

STEAM for the Future: A Comparative Evaluation of Educational Strategies in Pakistan and India

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Abstract: This study conducts a comprehensive comparative examination of the educational strategies related to Science, Technology, Engineering, Arts, and Mathematics (STEAM) in both Pakistan and India, uncovering distinctive methodologies addressing a common global necessity. Although both countries recognize the critical role of STEAM in developing a workforce suitable for the 21st century, their approaches to implementation are markedly different. India's National Education Policy (NEP) 2020 advocates for a decentralized and comprehensive framework, promoting a vibrant ecosystem characterized by public-private collaborations, extensive teacher professional development, and strong integration of technology, as demonstrated by initiatives such as the Atal Tinkering Labs. This approach produces measurable, evidence-based results indicating improved critical thinking and creativity among learners. By contrast, Pakistan's activities, mostly through the national "STEAM Pakistan" program, are more project-oriented and responsive. While having ambitious aspirations for transforming schools and teacher professional development, implementation is marred by significant systemic challenges, such as inadequate infrastructure, ingrained rote learning, and substantial financial and cultural challenges that disproportionately affect women. Impact evidence in Pakistan is mostly qualitative and perception-based, reflecting a beginning phase of change. India's systemic assimilation and empirical monitoring is noted by this review as a template for Pakistan, although it is also noted that transparent gender-based change initiatives for Pakistan and external stakeholder involvement hold potential lessons for India for increasing practical implementation. Finally, actionable recommendations are made to promote equitable, sustainable, and transformative STEAM learning in both countries.

Keywords: STEAM Education, Pakistan, India, Comparative Analysis, Educational Reform



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Introduction

This review involves a comparative analysis of how Science, Technology, Engineering, Arts, and Mathematics (STEAM) are applied in Pakistan and India. The fundamental findings indicate that there is a common acceptance of the significance of STEAM in creating a workforce equipped with 21st-century skills and competencies, but at the same time, they highlight a major point of difference in strategic implementation and performance. The strategic National Education Policy (NEP) 2020 has guided India to develop an ecosystem that is decentralized, multi-stakeholder-oriented, with benefits such as utilizing public-private partnerships and focusing on equity requirements. At the national level, this is reflected in the creation of the Atal Tinkering Labs and the introduction of robotics and AI into the curriculum from an early stage (SSRVM Trust, [n.d.](#); Kasi, [2025](#); Shubangini & Shubangini, [2025](#)).

Conversely, the attempts of Pakistan organized by the Ministry of Federal Education and Professional Training (MoFEPT) via the program called STEAM Pakistan are more centralized and project-oriented (STEAM Policy Unit, 2024). Although it has an ambitious scope of transforming thousands of schools and educating a large cohort of teachers, its initiation is often hindered by systemic obstacles, such as a deficient infrastructure, strongly ingrained rote-memorization practices, and insufficient funds (Malik, 2017; Usman, 2025).

The discussion reveals significant gaps in the implementation of pedagogies, technological accessibility, and equity performance, indicating a discrepancy between policy rhetoric and practical reality in both settings, and especially in rural and under-resourced schools. Indian studies offer more detailed, quantifiable evidence of effects, and the studies have shown statistically significant positive effects on critical thinking and creativity (Halimah et al., 2025). Meanwhile, much of the evidence presented by Pakistan is based on qualitative insights and the outcomes of pilot schemes (Abbas et al., 2024; Qayyum & Kamal, 2025).

The report concludes with actionable recommendations for both nations, emphasizing the need for sustained, equitable investment, enhanced teacher professional development, and the cultivation of a truly collaborative, multi-sectoral ecosystem to unlock the full potential of STEAM for future generations.

Contextualizing STEAM Education in South Asia

Global Imperative for STEAM

The world economy is experiencing a profound change. The 2020 report by the World Economic Forum suggested that in 2025, 85 million jobs across the globe will be replaced by automation, and 97 million new positions will be created that will demand a new set of skills (Usman, 2025). Such evolving workforce expects skills like digital literacy, analytical thinking, creativity, and problem-solving to be developed, yet traditional education models do not support such skill development (Abbas et al., 2024). STEAM has become an important framework in response to this global imperative. This interdisciplinary model is based on the same principles that produce the skills that will ensure success in the 21st century, as it does not focus on content memorization but on application and creativity (Usman, 2025; Abbas et al., 2024).

Policymakers in Pakistan have recognized the global demand to have a skilled workforce and have focused more on STEM education including the arts to facilitate transdisciplinary thinking and problem-solving skills (Abbas et al., 2024; SSRVM Trust, n.d.). Equally, the National Education Policy (NEP) 2020 of India is a strategic move towards abandoning rote learning in favor of skill acquisition and application in learning, as it acknowledges that the future-ready citizen needs a holistic and integrated approach to education (Samsidh, 2025). The similarity in the needs to modernize their education systems is in the fact that the two countries face a similar challenge in preparing their large and youthful populations to for the rapidly changing global context.

Rationale for a Comparative Study

Historically and educationally, Pakistan and India have had a similar background, namely the persistent focus on rote learning and the emphasis on examinations (SSRVM Trust, n.d.). The two nations are also experiencing similar demographic pressures besides sharing an ambitious economic development objective, which depend on the nurturing of a skilled labor force. An analytic review of their strategies in the application of STEAM is critically or comparatively evaluated presents an opportunity for evidence-based identification of successful models, diagnosis challenges that are commonly faced and derive some lessons that can be transferred to other case studies (Usman, 2025; Qayyum & Kamal, 2025). It is intended that findings from this review will provide a contextually relevant evidence base to inform strategic decision-making and enhance future learning in a South Asian setting.

Scope and Objectives

This review provides a comprehensive analysis of the differences in educational strategies for implementing STEAM education in Pakistan and India. The study is structured around five core thematic areas: national policy and curriculum, pedagogical strategies and teacher training, technology integration, equity and socio-economic inequalities, and influence on student outcomes and employability. The analysis draws solely from peer-reviewed



journals and government reports published between 2020 and 2025 to ensure the findings are contemporary and empirically grounded.

National Policy and Curricular Frameworks

Pakistan's Top-Down Approach

The recognition of the Pakistani government of the global demand for a STEM-oriented workforce has resulted in the creation of specific centralized programs (Abbas et al., 2024). The main policy tool that the country relies on to facilitate this educational transformation is the formally titled "STEAM Pakistan" project, a multi-strand initiative organized by the Ministry of Federal Education and Professional Training (MoFEPT) with the support of other partners, including the Malala Fund (Cheema, 2023). The program's ambitious objectives include improving STEAM learning for 5 million students, building the professional capacity of 100,000 teachers, and transforming over 13,000 government high schools by 2027. The strategic intent is to transition away from traditional, "primitive methods of teaching" toward more engaging, practical, and hands-on learning (MoFEPT, n.d.). A key component of this effort is the explicit focus on promoting gender transformation and scientific inquiry, particularly for girls who have been historically at a disadvantage (STEAM Policy Unit, 2023).

In a tangible curricular shift, Pakistan's new National Curriculum (2022–23) has been designed using the STEAM framework. A comparative analysis of this curriculum for college-level physics found it to be more flexible, relevant, and engaging for students compared to the older 2006 curriculum. However, the study also found that the old curriculum was rated higher in terms of content organization suggesting there is room for improvement on the new model (Choudhary, 2025). There are many obstacles to the adoption of such policies, described as formidable. There has also been an officially produced STEM program for building labs, and Google sponsor development of a code project at the local community level but this early stage effort continues to face implementation barriers (Abbas et al., 2024).

India's Visionary NEP 2020

The NEP 2020 is not a programme-oriented framework as in case of Pakistan but a holistic and transformational policy to make India a global knowledge powerhouse.

The key idea is to concentrate on the educational model away from rote learning toward a holistic, experiential, and interdisciplinary approach. One of the policy requirements is the explicit promotion of the integration of arts and humanities with the STEM disciplines, resulting in the emergence of the STEAM framework (SSRVM Trust, n.d.). The NEP 2020 requires the implementation of coding in Grade 6, the promotion of project-based learning (PBL) to develop the skills of critical thinking and problem-solving in students as they address real-life issues (Samsidh, 2025).

The NEP 2020 is decentralised in its implementation and envisages cooperation among various stakeholders including the state level boards (like CBSE) and individual ed-tech companies (SSRVM Trust, n.d.; Kasi, 2025). This has enabled a variety of innovative and scalable initiatives such as the Atal Tinkering Labs (ATLs), which offer students hands-on experience and create an environment conducive to innovation (Shubhangi, 2025). The NEP 2020 is more a philosophy than a set of instructions and appears to be heralding in something born of system rather than incremental change over time.

Comparison of the Policy Design

Discrepancies in policy The different thoughts of the national-level educational reform are reflected in the policy. While Pakistan is responsive in its project-based scheme with the individual hits, it offers an expedited route to pilot proof of concept exercises (Cheema, 2023; MoFEPT, n.d.). This center-monitored mode of governance is top-down and flexible, but perhaps cannot be universally implemented or endure when opting for side support without getting enmeshed with the global educational structure. By contrast, India's NEP 2020 is a foundational, philosophical shift that sets a broad, long-term vision for the entire education system (SSRVM Trust, n.d.). This decentralized framework allows for a more organic rollout across state-level boards and private sectors, which appears to foster a more resilient and ingrained culture of innovation. The NEP's broad-based vision may result in a slower initial rollout, but it is more likely to create a lasting, systemic transformation.



Table 1

A Comparison of the Key Features of the Two National Frameworks Highlights these Fundamental Differences in Approach

Feature	Pakistan (STEAM Pakistan Program)	India (NEP 2020)
Strategic Intent	Project-based, targeted, and focused on specific interventions.	Visionary, holistic, and a foundational policy shift.
Lead Agency	Ministry of Federal Education and Professional Training (MoFEPT), with partners like Malala Fund.	Ministry of Education, with decentralized implementation through CBSE, state boards, and private entities.
Key Mandates	Building STEAM/STEM labs, MoUs with universities, and a grassroots-level coding program (Abbas et al., 2024; Cheema, 2023).	Mandates coding from Grade 6, promotes multidisciplinary education, and fosters innovation through ATLs (Bharti & Soni, 2025).
Key Implementation Challenges	Limited funding, lack of resources, and cultural/societal barriers Malik, 2016; Qayyum & Kamal., 2025).	Implementation gaps, equitable access in rural areas, and persistent rote-learning culture (Usman, 2025).

This divergence in strategy sets the stage for the rest of the comparison, demonstrating how different policy frameworks can lead to varied outcomes in pedagogical practice, technology adoption, and equity.

Pedagogical Strategies and Teacher Training

Pakistan's Foundational Shifts

The education system in Pakistan has historically been criticized for its reliance on rote learning and for lacking hands-on, practical experiences (Usman, 2025). To counteract this, the new STEAM framework aims to foster inquiry-based learning, project-based learning (PBL), and interdisciplinary experimentation (Qayyum & Kamal, 2025). Private institutions like STEP Schools have pioneered this shift by championing PBL, where students engage in projects such as building a robot or designing a bridge, which helps them apply theoretical knowledge and develop critical thinking skills (Abiha-Yasir, 2025). Similarly, the MoFEPT's "STEAM Pakistan" program explicitly promotes activity-based learning and scientific inquiry to transform teaching methodologies across the country (Li, 2024; Abiha-Yasir, 2025).

However, a major barrier to the widespread adoption of these pedagogies is a significant deficit in teacher training (Malik, 2016). Many teachers are "untrained in STEAM methodology" and face difficulties in integrating arts and hands-on experiments into their science lessons (Usman, 2025). In response, the STEAM Pakistan initiative of the MoFEPT has been conducting workshops to help teachers gain access to innovative pedagogical methods and other essential digital tools (Abbas et al., 2024). In one of the studies on the professional development of teachers, it was discovered that this training increased their creativity, critical thinking and awareness of integrated STEAM pedagogy, which demonstrated a positive impact on their classroom practices (Qayyum & Kamal, 2025; Usman, 2025).

India's Experiential Learning Mandate

Experimental and inquiry-based learning has become one of the pillars of the Indian educational strategy because of NEP 2020 (SSRVM, n.d.). The CBSE curriculum is also being modified to incorporate the arts and focus on competency-based education (Samsidh, 2025). Project-based learning is also an integral component, and students are advised to apply their skills to solve real-world problems like renewable energy solutions (SSRVM, n.d.). This is also supported by the Atal Tinkering Labs (ATLs), which offer specific areas where practical activities, innovation, and problem-based learning are conducted (Samsidh, 2025).

Recognizing that the policy is not enough, NEP 2020 pays a particular emphasis on teacher empowerment in terms of continuous professional development (CPD) (SSRVM, n.d.). The gap between theory and practice is addressed through certified online training courses provided by such organizations as India STEM Foundation and STEAMCUBE that provide knowledge of project-based learning, robotics integration, and mentorship techniques (India STEM Foundation, 2023).



The Role of Teacher Professional Development

Analysis of pedagogical strategies in both countries shows that there is a significant divergence between what the policy prescribes and what is happening on the ground. Although the two countries acknowledge the necessity to abandon the idea of rote learning, the role of memorization in the culture of Pakistan is difficult to overcome at the individual level or even pilot initiatives (Malik, 2016). In India, the NEP 2020 provides a broader mandate for pedagogical reform, but the sheer size and diversity of the country's education system mean that achieving uniform implementation remains a persistent challenge, especially in rural areas (Usman, 2025; Mehddi et al., 2024). The existence of a robust ecosystem of private and public organizations offering certified training programs in India suggests that the demand for these new pedagogical skills is being met by a mix of players, a model that is less mature in the Pakistani context.

Technology Integration and Digital Equity

Digital Initiatives in Pakistan

Pakistan's government, through MoFEPT, has launched a number of digital innovation projects, though their direct integration into a comprehensive STEAM strategy is not always explicit. Initiatives include establishing 400 tech-enabled smart classrooms and deploying interactive smart boards in selected schools in rural districts. The eTaleem Portal and TeleSchool Mobile App have been developed to provide digital content and training, with an offline module for schools with limited internet access. A partnership with Google has been established to create digital infrastructure in schools, although the initiative has been hindered by a "lack of hardware" (MoFEPT, n.d.). The research indicates significant barriers to widespread technology adoption, including inadequate infrastructure and the high cost of advanced tools like virtual and augmented reality (Sahito et al., 2025).

India's Tech-Driven Ecosystem

The NEP 2020 framework enables India to build a more diverse and mature ecosystem, particularly in technology integration (SSRVM, n.d.). Its mandate for all students to learn coding from Grade 6 has spurred the establishment of AI and robotics laboratories in public schools, including Haryana's collaboration with STEMpedia (Kasi, 2025). The project provides tablets, high-speed internet, robotics kits, and a built-in Learning Management System (LMS). Another driver of democratizing access to quality education in India is the growth of online schools and ed-tech companies. These platforms deliver advanced curricula, virtual laboratories, and mentorship services, making high-quality education accessible to students in remote and underserved areas (Shubangini, 2025).

Comparative Analysis of Technological Readiness

Most of the technology deployment in Pakistan comes from small, government-led initiatives and collaborations, resulting in a fragmented digital connectivity that often proves unsustainable once program funding ends (MoFEPT, n.d.). While these projects are an asset, they usually fail to scale because the infrastructure is disjointed and hardware inconsistent. In contrast, India's NEP 2020 provides a national framework that has pushed central boards and state governments to invest in and expand technology integration, including by engaging more companies in the ed-tech sector (Kasi, 2025). The Haryana case study illustrates a model that can be replicated end-to-end, systematically covering technology, curriculum, and teacher training one of the main distinctions from Pakistan's piecemeal efforts. This represents a more sustainable and scalable path toward national digital transformation.

Addressing Equity and Socio-Economic Disparities

Gender and Financial Barriers in Pakistan

The problem of gender inequality in STEM education is a priority and a highly complex issue in Pakistan that is deeply entrenched in the social norms, cultural frameworks, and health inequalities (Qaisar, 2024). One of the strongest obstacles is family objections, especially in the case of women with the background of lower-middle socioeconomic groups since engineering and computer-related professions are often viewed as a socially unacceptable field because of the fear of daughters spending too much time outside the house (Bhutta et al., 2024). The factor of socio-economic inequality is also significant since students studying science belong to the privileged group capable of affording



personal tutoring (Qaisar, 2024). The study attests to the fact that households tend to make discriminatory choices in terms of educational spending and school choice by prioritizing male children (Malik, 2016; Bhutta et al., 2024).

The problem is clearly addressed within the program called STEAM Pakistan, which focuses on the aspect of gender transformation in all its work. It also strives to support female students by offering mentorship and role models especially women in leadership roles to join the STEAM careers (MoFEPT, n.d.). UNESCO is also working with Pakistan to organize events that introduce young girls to successful women of science and address systemic barriers to their participation (UNESCO, 2020; United Nations Pakistan, 2025).

Inclusivity and Targeted Interventions in India

The NEP 2020 of India emphasizes the concept of inclusivity and promotes the participation of the marginalized groups and female students into STEM by offering them scholarships and mentoring opportunities (SSRVM, n.d.). This study is in the Indian context as well: India Based on gender disparities to STEM, a 2025 study has found that socioeconomic factors i.e., family income and parental education have significant ability of association with female student's success in STEM field (Singh & Singh, 2025). This finding points to the need to develop targeted interventions that alleviate economic inequality and engender more gender-inclusive curricular experiences in STEM. The Haryana STEM lab program is a good example of implementation of such policy; the breaking of societal/ gender barriers enabled the program to have an immediate impact on female students and with an increased attendance in class, thus girls are actually equally attending classes (Shubhangi, 2025).

Furthermore, to address the problem of urban-rural divide, NEP 2020 has also emphasized on flexible teaching methods which can be adapted according to the local customs and setting so that STEAM will not remain as an urban phenomenon. The regional-language-first strategy adopted by the Haryana initiative, its execution in semi-urban and rural schools, make plain such a commitment to wider equity (Shubhangi, 2025).

Comparative Analysis of Equity Outcomes

Both nations aim to promote gender equity in STEAM; however, the evidence indicates that Pakistan faces more entrenched cultural and financial challenges (Qaisar, 2024; Bhutta et al., 2024). The case study of female students in Pakistan offers granular detail on the family-level obstacles that are less prominent in the Indian literature. In India, the policies appear to be translating into more tangible, quantitative outcomes, as evidenced by the significant increase in female participation in the Haryana case study (Shubhangi, 2025). The Indian policy framework seems to have created a more fertile ground for both government and private programs to successfully address equity challenges.

Table 2

Comparison of Barriers

Barriers	Pakistan	India
Lack of Infrastructure (Labs, Internet)	High, a top barrier cited by leaders and a constraint for digital initiatives (Malik, 2016; Abbas et al., 2024).	Present, but addressed by NEP 2020 and initiatives like ATLS and smart classrooms (SSRVM, n.d.)
Teacher Training Deficits	Significant, with many teachers untrained in modern pedagogies (Malik, 2016; Abbas et al., 2024; Usman, 2025).	Cited as a top challenge, but being addressed through mandated CPD and a mix of private/public certification programs (Shubhangi, 2025).
Cultural/Societal Barriers (Rote learning, Career preferences)	Deeply ingrained, with a preference for traditional careers and a culture of rote memorization. Engineering is considered "taboo" for women (Usman, 2025; Qayyum & Kamal, 2025).	Rote learning is being actively phased out by NEP 2020. Societal mindsets still present a challenge, but less so than in Pakistan (Smile Foundation India, 2023; Sentinel Assam, 2023).



Barriers	Pakistan	India
Financial Constraints (Government budgets, Family income)	Government allocates only 2.3% of GDP to education. Private tutors are required to afford science education (Cheema, 2023; Malik, 2016).	NEP 2020 promotes scholarships and fee waivers. Family income and access to resources are significant predictors of female enrollment in STEM (Singh & Singh, 2025).
Policy Gaps (Clarity, Centralization)	More centralized, project-based model with a lack of clear guidance and institutional support (Abbas et al, 2024; Qayyum & Kamal, 2025).	Decentralized framework provides flexibility but may lead to uneven implementation across regions (Usman, 2025).

This comparative table highlights that while both countries face common challenges, the depth and nature of these barriers differ, necessitating distinct policy responses.

Impact on Student Outcomes and Employability

Measuring Outcomes in Pakistan

The available research on the impact of STEAM education on Pakistani students is largely based on qualitative data and the perceptions of school leaders. A descriptive study of 100 school leaders found that the majority agreed that STEAM education develops a range of 21st-century skills, including technology and information literacies, problem-solving, critical thinking, and creativity. The Pakistani government's STEM project also explicitly aims to develop these skills, along with entrepreneurship, to create a future workforce (Abbas et al., 2024). However, the research also points to a significant gap between these positive perceptions and the actual implementation of hands-on activities, which limits the full realization of these benefits. The education system's heavy reliance on rote learning makes it difficult to foster creativity and critical thinking in practice (Qayyum & Kamal, 2025).

Empirical Evidence from India

India's research provides a more robust mix of quantitative and qualitative evidence of STEAM's impact. A quasi-experimental study found that a STEAM-based approach had "statistically significant effects" on critical thinking skills in primary school students (Halimah et al., 2025). The study's results are particularly compelling, as they demonstrate that the STEAM approach explained 19.3% of the variance in critical thinking skills and 13.9% of the variance in scientific attitudes, indicating meaningful practical significance (Halimah et al., 2025). These results were corroborated by stakeholder survey responses, with 60 per cent of stakeholders pin-pointing creativity and about 55% identifying problem-solving as major STEAM education outcomes. Institutionalisation of the culture of innovation is being promoted through NEP 2020 and associated initiatives like Atal Tinkering Labs (ATLs). ATLs enable learners to apply recognition and practical, problem-solving activities that prepare them for future job roles as (Bharti & Soni, 2025). And it's doing so in a way that's democratizing access to mentorship and specialized curriculum, training students to work collaboratively and interdisciplinarily (or whatever word you like best) as they must do in today's scientific research and innovation working environment.

Future-Proofing the Workforce

The discrepancy in the type of evidence available from each country is a crucial point of divergence. While both nations claim that STEAM develops 21st-century skills, India's initiatives have produced more measurable, empirical evidence of impact. This suggests a more mature, data-driven approach to evaluation. Pakistan's focus on perceptions and anecdotal evidence may reflect the nascent stage of its initiatives or a lack of robust research infrastructure for systematic evaluation (Halimah et al., 2025). India's government, through the NEP 2020 and its various programs, is creating a clear pipeline for future innovators and entrepreneurs, directly aligning education with the demands of a competitive global workforce.



Table 3*Comparison of Skills*

Skills	Pakistan (Qualitative/Perceptual Data)	India (Quantitative/Empirical Data)
Critical Thinking	School leaders agree it develops critical thinking, but implementation is limited by rote-learning culture (Abbas et al., 2024; Qayyum & Kamal, 2025).	STEAM approach has a statistically significant effect on critical thinking skills (Halimah et al., 2025).
Creativity	School leaders agree it promotes creativity and innovation. Lack of hands-on activities is a barrier (Abbas et al., 2024; Qayyum & Kamal, 2025).	60% of stakeholders cited creativity as a major outcome. STEAM fosters innovation through trial and error (Makersmuse, 2024).
Problem-Solving	Considered a key 21st-century skill. STEM project aims to develop this skill (Abbas et al., 2024).	55% of stakeholders cited problem-solving as a major outcome. PBL is a core element of NEP 2020 (SSRVM, n.d.).
Employability/Innovation	STEAM aims to develop an entrepreneurial workforce that is job-creating (Abbas et al., 2024).	NEP 2020 and ATLs prepare students for a competitive, innovation-driven workforce. Online schools provide mentorship (Bharti & Soni, 2025).

This table visually reinforces the difference in the nature of evidence, highlighting India's progress in moving beyond perceived benefits to documented, measurable outcomes.

Conclusions and Recommendations

Synthesis of Key Findings

The comparative analysis reveals that while both Pakistan and India have embraced STEAM education, their implementation pathways and outcomes diverge significantly. Indian NEP 2020 has created such an environment which is adaptable and innovation oriented due to the decentralized policy structure and collaboration between state and industry. This more integrated and holistic approach with a single vision is perceived as leading to a more institutionalised and sustainable reform. Pakistan has a distinct vision and also as projected by the governmental institutes but in addition, more systemic problems because of no resources plus more old-age educational norms thus its quite exploitation and project based.

Lessons Learned

Pakistan has much to learn in this respect, especially the need for an over-arching concept of reform in educational policy which India can teach. The idea of executing an umbrella national framework like NEP 2020 that enables innovation and diversification in strategies is a powerful one. The proactive stance on equity assumed in India with some regulation and significant outcomes where women's role is concerned, should provide a useful model for us to address at least something. The second lesson was that there is a matured ed-tech ecosystem available as system solution including virtual labs and online mentoring.

Pakistan Syndrome: But there are some useful lessons for India from Pakistan, where the gender transformation program is spelled out openly and linked to corporations and universities in a program called STEAM Pakistan. The model accordingly incorporated to program practice the practice of implementation by means of bringing real experience and mentorship from the outside world into schools there for providing the education is needed to be offered in more real terms taking it closer, directly part of those about to go professional.

Forward-Looking Recommendations

Based on this analysis, the following recommendations are proposed to enhance future-oriented learning outcomes in both contexts:



For Pakistan

1. **Systemic Policy Integration:** Policymakers should move beyond project-based initiatives to integrate STEAM principles directly into the national curriculum with clearer, more granular guidance and a focus on content organization, as suggested by the comparative study of the 2022-23 curriculum (Choudhary, 2025). This would ensure a more uniform and sustained implementation.
2. **Sustained Teacher Professional Development:** A nationwide, mandatory, and continuously funded program for teachers must be launched, focusing on hands-on and inquiry-based pedagogies. This is essential to address the significant deficit in teacher training and to effectively shift the deeply entrenched culture of rote learning (Malik, 2016; Usman, 2025; Abbas et al., 2024).
3. **Cultivate a Collaborative Ecosystem:** There is a need to foster a more robust public-private partnership model to address infrastructure gaps and leverage the expertise of the private sector, universities, and NGOs. Mirroring the more mature ecosystem in India, this would bring real-world resources and mentorship into schools (MoFEPT, n.d.).

For India

1. **Address the Implementation Gap:** Despite a strong policy framework, a significant gap exists in the equitable distribution of resources. Efforts should focus on ensuring that the benefits of the NEP 2020 and initiatives like the ATLs reach all students, particularly those in rural and semi-urban areas, so that STEAM education does not become an "urban-centric success story".
2. **Standardize Outcome Measurement:** A national framework for evaluating the effectiveness of STEAM programs should be implemented with consistent, quantitative metrics. This would provide a more comprehensive and data-driven picture of the impact on learning outcomes and future skills, building upon the strong empirical evidence already available (Halimah et al., 2025).
3. **Reinforce Societal Shift:** Continued investment in public awareness campaigns and mentorship programs is necessary to combat deep-seated cultural and gender stereotypes that still act as barriers for female students, as evidenced by the research (Singh & Singh, 2025). While progress has been made, these persistent barriers require ongoing, targeted interventions to ensure complete inclusivity.



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