareness of the nature of creation and selfunderstanding<sup>3</sup> . A deep analysis of spiritual ecology in Upanishads can result in finding practical ways to achieve ecological harmony. What is Spiritual Ecology? ‘Spiritual ecology is a field of study and practice that explores the relationship between spirituality, religion, and the environment. It recognizes that our ecological and environmental challenges are not just physical or material in nature but also have deep spiritual and ethical dimensions.’<sup>4</sup> Scientists and academicians study the relationship between religion and ecology. It encourages the individual to transcend his mind from the physical view to the spiritual view of the world and hence respond to nature with a sense of respect and compassion. We can find different aspects of spiritual ecology in books like ‘Spiritual Ecology: A Quite Revolution’ by Leslie Sponsel, in the collection of essays by various authors in the book ‘Spiritual Ecology: The Cry of the Earth’ and in the teachings of the renown philosopher Jiddu Krishnamurthy. Although the definition of the term spiritual ecology varies among scholars, the idea of relating spirituality and nature remains the same. It is inspired from different cultures and traditions from various parts of the planet.

While enquiring about spiritual ecology, the term eco-philosophy was discovered. It is defined as the philosophy of ecological harmony or equilibrium. It inspires several traditions which can contribute to alternative interpretations and thus proposed solutions to environmental issues. This philosophy united with ecology proposes human to be an

intrinsic part of nature and the nature to be a part of human. Thus, pertaining to the oneness of the dual world. Eco-philosophy expresses that the nature has intrinsic value, rather than just its usefulness to humans. The view of the world as a Sanctuary and to heal the world is to heal oneself is the central concept of this philosophy. It gives an insight into the interrelatedness of all living and non-living beings of the world and expresses the need to identify oneself with plants and animals.

### Findings

The interplay between spirituality and ecology has gained significant attention in recent years as humanity grapples with the urgent need to address environmental issues. The concept of spiritual ecology is not a modern phenomenon. We can find an extensive literature on this in many ancient scriptures of the Indian culture and philosophical traditions like Buddhism and Hinduism. The Upanishads occupy a unique place in the development of Indian thought and it is the core of Indian philosophy. The philosophical concepts implicit in the Vedic hymns are developed through the Upanishads. The Upanishads represent the profound understanding of early Indian seers to solve the problems of origin, nature and destiny of human beings and of the universe. The whole emphasis of the Upanishadic scriptures is that human beings cannot separate themselves from the nature through the concern for nature by providing a metaphysical union between the human and non-human beings, the adherence to which seems necessary for us to establish and sustain a proper relationship between the nature and us.<sup>5</sup>

According to Upanishads Brahman is the supreme, all-pervading consciousness and the ultimate reality. This Brahman is present in every aspect of the world, as said in the Upanishad – “eko devaḥ sarvabhūteṣu gūḍhaḥ sarvavyāpī sarvabhūtāntarātmā | karmādhyakṣaḥ sarvabhūtādhivāsaḥ sāksī cetā kevalo nirguṇaśca ||” 6 . “agniryathaiko bhuvanaṃ praviṣṭo rūpaṃ rūpaṃ pratirūpo

babhūva | ekastathā sarvabhūtāntarātmā rūpaṁ rūpaṁ pratirūpo bahiśca ||” 7 verse expresses that one Brahman is found in different forms in the world. Before the origin of this world Brahman was the only being, one without the second - “sadeva somyedamagra āsīdekamevādvitīyam |” 8 and from Brahman the whole world is born, lives and absorbed at the end - “yato vā imāni bhūtāni jāyante |yena jātāni jīvanti | yat prayantya abhisamviśanti | tadvijijñāśasva | tad brahmeti |” 9 . “so’kāmāyata |bahu syām prajāyeyeti | sa tapo’tapyata | sa tapastaptvā |idaṁ sarvamasrjata | yadidaṁ kiñca | tat sṛṣṭvā tadevānuprāviśat | tadanupraviśya | sacca tyaccābhavat| niruktaṁ cāniruktaṁ ca | nilayanaṁ cānilayanaṁ ca |vijñānaṁ cāvijñānaṁ ca | satyaṁ cānṛtaṁ ca satyamabhavat |yadidaṁ kiṁ ca|” 10 verse tells that Brahman created the universe and has manifested itself in the form of living and non-living beings. When one realizes that it is oneself, that is, Brahman that we see in the world through different forms and in oneself the whole world exists, then we cannot experience any disgust or hatred towards anything - “yastu sarvāṇi bhūtāni ātmanyevānupaśyati | sarvabhūteṣu chātmānaṁ tato na vijugupsate ||” 11. This sense of oneness not only liberates oneself but also protects the world around from exploitation. This perspective elevates nature to a sacred and divine realm, making it an essential part of one’s sense of purpose for embarking on a spiritual journey.

‘The Upanishads also emphasize the interconnectedness of all living beings and the environment. They teach that the individual self, known as “Atman,” is not separate from Brahman but, in fact, a microcosm of the divine. The interconnectedness of all beings is symbolized in the Upanishads through the idea of “neti-neti,” which means “not this, not that.” It suggests that we should strip away our identification with the superficial and transient aspects of the self and instead recognize the interconnected web of existence. In doing so, we acknowledge our

oneness with nature and all living creatures as equals.’ 12 Here we can see that spiritual ecology is emphasized in Upanishads.

This is not just an abstract ideology but can be practiced in physical form. Upanishads have shown many environmental conservation-oriented practices. “annaṁ brahmeti vyajānāt” 13 , “annaṁ na nindyāt | tad vratam |” 14 , “annaṁ na paricakṣīta | tad vratam |” 15 , these verses of Taittiriya Upanishad remind us the importance of food and seek not to exploit it. In fact, the Upanishad asks to take care of the one who has come to our abode by sharing food with them – “na kañcana vasatau pratyācakṣīta | tad vratam |tasmādyayā kayā ca vidhayā bahvannaṁ prāpnuyāt| arādhyasmā annamityācakṣate |etadvai mukhato’nnaṁ rāddham| mukhato’smā annaṁ rādhyate| etad vā madhyato’naṁ rāddham| madhyato’smā annaṁ rādhyate |” 16

There are many instances in Upanishads where all plants and animals are treated as divine and are to be respected and protected as they are none other than Brahman. In Brihadaranyaka Upanishad, a female seer Gargi says we should meditate upon Sun as Brahman. She points out natural objects of meditation like lightning, space, air, fire, water, sound etc. to be meditated as the supreme Brahman. Meditating on nature helps in demolishing the ego-centric individual identity and transcending one’s awareness to from individual self to higher planes of consciousness and thus resulting in selflessness and equilibrium.

## Conclusion

Conservation of the environment requires spiritual ecology which vouches for the unity of whole existence. It is observed that throughout the human history, the empirical sciences and the materialistic philosophies have failed to generate this view of oneness and interconnectedness of all beings. This view of the world as a sacred place and not just a means of survival is found in Upanishads. Though its an ancient thought from ancient scriptures, it still acts as a

remedy to several ecological problems that the modern society is facing today. It is the eternal truth and truth never varies.

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# Targeting Critical Protein-Protein and Protein-RNA Interactions in SARS-CoV-2 as Therapeutic Strategies against COVID-19

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## Abstract:

*The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of the COVID-19 pandemic, relies on a complex interplay of protein-protein and protein-RNA interactions to facilitate its entry into host cells, viral replication, and assembly of infectious viral particles. This research work investigates the potential of disrupting these critical interactions as therapeutic strategies against COVID-19. Specifically, we explore the S1 domain interaction between the viral spike protein and the human ACE2 receptor, which mediates viral entry. Additionally, we examine the S2 domain-mediated membrane fusion process, essential for viral genome release into the host cell. Furthermore, we investigate the M-M and E-E interactions among the membrane and envelope proteins, respectively, crucial for viral assembly and envelope formation. Moreover, we focus on the N-RNA interactions between the nucleocapsid protein and the viral RNA genome, which are vital for viral genome packaging and replication. Disrupting these interactions could potentially inhibit the production of infectious viral particles and limit viral spread. Through a combination of computational approaches, biochemical assays, and in vitro experiments, we aim to identify and characterize small-molecule inhibitors, antibodies, or other therapeutic agents that can specifically target these critical interactions. By interfering with these essential processes, we seek to develop novel antiviral strategies that could impair SARS-CoV-2 replication, viral particle assembly, and infection, ultimately contributing to the development of effective treatments or preventive measures against COVID-19. This research provides insights into the molecular mechanisms underlying SARS-CoV-2 infection and highlights promising targets for therapeutic intervention, offering potential avenues for combating the ongoing COVID-19 pandemic and future emerging coronavirus threats.*

**Keywords:** SARS-CoV-2, Protein-Protein Interactions, Protein-RNA Interactions, Therapeutic Targets, COVID-19 Antivirals

## Background

Viral surface glycoproteins play a pivotal role in the intricate interactions between viruses and their hosts. These proteins adorn the viral envelope and dictate crucial processes such as host cell recognition, entry, and immune evasion. Among the most extensively studied viruses, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), the causative agent of the ongoing COVID-19

pandemic, features a prominently important spike glycoprotein (S). (1) Understanding the significance of these glycoproteins and their roles in viral infection has far-reaching implications for scientific endeavors aimed at benefiting humanity. (2)

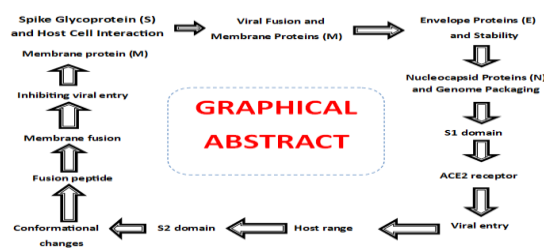
**Spike Glycoprotein (S) and Host Cell Interaction:** The SARS-CoV-2 spike protein,<sup>6</sup> consisting of S1 and S2 subunits, interacts with the host cell receptor

ACE2 in a process akin to a molecular handshake. (4) This interaction facilitates the virus's entry into respiratory epithelial cells, initiating the infection process. Extensive research has dissected the binding kinetics of this interaction, revealing its exquisite specificity. Unravelling the intricacies of the S-ACE2 interface provides valuable insights that inform drug design, vaccine development, and potential therapeutic interventions.

**Viral Fusion and Membrane Proteins (M):**

Following the initial interaction with the host cell receptor, the S2 domain of the spike protein orchestrates the crucial process of membrane fusion. Upon receptor binding, the S2 (5) domain undergoes conformational changes that ultimately lead to viral entry into the host cell. Membrane proteins (M) play a supporting role in this process by interacting with each other during virus assembly and shaping the viral envelope. Disrupting these M-M interactions could potentially halt the virus assembly process, representing a promising therapeutic avenue. (6)

**Figure 1: Graphical Abstract of Current Review**



The present review delves into the intricate web of interactions involving the surface glycoproteins of SARS-CoV-2, the virus responsible for the COVID-19 pandemic. These glycoproteins, particularly the spike (S) protein, play pivotal roles in the virus's life cycle and pathogenesis. The review dissects the molecular mechanisms underlying the S1 domain's interaction with the human ACE2 receptor, facilitating viral entry into host cells. Furthermore, it explores the S2 domain's role in mediating membrane fusion, a critical step

for viral genome release. The review also sheds light on the M-M and E-E interactions, which govern viral assembly and envelope formation, respectively. Notably, the review examines the crucial N-RNA interactions between the nucleocapsid protein and the viral RNA genome, essential for genome packaging and replication. By unravelling these intricate interactions, the review provides insights into potential therapeutic targets that could disrupt the virus's ability to infect, replicate, and spread, ultimately contributing to the development of effective antiviral strategies against COVID-19. (Figure 1)

**Envelope Proteins (E) and Stability:**

Envelope proteins (E) are essential for the formation of the viral envelope. The interactions between these proteins, known as E-E interactions, contribute to the stabilization of the envelope structure. Targeting these E-E interactions could destabilize the virus, potentially rendering it less infectious. Insights into the dynamics of envelope proteins guide the development of novel antiviral strategies. (7)

**Nucleocapsid Proteins (N) and Genome Packaging:**

Nucleocapsid proteins (N) play a crucial role in binding to the viral RNA genome, ensuring its proper packaging and enabling viral replication. (8) Disrupting the interactions between these proteins and the viral RNA (N-RNA interactions) could halt the viral replication process. (9) Furthermore, nucleocapsid proteins serve as diagnostic markers, as they are targeted by antibody-based tests to detect SARS-CoV-2 infection. (10)

The significance and benefits of understanding viral surface glycoproteins extend far beyond the COVID-19 pandemic. First, insights into glycoprotein interactions aid in the design of effective vaccines, as exemplified by the success of mRNA-based

vaccines targeting the SARS-CoV-2 spike protein. Second, the development of inhibitors targeting glycoprotein interactions, including small molecules, peptides, and neutralizing antibodies, holds promise for novel therapeutic interventions. Third, glycoproteins serve as diagnostic markers, enabling the detection of anti-SARS-CoV-2 antibodies and aiding in disease diagnosis and surveillance efforts. Finally, the knowledge gained from studying SARS-CoV-2 glycoproteins informs pandemic preparedness strategies, equipping us with valuable lessons to shape our responses to future outbreaks of emerging viral threats. (11)

### **S1 domain:**

The spike protein on the surface of SARS-CoV-2 is a large protein that plays a crucial role in viral entry into host cells. (12) This spike protein has two subunits: S1 and S2. The S1 domain is responsible for binding to the host cell receptor.

### **ACE2 receptor:**

For SARS-CoV-2, the host cell receptor that the S1 domain binds to is called ACE2 (angiotensin-converting enzyme 2). ACE2 is a protein found on the surface of many human cells, particularly in the lungs, heart, and blood vessels. (13)

### **Viral entry:**

The interaction between the S1 domain of the spike protein and the ACE2 receptor is crucial for viral entry into the host cell. This binding allows the virus to attach to the cell and initiate the process of membrane fusion, which ultimately leads to the release of the viral genetic material into the host cell. (14)

### **Host range:**

The binding affinity or the strength of the interaction, between the S1 domain and ACE2

determines the virus's host range. A higher binding affinity means that the virus can more effectively infect and replicate in cells expressing the ACE2 receptor. (15) This binding affinity plays a role in determining which species the virus can infect and how efficiently it can spread within a host population. S1 domain interaction refers to the crucial binding between the S1 subunit of the SARS-CoV-2 spike protein and the ACE2 receptor on human cells. This interaction is essential for viral entry and determines the virus's ability to infect and spread among humans, making it a crucial target for therapeutic interventions and vaccine development. (16)

The S2 domain interaction refers to the second crucial step in the viral entry process of SARS-CoV-2 after the S1 domain has bound to the ACE2 receptor. Here's an explanation of the key points:

### **S2 domain:**

The S2 subunit of the spike protein is responsible for mediating the fusion of the viral membrane with the host cell membrane, enabling viral entry.

### **Conformational changes:**

Upon binding of the S1 domain to the ACE2 receptor, the S2 domain undergoes structural changes, or conformational changes, which expose and activate specific functional regions within the S2 subunit. (17)

### **Fusion peptide:**

Within the S2 domain, there is a region called the fusion peptide. This fusion peptide is a short sequence of amino acids that can interact with and insert into the host cell membrane.

### **Membrane fusion:**

The interaction between the fusion peptide of the S2 domain and the host cell membrane initiates the process of membrane fusion. This fusion process brings the viral membrane and



the host cell membrane together, creating a single continuous membrane and allowing the viral genetic material to be released into the host cell cytoplasm. (18)

### **Inhibiting viral entry:**

Since the S2 domain-mediated membrane fusion is a critical step for viral entry, inhibiting this interaction could potentially prevent SARS-CoV-2 from entering and infecting host cells. Developing drugs or antibodies that block or interfere with the conformational changes, fusion peptide interactions, or membrane fusion process could be a therapeutic strategy to combat COVID-19. (19) S2 domain interaction involves the structural changes and fusion machinery within the S2 subunit of the SARS-CoV-2 spike protein, which facilitates the fusion of the viral and host cell membranes, enabling viral entry. Disrupting this interaction could be a target for preventing viral infection and disease progression. (20)

### **Membrane protein (M):**

The membrane protein (M) of SARS-CoV-2 plays a pivotal role in the virus assembly process through interactions known as M-M interactions. During virus assembly, these membrane proteins interact with each other via specific protein-protein interactions. These M-M interactions are essential for the proper organization and shaping of the viral envelope, which is a lipid bilayer derived from the host cell membrane. The M-M interactions facilitate the assembly of the viral components, including the viral genome, nucleocapsid proteins, and envelope proteins, into a complete virus particle. They act as a scaffold, providing a platform for the assembly of the other viral components and the formation of the viral envelope. Importantly, the M-M interactions help to curvature the viral envelope, giving the virus its characteristic spherical shape, which is crucial for the stability and infectivity of the virus particle. Disrupting these M-M interactions could potentially impair the virus assembly process and the formation of the

viral envelope, thereby preventing the virus from efficiently packaging its genetic material and producing infectious particles. As a result, targeting the M-M interactions with small molecules or other therapeutic agents could be an approach to inhibit viral replication and spread, making them a potential target for therapeutic interventions against COVID-19. (21)

### **Envelope protein (E):**

The envelope protein (E) of SARS-CoV-2 plays a vital role in the formation and stabilization of the viral envelope through specific protein-protein interactions known as E-E interactions. During the virus assembly process, these envelope proteins interact with each other via E-E interactions, facilitating the proper assembly and organization of the envelope proteins within the viral envelope, which is a lipid bilayer derived from the host cell membrane. These E-E interactions are essential for the proper formation and shaping of the viral envelope, as the envelope proteins act as building blocks, coming together and interacting through E-E interactions to form the complete envelope structure that encapsulates the viral genome and other components. Moreover, the E-E interactions contribute significantly to the structural stability of the envelope, helping to maintain its integrity and rigidity, ensuring that the virus particle remains intact during its life cycle and transmission. (22) Disrupting these E-E interactions could potentially destabilize the viral envelope structure, making the virus more susceptible to environmental factors or host defenses. As a result, targeting these interactions with small molecules or other therapeutic agents could be an approach to impair viral stability and infectivity, thereby inhibiting viral replication and spread, making the E-E interactions a potential target for therapeutic interventions against COVID-19.

### **Nucleocapsid protein (N):**

The nucleocapsid protein (N) of SARS-CoV-2 plays a pivotal role in the viral life cycle

through its interactions with the viral RNA genome, known as N-RNA interactions. These interactions are essential for the proper packaging and organization of the viral genetic material. During virus assembly, the N-RNA interactions facilitate the encapsidation of the viral RNA genome into a compact structure called the nucleocapsid, which is a complex consisting of the viral RNA tightly bound to multiple nucleocapsid proteins, forming a protective and organized structure. (23) Proper packaging of the viral genome is crucial for the subsequent steps of virus assembly and the production of infectious viral particles. Additionally, the N-RNA interactions also play a role in the viral replication process, as the nucleocapsid proteins interact with the viral RNA genome during the transcription and replication stages, facilitating the synthesis of new viral RNA molecules. (24) Disrupting these N-RNA interactions could potentially inhibit the viral replication machinery, preventing the virus from producing new copies of its genetic material. Consequently, targeting the N-RNA interactions with small molecules, antibodies, or other therapeutic agents could potentially disrupt the packaging and replication of the viral genome, thereby inhibiting the production of infectious viral particles and limiting viral spread and disease progression. (25) Thus, the N-RNA interactions represent a promising target for antiviral interventions against COVID-19, as disrupting these interactions could be an effective strategy for inhibiting SARS-CoV-2 replication and spread.

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## Exploring Nonverbal Communication Cues and Role-Play Activities for Developing English Communication Skills Among Sanskrit Undergraduate Learners

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### Abstract:

*Effective communication skills are essential for success in various academic, professional, and social contexts. This research paper investigates the use of nonverbal communication cues and role-play activities as a pedagogical tool for enhancing English communication skills among Sanskrit undergraduate learners. In an increasingly globalized world, proficiency in English communication is crucial for academic and professional success. However, language learners often face challenges in acquiring fluent communication skills, particularly when English is not their first language. This study aims to address this issue by exploring communicative language teaching approaches that leverage nonverbal communication cues and role-play activities to facilitate language acquisition and enhance communication competence. The research employs analysis of pre-and post-test assessments with qualitative insights gathered through classroom observations. The findings suggest that NVC cues and role-play activities enhance learner vocabulary, conversation skills, and linguistic fluency in English language teaching, particularly for Sanskrit undergraduate learners. It served as a platform for learners to acquire proficiency in the English language and communicate fluently. Additionally, it played a crucial role in promoting and popularizing the Sanskrit language worldwide. Consequently, learning and speaking English can generate interest among individuals speaking other languages to learn the Sanskrit language.*

**Keywords:** *Nonverbal Communication, Role-Play, English Communication Skills, Sanskrit Undergraduate Learners, Language Fluency*

### Introduction

In recent decades, English has grown significantly. English is a global language. It is a medium of communication. It allows people from different linguistic backgrounds to communicate effectively. It has become a bridge language and the only medium of communication internationally. Over the years, English has taken its place above all languages in every field, whether business, academia, government, trade, science & technology, or international communication business. In India, English is observed and commonly taught as a second language. There is no doubt that English as a language of communication holds a special place in India.

Therefore, proficiency in English communication has become increasingly essential for academic, professional, and social interactions. It is often seen as the language of opportunity and progress. It also serves as a common language for international travellers, tourists, and migrants who can communicate effectively in various contexts, including airports, ship ports, hotels, taxi drivers, tourist guides and tourist attractions destinations. English has gained its global status and is used as a means of communication among people from diverse linguistic and cultural backgrounds.

English communication is a basic essential part of our daily lives. Communication is

defined as the process of understanding and sharing meaning (Pearson & Nelson, 2000). Communication is to share and express thoughts, feelings, beliefs, emotions and ideas verbally, non-verbally or in writing. Teaching-learning English communication among young Sanskrit Language Learners is challenging due to unique linguistic, cultural and educational barriers. English is an additional language for Sanskrit learners. Primarily, they do not use English as a medium of instruction. Besides, these learners face difficulty in using English for communication purposes. One of the major challenges faced by these learners is the lack of an English-speaking environment, which hinders the development of their communication skills.

We living in the 21st century still practice and prefer using old traditional methods of teaching English to Sanskrit language learners. We use GTM (Grammar translation method), direct method, and drill method, and often emphasise rote learning and memorisation (repetition of words, phrases and sentences). Class is more teacher-centric teaching, thinking this would make teaching English easy for young minds and will retain the information. In the past, research has shown that “one for the main reason being that vital aspect of teaching, like NVC, are either neglected or not understood by the teacher” (Muchemwa, 2013). Most of us are neglecting the crucial role of nonverbal communication cues and interactive learning activities in language acquisition. This research aims to bridge this gap by investigating the effectiveness of integrating nonverbal communication cues and role-play activities into English language teaching for Sanskrit undergraduate learners.

By exploring the combined impact of nonverbal communication cues and role-playing activities in English language classrooms within the context of Sanskrit education, this research paper aims to provide new communicative language teaching and learning methodology and foster effective

communication skills among Sanskrit learners.

Role-play activities and Nonverbal communication cues will aid learners

- To enhance awareness about nonverbal communication cues
- To promote confidence and fluency in English communication skills
- To prepare students for real-world communication in social contexts
- To encourage active engagement and participation
- To develop an awareness of interpersonal skills and social etiquette
- To facilitate a supporting learning environment and promote peer learning

### Methodology

This study evaluates the effectiveness of integrating nonverbal communication cues and role-play activities in English language classrooms for developing fluency in speaking English among Sanskrit undergraduate learners, using classroom observation methods.

### Participants

The participants in this study consist of 1st year Sanskrit undergraduate students enrolled in a Compulsory English Communication Skill course at a Central Sanskrit University, Lucknow Campus, Lucknow, Uttar Pradesh, India. A total of 60 students (male and female) participated in the study.

This study involves

Incorporating NVC cues such as

- Facial expressions (smiling, frowning, or raising eyebrows)
- Eye contact (indicating interest, attention, or dominance)
- Gestures and movement (nodding, pointing, or waving)
- Tone of voice, which can convey emotion, attitude, or emphasis

- Physical touch (hugging, shaking hands, or patting shoulders)
- Appearance (clothing, hairstyle, or accessories)
- Artifacts (symbols, signs, or logos)
- Proxemics, or personal space (intimacy, power, or comfort)
- Paralinguistics (loudness, pitch, or pace of speech)
- Non-language sounds (whistling, clapping, or sighing)

And role-play activities in the classroom. This observation took almost eight weeks, with sessions conducted for two hours, five days per week. Pre- and Post-test assessments were administered to measure changes in English communication skills among the participants. Additionally, data was gathered through classroom observation from the participants to gain insights into the learner's experiences and views of the test.

### Results

After analyzing the classroom observation data, it was found that there was a significant improvement in the English communication skills of the participants. It was observed following the pre-and post-tests. Moreover, findings suggest that NVC cues and role-play activities enhance learner vocabulary, conversation skills, and linguistic fluency. Even students who are shy and hesitant to speak did well during the role-play activity. Students using realia and props bring a role-play in life into the classroom. It brings enjoyment to the classroom and automatically leads to better learning. It also promotes interaction in the classroom and positive feedback to the participants builds confidence and increases motivation to learn the language.

Moreover, these pedagogical techniques enable teachers and students to engage in interactive, context-based learning to support the growth of holistic communication skills, essential for success in both the classroom and the workplace. Organising training,

workshops, and professional development courses for educators is necessary to improve pedagogical approaches so that they can implement them in their classrooms.

### Conclusion

To sum up, this study highlights the value of communicative language teaching approaches that use role-playing exercises and nonverbal cues to improve Sanskrit undergraduate students' English communication skills. Practising role-play helps learners to build confidence, vocabulary, conversation skills, social relationships and comprehension of the subject matter. It also encourages peer learning and sharing responsibility for the learning process which aids in developing relationship bonds. Teachers can establish more engaging and productive learning environments that support language proficiency and acquisition by incorporating these strategies into language learning.

It can be recommended that teachers should encourage their learners to use gestures, facial expressions, and eye movements, to develop interest and draw attention to speak, listen and comprehend effectively. Furthermore, teacher training workshops, curriculum developers and language instructors should be introduced to new strategies for language teaching and new pedagogical ways to deal with young minds who are developing their cognitive and linguistic abilities. Teachers should be trained accordingly so that they can empower students to build self-confidence and leadership qualities. Additionally, speaking English will play a crucial role in promoting and popularizing the Sanskrit language worldwide. Consequently, learning and speaking English can generate interest among individuals speaking other languages to learn the Sanskrit language.

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