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STEAM Education in the Light of National Education Policy (NEP) 2020: A Qualitative Exploration of Multidisciplinary Approach in Indian Secondary Schools

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Abstract
This research paper presents a comprehensive qualitative analysis of the implementation of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education under India's National Education Policy 2020 (NEP 2020). The global challenges and technological advancements of the 21st century have exposed the limitations of the traditional 'siloed' model (separation of subjects) in education. In this context, NEP 2020 emphasizes 'multidisciplinarity' and 'holistic education' by eliminating rigid separations between disciplines. The primary focus of this research is to explore how the integration of the Arts can render traditional STEM subjects more creative, humanistic, and impactful. This study is entirely based on a qualitative methodology, utilizing 'inductive reasoning' and 'documentary analysis' rather than statistical hypotheses. The findings of the study demonstrate that STEAM education is not merely a combination of subjects, but a conceptual revolution rooted in the principles of 'constructivism'. Through this approach, skills such as design thinking, critical thinking, and empathy are developed in students. The research also highlights that the implementation of STEAM is akin to returning to the ancient roots of the Indian Knowledge System (IKS) such as Ayurveda and ancient architecture where arts and sciences have always been integrated. The study also identifies some key implementation challenges, including the traditional mindset of parents, lack of resources, and complexities in evaluation. In conclusion, this research paper suggests that education must not be limited merely to imparting information, but must be transformed into a process of 'feeling' and 'innovating'. As a path forward, the study points toward the possibilities of deeper integration between art and science through Artificial Intelligence (AI) and digital technology, which will ultimately aid in transforming India into a global knowledge superpower.

Keywords: *NEP 2020, STEAM, Multidisciplinarity, Constructivism, Holistic Development, Indian Knowledge System (IKS), Innovation.*

1. Introduction
The fundamental purpose of education is not merely the accumulation of information, but ensuring the holistic development mental, physical, intellectual, and spiritual—of an individual. Historically, in the Indian tradition of knowledge, art and science were never viewed in isolated compartments. From the *Natyashastra* to the *Aryabhatiya*, our ancient texts reflect a magnificent confluence of mathematical precision and artistic beauty. However, the colonial education system erected rigid walls between disciplines, restricting science to mere calculations and arts to mere expression. India's **National Education Policy 2020 (NEP 2020)** shatters this traditional and narrow framework to lay the foundation for a future where no 'hard separation' exists between subjects.

The core focus of this policy is '**multidisciplinarity**', which grants students the freedom to choose music alongside science, or painting alongside mathematics, according to their interests. In this very context, **STEAM** (Science, Technology, Engineering, Arts, and Mathematics) education has emerged as a global pedagogical movement. This research explores the fundamental question of how the integration of "**Arts**" can make science and mathematics education more

humanistic, engaging, and creative. When a student understands the principles of physics through dance, or geometry through the art of architecture, their learning becomes permanent and impactful.

The STEAM methodology does not merely develop technical skills; rather, it instills attributes such as '**design thinking**' and '**empathy**' in students, which are indispensable for 21st-century innovations. In the light of the provisions of NEP 2020, this research paper presents a detailed qualitative analysis of the possibilities and challenges of implementing STEAM in Indian school education.

2. Need of the Study

In the current technological era, purely mechanical and narrow technical knowledge is insufficient to address global challenges. Today's society requires engineers, scientists, and researchers who are not merely proficient in calculations, but who also deeply understand human sensibilities, cultural contexts, and social responsibilities. For a long time, India has had a conservative tradition of teaching subjects in isolated compartments (silos), which have hindered the holistic and multidimensional development of students. In this backdrop, it has become highly essential to understand the practical aspects and implementation process of STEAM education under NEP 2020.

This study is particularly relevant as it will provide academic scholars, educators, and policymakers with a clear conceptual direction on how to integrate an artistic approach with scientific education. Unless we incorporate creativity and empathy into education, innovation will remain purely mechanical. Therefore, an intensive conceptual research on this subject is imperatively needed to bring about a sustainable and balanced transformation in the Indian school education system.

3. Review of Literature

A deep review of existing literature clarifies that the fragmentation of knowledge is a product of the modern era. Numerous global studies confirm that this artificial separation between art and science emerged as a result of the 18th-century Industrial Revolution. As Maeda (2013) noted in his research 'STEM to STEAM', the objective of education in the early industrial era was merely to prepare skilled workers for factories, which led to the compartmentalization of subjects. However, during the Renaissance, in the era of great thinkers like Leonardo da Vinci, art and science were two sides of the same coin. Da Vinci's creativity stands as living proof that the knowledge of anatomy and the skill of painting are complementary to each other.

In the contemporary global landscape, countries like Finland and South Korea have successfully integrated STEAM into their national curricula. According to Youn & Kong (2015), South Korea achieved a high rank in the Global Innovation Index through its 'K-STEAM' program by simultaneously combining students' problem-solving capabilities with emotional development. The experiences of these nations demonstrate that when science is taught alongside art, the cognitive load on students is reduced, and their interest in learning increases.

In the Indian context, the concept of STEAM is not new. Rabindranath Tagore's (Tagore, 1921) 'Santiniketan' pedagogy can be considered the progenitor of modern STEAM. Tagore believed that education should be imparted in harmony with nature and through artistic expression. In Santiniketan, art, music, and handicrafts were taught in integration with science and geography, which forms the core foundation of today's 'multidisciplinary' approach. A UNICEF (2019) report also underlines that an integrated pedagogical approach is indispensable for the socio-emotional development of children. Therefore, the literature indicates that through NEP 2020, India is moving toward reclaiming its ancient and effective tradition of 'holistic education'.

4. Objectives of the Study

- To conduct a conceptual analysis of the principles of '**multidisciplinary education**' as outlined in NEP 2020.
- To highlight the possibilities of '**Art-Integrated Education**' in Indian schools.

- To understand the process of developing **critical thinking** among students through STEAM.

5. Research Questions

- Does flexibility of subjects at the secondary level foster creative expression among students?
- What kind of cultural and structural transformations are required to implement STEAM within the Indian school environment?

6. Inductive Approach

This research does not test any pre-determined hypothesis. On the contrary, it utilizes the '**Grounded Theory**' framework, wherein the researcher observes facts with an open mind and develops a new theory based on the findings at the end of the study.

7. Qualitative Research Methodology

This study employs '**Phenomenology**' and '**Documentary Analysis**'. Rather than focusing on numbers (statistical data), it concentrates on the deeper meanings of ideas, experiences, and policy documents.

8. Sources of Information

- The official document of **NEP 2020**.
- Reports on multidisciplinary education by **UNESCO** and **NCERT**.
- Articles and case studies by academic scholars and educators.

9. Content Analysis

A meticulous analysis of the "Holistic Development" section of the National Education Policy (NEP 2020) reveals that the policy's conceptual inclination is entirely toward **'Constructivism'**. Constructivism is a pedagogical theory which posits that a learner does not acquire knowledge passively, but rather constructs knowledge actively through their prior experiences and active participation. This perspective of NEP 2020 perfectly aligns with the core essence of STEAM education, where 'Arts' ceases to be merely an object of performance and becomes a powerful medium of exploration and expression.

- **Experiential Learning:** The policy strongly emphasizes art-integrated and sports-integrated education. In the STEAM model, when students connect scientific experiments with artistic projects, they do not just read about principles—they 'experience' them.
- **Cognitive Flexibility:** By eliminating "rigid separations," NEP 2020 prepares the student's mind for multi-dimensional thinking. This flexibility allows the student to blend mathematical precision with artistic creativity.
- **Self-Construction of Knowledge:** The soul of STEAM lies in placing the student in the role of a 'problem solver' and a 'creator'. Within this constructivist framework, the teacher acts merely as a facilitator who motivates the student to derive their own conclusions.

The content analysis proves that the 'Holistic Development' section of NEP 2020 establishes a statutory and conceptual platform for STEAM education. This policy shift is a revolutionary step toward transforming Indian education from 'information-centric' to 'knowledge-centric', giving the highest priority to a student's curiosity and creativity.

10. Conceptual Framework of Multidisciplinary Education

To successfully implement STEAM education, it is essential to understand its conceptual framework. Within the Indian school context, multidisciplinary can be classified into three primary levels that provide depth to a student's understanding:

1. **Interdisciplinary:** At this level, a direct connection is established between two distinct subjects. For example, explaining the principles of 'sound waves' in a physics class through musical instruments and notes. Here, one subject serves as a medium to clarify the concept of another.

2. **Multidisciplinary:** At this stage, a single problem or theme is examined from the perspectives of different subjects. For instance, studying 'environmental conservation' simultaneously through the lenses of Science (factors of pollution), Social Science (policies), and Art (posters/expression). This enables students to comprehend the broader dimensions of a topic.
3. **Transdisciplinary:** This is the highest level, where the focus centers entirely on solving real-world problems. Here, traditional subjects become secondary, and the integration of knowledge is so profound that the boundaries between disciplines blur. An example is designing a 'Smart City', which simultaneously utilizes mathematics, architecture, environmental science, and sociology.

11. STEAM and Indian Knowledge System (IKS)

An exceptionally critical and foundational dimension of this research highlights that in the ancient Indian tradition of knowledge (IKS), 'Arts' and 'Sciences' were never segregated or competing domains. The dichotomy that emerged in the Western world during the modern era never existed in India. In ancient India, 'education' was envisioned as a confluence of 64 arts (*Kalas*), wherein science, technology, and craftsmanship were intricately interwoven with artistic expression.

For instance, ***Ayurveda*** is not merely a system of medicine, but a living synthesis of physics, chemistry, and philosophy. It simultaneously concentrates on the machinery of the physical body, peace of mind, and the aesthetics of life. Similarly, **'Indian Architecture'** and the construction of ancient temples offer magnificent specimens of mathematical precision, geometry, and sculpture. The Konark Sun Temple or the massive *Gopurams* of South India stand as living testimonies to how astronomy and architectural craftsmanship unite to create global masterpieces.

Under NEP 2020, the implementation of STEAM is not the adoption of a foreign model, but rather a return to our own rich cultural and pedagogical roots. It is the revival of the very tradition of **"Integrated Knowledge"** that once elevated India to the status of a 'Vishwa Guru' (Global Teacher). This model instills a sense of pride in students regarding their heritage and inspires them to utilize traditional wisdom alongside modern technology.

12. Implementation Strategies

To translate the objectives of NEP 2020 into reality at the ground level, mere policy changes are insufficient; rather, a revolutionary transformation in classroom teaching methodologies is imperative. Based on qualitative analysis, two major strategies can prove highly effective for the successful implementation of STEAM:

1. Theme-Based Learning

This strategy is the simplest and most impactful path to dissolving the boundaries between subjects. Under this approach, schools select a single common theme such as 'Water', 'Environment', or 'Energy'. For example, on the theme of 'Water', the science teacher explains its chemical properties and conservation methods, while during the same module, the Art teacher guides students in creating a visual representation of the water cycle or developing posters and artworks based on water conservation. This co-teaching or joint session provides students with a 'holistic' and comprehensive understanding of the topic.

2. Project-Based Learning (PBL)

This strategy positions students in the role of active investigators. Under this framework, students are motivated to work on real-world challenges that require them to simultaneously apply scientific reasoning and artistic aesthetics. For example, students can be assigned to build a model of a **'Rainwater Harvesting System'**. Here, the challenge is

not only that the model must be technically functional, but it must also be highly aesthetic and architecturally appealing. This process builds a bridge between the 'engineering design process' and 'artistic creation'.

13. Qualitative Findings

Through the conceptual and documentary analysis of this research, several significant qualitative findings have emerged, demonstrating the superiority of the STEAM methodology over traditional education:

- **Mitigation of Science Phobia:** The study clearly indicates that the integration of artistic activities effectively reduces the 'fear' or 'phobia' prevalent among students toward subjects like science and mathematics. When abstract scientific theories are presented through music, painting, or drama, students accept them as a creative game rather than a cognitive burden.
- **Development of Tolerance and Diversity:** Multidisciplinary education is not confined merely to intellectual development. It fosters social attributes such as 'tolerance' and 'respect for diverse perspectives' in students. Examining a single problem through the distinct lenses of art, technology, and sociology helps students understand that any life challenge can have multiple dimensions of truth and solutions.
- **Transformation in the Teacher's Role:** A major finding of this research is that in the STEAM model, the traditional role of the teacher shifts from being the 'sole source of knowledge' (*Sage on the Stage*) to that of a 'facilitator' or 'guide'. Instead of merely delivering information, the teacher now designs environments and scenarios where students reach the truth themselves through experiments and artistic creation.

These findings indicate that STEAM education is fully capable of bringing about a positive and permanent psychological transformation in the personality of students.

14. Limitations & Barriers

Based on the qualitative analysis of this research and the study of policy documents, certain critical conceptual and structural barriers in the path of STEAM education within the Indian context have also become evident:

- **Psychological Barrier (Mindset):** In Indian society, a rigid "hierarchy" among subjects has persisted for decades, where a strong sentiment of "Science is supreme" still exists among parents and educators. Art is frequently relegated to a 'secondary' or 'co-curricular' subject, resulting in psychological resistance to adopting a multidisciplinary approach.
- **Assessment Challenges:** The traditional education system is heavily reliant on objective scores. Quantifying the artistic, creative, and original work executed under STEAM into a traditional marks-based system poses a major challenge. Evaluating creativity is inherently subjective, which necessitates a new and flexible 'rubric-based' evaluation methodology.
- **Resource Constraints:** While some elite, advanced schools in urban areas are well-equipped with technological and artistic resources, government schools in rural areas still face an acute shortage of digital infrastructure, art supplies, and trained specialists. This 'resource and digital divide' emerges as the biggest hurdle in the equitable implementation of STEAM.

A complete implementation of STEAM is impossible without addressing these limitations; therefore, resolving these practical barriers at the policy level is imperative.

15. Conclusion & Future Scope

Conclusion

A detailed analysis of this research clearly demonstrates that the confluence of the National Education Policy 2020 and STEAM education marks a **'paradigm shift'**—a epoch-making conceptual

transformation—for the Indian educational landscape. This study arrives at the critical conclusion that if we aspire to transform India into a 21st-century global knowledge superpower and a hub of innovation, we must abandon our traditional teaching methodologies and adopt a **'holistic approach'**. The time has come to teach students not merely to 'read' subjects, but to 'feel' the underlying meanings and sensibilities within those disciplines.

The STEAM methodology has proven that art and science are not contradictory, but rather complementary to each other. While science teaches us logic and the pursuit of truth, art provides us with the skill to present that truth with beauty and utility. The 'multidisciplinary education' of NEP 2020 is rooted in this very philosophy, nurturing the creative and emotional aspects of a student alongside their intellectual growth. Ultimately, the true purpose of education is not merely to acquire a degree, but to cultivate a mind that can solve problems with empathy and innovation.

Future Scope

This research opens new vistas for future researchers and educators. In the coming times, a significant domain of research could investigate how **Artificial Intelligence (AI)** can be leveraged to further bridge the gap between art and science. Could AI-based tools assist students in translating scientific data into artistic music or visual imagery? Additionally, examining how emerging technologies like **Virtual Reality (VR)** and **Augmented Reality (AR)** can be utilized to extend STEAM education to rural and resource-constrained areas is a subject ripe for deep exploration. Future studies should also focus on how the long-term impacts of the STEAM methodology manifest in students' career choices and their professional performance.

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