An Assistive Learning Model For 21st-Century Steam Skills

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Abstract: This paper investigates STEMROBO, an assistive artificial intelligence (AI) ecosystem created to improve K-12 STEAM education, operating under the brand name STEMROBO Technologies. According to the National Education Policy (NEP) 2020 and the Universal Design for Learning (UDL) framework, the study sought to determine how well STEMROBO's integrated components the AI Connect platform, physical and virtual innovation labs, and teacher professional development programs promote inclusive, experiential, and inquiry-based learning. Ten educators and three administrators participated in semi-structured interviews, document analysis, and observations of both in-person and virtual innovation lab sessions as part of a qualitative descriptive technique. The results of the thematic analysis showed that STEMROBO successfully combines hardware kits, AI-powered platforms, and scaffolded curriculum to increase teacher capacity, promote inclusion, and enhance student engagement. However, barriers such as limited digital infrastructure, high initial costs, and the need for sustained technical support were identified. The findings suggest that STEMROBO holds significant potential as an assistive AI tool for STEAM education, provided that systemic challenges are addressed through targeted investment and capacity-building initiatives by the school administrations.

Key Words - STEAM Education, Assistive AI, Robotics, UDL, NEP 2020, STEMROBO Technologies.

1.   Introduction

The 21st century is witnessing an educational paradigm shift driven by emerging technologies that integrate artificial intelligence (AI), robotics, and coding into K–12 learning environments. This shift is particularly prominent in STEAM education an interdisciplinary approach that merges Science, Technology, Engineering, Arts, and Mathematics to nurture creativity, problem-solving, and innovation (Yakman & Lee, 2012). STEAM's emphasis on experiential and project-based learning aligns with global demands for skills in computational thinking, collaboration, and digital literacy (UNESCO, 2021).STEAM education integrates Science, Technology, Engineering, Arts, and Mathematics, nurturing critical thinking, creativity, and interdisciplinary learning. In India, STEMROBO Technologies commonly known as STEMROBO offers an integrated suite of AI, coding, and robotics tools, including AI Connect, Atal Tinkering Lab setups, and a virtual Tinker Studio, aimed at delivering experiential STEAM education aligned with NEP 2020 (STEMROBO Technologies, Knowles, 2023). In India, the National Education Policy (NEP) 2020 underscores the importance of transforming classrooms into spaces for inquiry, critical thinking, and hands-on learning, particularly through the use of digital tools and innovation labs (Government of India, 2020). This has created a fertile ground for assistive AI tools technologies that scaffold learning by providing cognitive support, adaptive content delivery, and multimodal engagement for diverse learners (Rose et al., 2006). STEMROBO (officially STEMROBO Technologies) has emerged as a notable player, offering an integrated ecosystem that includes AI Connect, virtual and physical innovation labs, coding platforms, and professional development programs for educators (STEMROBO Technologies, Patel, 2025). These tools are designed not only to make STEAM learning engaging and accessible but also to address disparities in infrastructure and teacher readiness, particularly in under-resourced contexts (Knowles, 2023).The

company's platforms incorporate block-based and text-based coding, AI-powered simulations, gamified problem-solving and remote-access labs. This positions STEMROBO as both a pedagogical scaffold helping teachers implement curriculum effectively and a cognitive assistive tool enabling students of varied learning profiles to engage meaningfully in STEAM subjects (Bers, 2018; Mubin et al., 2013). Its alignment with Universal Design for Learning (UDL) principles ensures multiple means of representation, engagement, and expression, thereby making learning inclusive (Rose et al., 2006).Given its multiple roles, it becomes essential to critically examine STEMROBO's contributions as an assistive AI tool within the STEAM education ecosystem. This paper aims to bridge the gap between technological potential and educational effects by evaluating STEMROBO's design, accessibility features, and pedagogical effectiveness through a structured mixed-method research framework.

2. OBJECTIVES OF THE STUDY

The objectives of this study are

2.1.   To analyse STEMROBO's features as assistive AI tools in STEAM education.

2.2.   To evaluate how STEMROBO reduces cognitive, pedagogical, and infrastructural barriers to

STEAM education.

2.3.   To compare STEMROBO with UDL principles and NEP 2020 educational goals.

3. REVIEW OF THE RELATED LITERATURE

Assistive AI tools are defined as technology-driven systems that enhance teaching and learning through personalized support, adaptive content delivery, and multimodal interaction (Rose et al., 2006). These tools often integrate visual programming, hardware kits, and scaffolded curricula to facilitate inquiry-based learning and support diverse learning needs (Bers, 2018; Mubin et al., 2013). AI-powered platforms can assess learner performance in real time, suggest adaptive pathways, and provide multimodal representations to cater to different learning styles (Luckin, 2017).

The Universal Design for Learning (UDL) framework emphasizes that educational technology should provide multiple means of representation, engagement, and expression, ensuring accessibility for all learners (Rose et al., 2006). AI-enabled assistive tools operationalize UDL principles by reducing cognitive load, providing real-time feedback, and enabling differentiated instruction, especially in STEAM subjects where abstract concepts can be made tangible through simulations and robotics (Eguchi, 2014).

Robotics has become a prominent component of STEAM (Science, Technology, Engineering, Arts, Mathematics) education, offering students hands-on opportunities to develop problem-solving, creativity, and computational thinking skills (Yakman & Lee, 2012). Studies indicate that robotics integration into K-12 curricula nurtures engagement, collaboration, and critical thinking (Bers, 2018; Alimisis, 2013). However, barriers such as limited teacher readiness, lack of adequate training, and insufficient infrastructure continue to hinder effective adoption (Alimisis, 2013; UNESCO, 2021). Teacher professional development, curriculum alignment, and affordable hardware solutions are therefore critical for scaling robotics-based STEAM initiatives (Bybee, 2013).

In India, the National Education Policy (NEP) 2020 highlights the importance of integrating coding, robotics, and AI into school curricula to promote 21st-century skills such as creativity, innovation, and digital fluency (Government of India, 2020). The policy encourages the establishment of Atal Tinkering Labs and similar innovation spaces, aligning with the global movement towards AI for Education (UNESCO, 2021). Given these policy directions, solutions like STEMROBO can help operationalize NEP's vision by providing integrated ecosystems that merge physical infrastructure with AI-powered digital learning environments.

STEMROBO (operated by STEMROBO Technologies) offers a blended learning ecosystem that integrates physical innovation labs, AI-powered online platforms, and teacher training programs. Its platforms support both block-based and text-based coding, enabling students to transition from beginner-friendly visual programming to advanced programming languages.

The AI Connect platform, for example, includes computer vision modules, machine learning toolkits, and data analytics simulations, allowing students to engage with cutting-edge AI concepts while developing computational thinking skills (Patel, 2025). Professional development programs ensure teachers are equipped with both the technical skills and the pedagogical strategies necessary for effective implementation.

By integrating hardware kits with cloud-based platforms, STEMROBO also addresses infrastructure limitations in resource-constrained schools, enabling remote access to labs and ensuring continuity of learning during disruptions such as the COVID-19 pandemic.

4. RESEARCH GAP

While research broadly supports the role of robotics and AI tools in enhancing STEAM education outcomes (Bers, 2018; Eguchi, 2014; Mubin et al., 2013), there is limited empirical evidence evaluating integrated solutions like STEMROBO within diverse Indian classroom contexts. This paper addresses these gaps by evaluating STEMROBO's contributions to assistive STEAM education within the Indian educational framework and NEP 2020.

5. METHODOLOGY OF THE STUDY

This study used a qualitative research method through literature analysis and web surfing.

Data collection procedure

Data on STEMROBO was gathered via document analysis of current literature and web resources and discussions with educators.

6. RESULTS AND FINDINGS

This study discovered that so many AI tools as assistive technology may highly enhance the STEAM education. STEMROBO AI tools based on a detailed analysis of their features, accessibility, and hands-on activity.

6.1. Features of STEMROBO

STEMROBO, operationally known as STEMROBO Technologies, is a leading Indian ed-tech company specializing in Artificial Intelligence (AI), robotics, and STEAM-based learning solutions for K-12 education. The company delivers an end-to-end ecosystem that integrates physical innovation labs, digital learning platforms, structured curricula, and teacher professional development programs, aligning closely with the National Education Policy NEP 2020. Its mission is to equip students with essential 21st-century skills such as computational thinking, creativity, problem-solving, and STEM literacy, while also supporting educators through scaffolded training and resources. One of its flagship offerings is the AI Connect Platform, which enables learners to transition seamlessly from block-based programming to text-based coding, incorporating AI and machine learning modules in an engaging, gamified environment. STEMROBO also establishes Innovation Labs both physical and virtual, covering domains like robotics, IoT, AI, and AR/VR, designed to nurture inquiry-based, experiential learning. The company also provides a curriculum-aligned learning management system (LMS) that integrates coding modules, virtual robotics, quizzes, and DIY project kits, along with performance tracking for both students and teachers. By combining hardware kits, AI-enabled platforms, and pedagogically sound curricula, STEMROBO aims to make advanced STEAM education accessible to diverse learners and empower educators to deliver future-ready instruction. This holistic approach directly supports NEP 2020's emphasis on hands-on, competency-based learning, positioning STEMROBO as a transformative force in modern K-12 education in India.
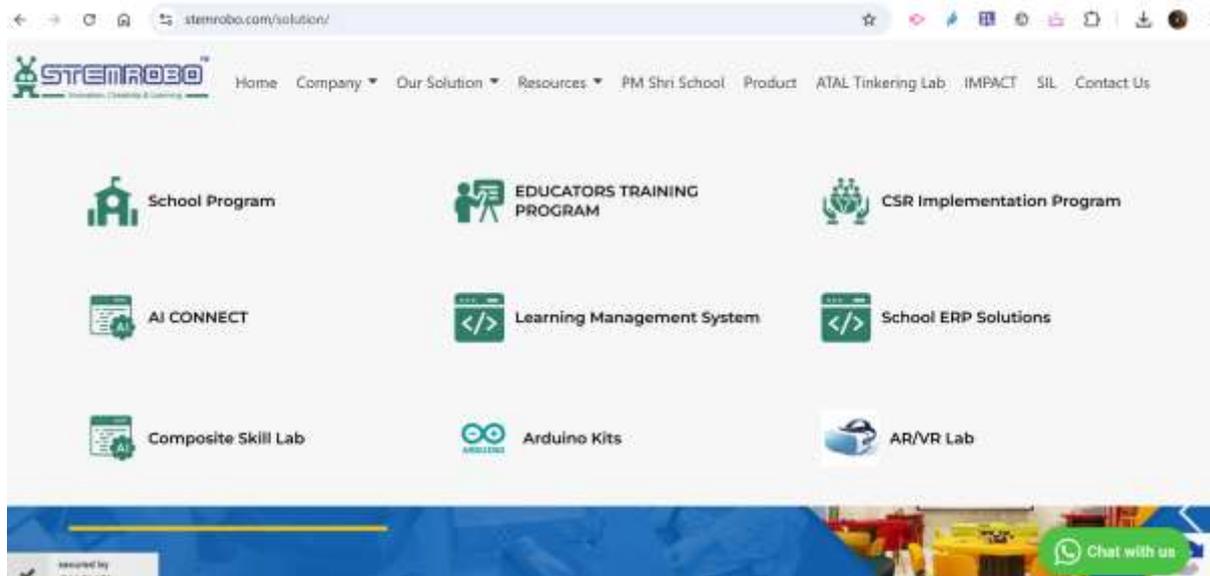
Image 1: Core Components of STEMROBO

STEMROBO offers a comprehensive ecosystem that integrates multiple components to promote STEAM education effectively. One of its key features is the establishment of specialized labs such as STEM and Robotics Labs, AI and IoT Labs, AR/VR Labs, and Pre-Tinkering and Atal Tinkering Labs. These labs encourage hands-on, experiential learning, allowing students to practically engage with scientific and technological concepts while encouraging creativity and problem-solving skills.Another significant innovation is the AI Connect platform, which provides students with opportunities to explore artificial intelligence through visual block-based programming, real-time block-to-text and text-to-block conversions, Python integration for advanced coding, and introductory projects in machine learning. This platform makes AI accessible to young learners by combining simplicity with depth, preparing them for future technological landscapes. The Learning Management System (LMS), available through both web and mobile applications under STEMROBO Learn, further strengthens the teaching–learning process. It delivers grade- and session-wise curricula, lesson plans, quizzes, and digital content, while also offering certification for both students and teachers. Additionally, it includes tools for monitoring progress, assessing performance, and ensuring effective engagement in digital learning spaces. To support teachers, STEMROBO emphasizes educator training and professional development. Through certified training programs in coding, robotics, AI, and IoT, educators are empowered to implement project-based STEAM education more effectively. These initiatives are reinforced by access to pedagogical resources, community networks, assessment tools, and continuous technical support, thereby ensuring sustainability in STEAM integration. Beyond classrooms, STEMROBO also provides a platform for global innovation through the STEAM Innovation League (SIL), which encourages K–12 students to develop and present sustainable, real-world solutions using AI, robotics, and coding. This initiative not only nurtures creativity and innovation but also offers opportunities for students to showcase their projectors on international platforms, inspiring a culture of collaboration and global problem-solving.

Educational Impact & Alignment

The impact of STEMROBO lies in its ability to nurture twenty-first century skills among learners. By offering interactive tools and project-based environments, it cultivates creativity, innovation, critical thinking, and teamwork. Students are encouraged to transition from passive recipients of knowledge to active creators of solutions as they engage in meaningful projects involving robotics, IoT, and AI systems. The platform also ensures inclusivity and scalability by providing mobile and web-based LMS access, modular labs, and DIY kits, thereby making STEAM education available across both urban and rural contexts, including government initiatives like PM-SHRI School Yojana.

ABOUT PM SHRI SCHOOL YOJANA

PM SHRI School is a centrally sponsored scheme by the Government of India. This initiative is intended to develop more than 14500 PM SHRI Schools managed by Central Government/State/UT Government/local bodies including KVS and NVS in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where

good physical infrastructure and appropriate resources conducive to learning are available to all students. It will nurture students in a way that they become engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by the National Education Policy 2020. Over 20 lakh students are expected to be the scheme's direct beneficiaries. The scheme will also promote an understanding of various dimensions of the Quality of school education and inform Policy, Practice, and Implementation. The learning from these schools will be scaled up to other schools in the country. The Scheme is proposed to be implemented over 5 year's w.e.f. 2022-23 to 2026-27.

Partner with STEMROBO:

It aims to enhance the educational experience for students aged 6-18 across India. Through the integrated STEAM, Artificial Intelligence, Robotics, and Coding curriculum, coupled with cutting-edge technology products, it aspires to contribute to the holistic development of students aligned with the objectives of PM SHRI Yojana.

Comprehensive STEAM Education for PM Shri Schools:

STEMROBO pioneers comprehensive STEAM education through a world-class curriculum that serves as a foundation for 'End-To-End Solution to K-12 Schools,' aligning with the objectives of PM SHRI School Scheme. Its world-class curriculum serves as a catalyst for Nurturing Innovation & 21st Century Skills among students aged 6-18 worldwide. By seamlessly integrating STEM, Robotics, AI, ML and coding we create a dynamic learning environment that fosters creativity, critical thinking, and problem-solving skills. For PM SHRI Schools, it offers specialized made in India Robotics kits for PM Shri School, DIY kits, and AI kits, STEM Kits for PM Shri Schools, ensuring that each student has access to cutting-edge resources.

For PM Shri Yojna, it facilitates Tinkering Labs for PM SHRI Schools, promoting a practical and experiential approach to learning. Serving as the Robotics & DIY Kits Vendor for PM SHRI Schools and providing lab equipment for PM Shri Schools, STEMROBO not only empowers students to become Creative Thinkers and Problem Solvers but also conducts teacher training programs, led by STEM innovation engineers across India, to equip educators with essential 21st-century skills. STEMROBO's efforts are geared towards preparing students for a brighter tomorrow, in harmony with the objectives outlined in the PM Shri Yojna.

Technology-Driven Learning and Smart Classroom Integration for PM Shri Schools

Under the umbrella of Technology-Driven Learning, STEMROBO takes the lead with its Learning Management System (LMS) catered specifically for Schools. This platform integrates Smart Class technologies, creating a seamless and innovative educational experience. For schools, it's LMS simplifies exam scheduling, academic year planning, and report card generation, ensuring a streamlined educational workflow, serving as an all-encompassing solution, this STEMROBO platform integrates Smart Class technologies for PM Shri Schools, creating a seamless and innovative educational experience. It acts as a one-stop solution, organizing educational materials centrally and providing comprehensive insights into student performance throughout the year. Students benefit from the flexibility of accessing live and recorded lectures, enabling convenient and efficient studying from any location.

The system maintains a record of grades and marks, aiding students in self-assessment and improvement. Teachers find the LMS platform invaluable, automating tasks such as grading, attendance management, and exam scheduling, allowing them to focus on enhancing teaching techniques and engaging with students. Parents, too, become integral partners in their child's education through real-time updates on academic progress, attendance records, and assignment scores. In essence, STEMROBO's Technology-Driven Learning approach, the LMS for PM Shri Schools hopefully reshape 21st-century education by seamlessly integrating accessibility, technology, and active student participation into the fabric of PM SHRI Schools.

Illustrative Visuals

The significance of STEMROBO can also be understood through its visuals, which depict how the platform brings STEAM education to life. The interactive ecosystem highlights student engagement across diverse disciplines, while the AI Connect features demonstrate the ease of transitioning from block-based programming to Python coding. Another visual emphasizes the development of critical thinkers by showcasing how students analyse, question, and innovate through guided projects. Finally, the AI and Robotics depictions in K-12 classrooms illustrate the immersive, technology-rich environments that prepare learners for future challenges.

6.2. ASSISTIVE FEATURES OF STEMROBO

One of the most notable assistive features of STEMROBO is its emphasis on cognitive accessibility. Through its AI Connect platform, learners can begin coding using block-based Python, where drag-and-drop visual blocks simplify complex coding concepts. The system further allows block-to-text and text-to-block conversions, enabling students to gradually transition from visual programming to full text-based coding. For instance, a beginner student can design a robot that navigates a maze by arranging visual coding blocks, while a more advanced peer can simultaneously view and edit the equivalent Python script. This dual-mode approach not only eases entry into coding but also bridges diverse learning preferences, ensuring that both visual and analytical learners benefit from the same platform.   Another critical assistive aspect is pedagogical scaffolding, which helps teachers and students progress step by step in their STEAM journey. STEMROBO integrates guided curricula, interactive puzzles, and structured LMS content that build concepts progressively (Patel, 2025). For example, a middle-school class working on an IoT weather station can first access simplified tutorials on sensors, then move on to problem-based assignments like data logging, and eventually develop a functional prototype. This scaffolding allows students to achieve higher-order learning outcomes, while teachers benefit from lesson plans, assessments, and progress tracking that ensure effective instruction.In terms of infrastructure access, STEMROBO offers both physical and virtual learning environments to democratize STEAM education. Its specialized AI & Robotics Labs, AR/VR setups, and Atal Tinkering Labs provide hands-on exposure in schools, enabling learners to work directly with hardware kits and immersive technology. For instance, students in an urban CBSE school might collaborate in an AI lab to build a face-recognition attendance system, applying machine learning to real-world challenges. At the same time, STEMROBO's virtual Tinker Studio ensures that students in rural or under-resourced schools are not excluded; they can log in remotely to practice simulations of circuits, coding, and robotics projects. During the COVID-19 pandemic, such virtual environments proved invaluable, allowing continuity of practical learning even outside physical classrooms (STEMROBO Technologies, Express Computer, 2021).

6.3. ALIGNMENT WITH UDL AND NEP 2020

Table 6.3.1: Alignment with UDL and NEP 2020

UDL Principle	STEMROBO Feature
Engagement	Gamified coding puzzles, hands-on labs, competitions
Representation	Visual blocks, textual code, simulations, physical and virtual artifacts
Action & Expression	Builds, coding, design projects, creative storytelling

This aligns with NEP 2020's push toward experiential, interdisciplinary, and competency-based learning (Knowles, 2025). The National Education Policy (NEP) 2020 envisions a transformation of the Indian education system by focusing on experiential learning, coding, artificial intelligence, and skill development across school levels. For example, NEP 2020 encourages the establishment of coding and robotics programs from the middle school stage so that learners can develop computational and design thinking skills. In this context, STEMROBO directly contributes to the realization of NEP 2020's vision by setting up AI & Robotics Labs in schools, where students not only learn programming but also apply it to real-world problem solving. A practical example is a project where middle school learners use STEMROBO's IoT kits to design a smart irrigation system for water conservation. Such projects align with NEP 2020's emphasis on sustainability, innovation, and applied knowledge.

Similarly, NEP 2020 underlines the need for multidisciplinary and holistic learning, which includes integrating arts into science and technology education. STEMROBO supports this vision through its AR/VR labs and tinkering projects, where students engage in design-oriented and creative expression alongside technical work. For instance, a student team might design a virtual museum exhibit using VR tools while combining historical knowledge (arts) with coding and design skills (technology). This integration reflects the STEAM approach, where the "A" for Arts complements STEM disciplines.

In parallel, the Universal Design for Learning (UDL) mission emphasizes inclusivity and accessibility in education by offering multiple means of engagement, representation, and expression. STEMROBO

demonstrates strong alignment with UDL principles. Its AI Connect platform allows learners to begin with visual block-based programming and then gradually transition to Python, ensuring that beginners, advanced coders, and students with diverse learning styles can all participate meaningfully. For example, a child with limited exposure to coding can use drag-and-drop blocks to design a robot's movement, while another student with advanced skills can directly edit the Python script—both achieving the same learning outcome through different pathways.

Moreover, STEMROBO's Learning Management System (LMS) offers adaptive resources such as lesson videos, quizzes, and simulations. This provides teachers the flexibility to cater to learners with varied needs visual learners benefit from animations, hands-on learners engage through DIY kits, while analytical learners explore coding challenges. Such an inclusive ecosystem illustrates UDL's philosophy in action by removing barriers to learning and allowing each student to express understanding in their own way. Therefore, STEMROBO can be seen as a bridge between policy frameworks like NEP 2020 and pedagogical philosophies like UDL. By integrating technology, creativity, and inclusivity, it not only prepares students for future careers but also ensures that education is equitable, engaging, and accessible to all.
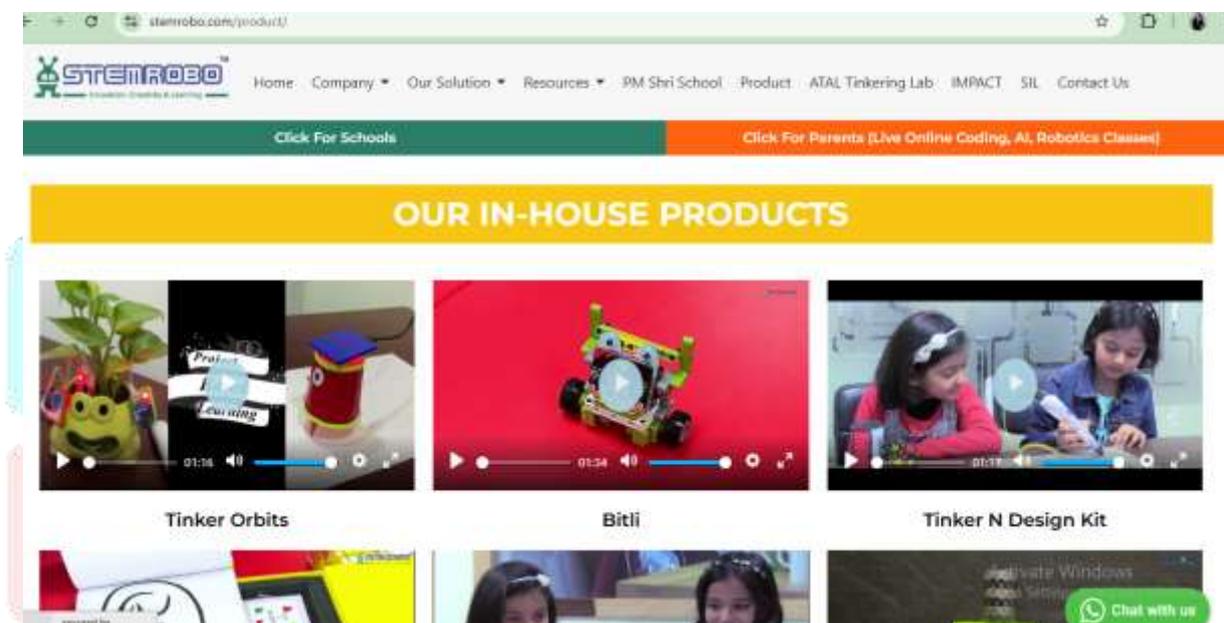
7. FUTURE RECOMMENDATION:

Image 2 : Products of STEMROBO

STEMROBO as a brand name emphasizes STEM (Science, Technology, Engineering, Mathematics), but the company's philosophy and products clearly integrate the "A" for Arts, making it a complete STEAM-based approach. The AR/VR labs, creative design activities, tinkering projects, and innovation challenges supported by STEMROBO all involve artistic expression, design thinking, and creativity, which are the foundation of the Arts component in STEAM. Therefore, a more accurate representation of its mission and ecosystem would be "STEAMROBO". This change would not only highlight its comprehensive coverage of all five dimensions of STEAM education but also position it more inclusively as an arts-integrated innovation platform. By adopting the name "STEAMROBO", the company can better align its identity with international trends in education, where the Arts are seen as essential to creativity, empathy, and holistic problem-solving.

8. CONCLUSION:

As an assistive AI ecosystem, STEMROBO reduce barriers to STEAM learning by offering inclusive cognitive access, pedagogical scaffolding, and blended infrastructure. Empirical evaluation via the proposed methodology can guide scalability and policy adoption. Assistive AI tools like STEMROBO hold significant potential to transform STEAM education. By integrating artificial intelligence with robotics, coding platforms, and interdisciplinary learning approaches, these tools can create more personalized, engaging, and effective learning experiences for students. While a detailed analysis would require specific information about STEMROBO's products and their effectiveness, the general trend suggests that AI-powered assistance is a promising avenue for advancing STEAM education and equipping students with the skills needed for the

future. Further research and evaluation of such tools in real-world educational settings are crucial to fully understand their impact and optimize their implementation.

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