

Competitiveness Strategy of Education Technology Enterprises Based on Intelligent Hardware under the "Double Reduction" Policy-Taking Zuoyebang Learning Machine as an Example

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Abstract. China's "Double Reduction" policy was officially implemented in 2021, bringing profound changes to the K12 subject-based after-school training industry, and educational technology enterprises face an urgent need for transformation. As an important carrier of the "non-practical training" track, intelligent hardware has become a key factor for enterprises to find growth points. This paper takes the Zuoyebang learning machine as the research object, uses the PEST model to analyze the impact of the macro environment on the educational hardware industry, and employs the SWOT model to sort out the internal strengths and weaknesses as well as external opportunities and challenges of the Zuoyebang learning machine, focusing on exploring the core role of artificial intelligence technology in building product competitiveness. The study finds that the core competitiveness of the Zuoyebang learning machine stems from its deep question bank data and mature AI algorithms, but it faces challenges in the hardware ecosystem and channel penetration. The paper proposes strategic recommendations such as focusing on deep AI applications, building an integrated software-hardware ecosystem, and expanding compliant education application scenarios, providing references for the sustainable development of educational technology enterprises after the "Double Reduction" policy.

Keywords: Double Reduction Policy, Edtech, Zuoyebang, Smart Hardware, Competitiveness.

1. Introduction

Issued in July 2021 by the General Office of the Central Committee of the Communist Party of China, the document entitled "Opinions on Further Reducing the Homework and Training Burden for Students in the Compulsory Education Stage" colloquially designated as the "Double Reduction" policy, effected unprecedented perturbations within the extant Chinese educational ecosystem [1]. Specified expressly therein was a categorical proscription against capitalized activities of subject-specific training institutions and vacation-period tutorial programs. The traditional educational technology firms, whose operational axis previously situated around online synchronous instructional modalities, confronted an existential challenge; trajectories adopted thenceforward transform towards informatization initiatives centering quality-oriented education or hardware-intelligentization compositionality.

Acceleration in market momentum became particularly discernible regarding intelligent educational devices—including learning tablets, machines, and dictionary pens—the utility claims of which cohere notably with policy imperatives to facilitate individualistic academic pursuits. Referenced through iResearch datasets, quantifications set the domestic educational intelligence-device marketplace at approximately 43.1 billion yuan by the close of 2022, with projections that indicate a probable surpassing of 100 billion yuan prior to 2025 [2]. Business entities operating formerly at forefronts of digital pedagogy — an example being Zuoyebang — expedited transition of organizational strategizing post-policy enactment, electing to introduce, during 2022, its proprietary Learning Machine product as central to subsequent developmental efforts. Through such recourse, implementation actualizes not only question bank resources but also systematized curricular content, as well as algorithmic pedagogical support facilitated by advanced AI architectures. Strategic diagnosis is initially structured upon deployment of analytical instruments, including the PEST

paradigm, which renders the macro-environmental landscape legible across quadripartite analytic strata: polity, economy, societal patterns, and technological evolution. Sequentially, application of SWOT assessment further illuminates intrinsic drawbacks located in the Learning Machine artifact itself and delineates opportunity fields alongside exogenous risk potentials emergent in contemporaneous market configurations.

Detected from discussions about the industry environment catalyzed under the aegis of the “Double Reduction” regulatory regime, this research endeavor herewith integrates systematic inquiry into those mechanisms underpinning the ascension and consolidation of competitive advantage for the Zuoyebang Learning Machine platform. Especially privileged are interrogations probing how artificial intelligence functionalities may be harnessed so as to counteract burdens stipulated by regulatory interventions, thereby consonant with ongoing projects of modernizing educational schemas and expediting compulsory education’s recalibration toward evaluative excellence and structural modernity [3]. Entailed in summation are operative recommendations resonantly directed at actionable advancement pathways.

2. Analysis of Educational Intelligent Hardware Industry Environment Via the Pest Framework

Posited as determinative foundations underlying enterprise-level strategy formation, the macro-environmental factors become decipherable through the utilization of the PEST schema; in the context of smart-educational hardware, both driving forces and constraints can thus be distinguished with enhanced clarity.

At the epicenter of regulatory reform within the educational hardware sector stands the “Double Reduction” policy, by whose provisions a stringent circumscription of subject-centric tutoring and financialization processes is imposed; a deliberate prioritization with respect to compliance in smart education hardware emerges, technology-pedagogy integration being given explicit endorsement. Situated concomitantly beside this framework, one finds the national infrastructure initiative directed at education, strategic underpinnings to digital transformation therein manifested. Notably observable through intensifying industry scrutiny and escalated moderation mechanisms concerning content, for products encroaching upon out-of-syllabus instructional territories or bearing semblance to covert question-seeking utilities, an elevation in compliance barriers as well as policy-driven risk scenarios subsequently unfolds.

Economically speaking, Chinese households' proclivity for investing in their offspring's learning persists robustly, as an examination of National Bureau of Statistics data regarding 2022 per capita disbursement on education, culture, and entertainment—measured at 2,469 yuan—makes apparent; from this datum, the inflexibility characterizing education consumption patterns may be inferred [4]. The deployment of “Double Reduction,” further shifting the paradigm, has witnessed significant reorganization within household expenditure: passive acquiescence to exorbitant training tuition has been replaced markedly by voluntary procurement of technological apparatus oriented towards heightened academic efficiency, thus catalyzing heterogeneity in market needs across sundry price stratifications.

Analyzed on a sociocultural plane, amplification rather than abatement of parental anxieties toward their children’s schooling materializes post-policy implementation. Derivable from prevailing trends, demand foregrounding intelligent devices designed for adaptive guidance and incremental score advancement demonstrates acceleration. Within contemporary parenting communities, particularly among younger cohorts—a pronounced receptiveness towards these educational solutions becomes evident, collective acknowledgment of autonomous study capacity increasingly positioning educational machines into spaces denoting essential pedagogical value.

Interrogated amid the intricate contingencies endemic to present-day educational reformulations, the technological environ—not solely as contextual substrate but rather as operative determinant —emerges with unmistakable agency in processes that refigure epistemic paradigms of smart hardware.

Positioned at the nucleus of such shifts is momentum imparted through AI innovation typified by paradigmatic ruptures. Through computer vision, actualized modalities are capable of nuanced, stratified evaluation and automatic retrieval of responses set apart from conventional apparatuses by efficiencies unanticipated previously; thus, are rendered assessment routines whose granularity had been outside historical reach. As an added vector, one may find the ascendancy of natural language processing whereby reconsiderations of assessment become realizable: mechanisms for essay revision alongside diagnoses regarding spoken proficiency accrue a sophistication grounded not simply incremental enhancement but in a newly articulated analytic capacity heretofore scarce.

Illustrative within this broader schematic framework becomes the superimposition observable between knowledge graph structures and responsive learning algorithms driven prominently by adaptivity imperatives—their conjunction providing the substructure upon which models of “personalized precision learning,” as scholarly literature expounds, take provisional shape. Conceived further are new pedagogic possibilities as generative computational forms (notably expansive linguistic models) recast the perimeter of instructional engagement [5]. Among instantiations implicating these developments, Zuoyebang’s proprietary “Galaxy” large-scale model can be referenced: here, physical device inertia is reframed via recursive, dialogically structured interactivity. The resultant exchanges serve not merely functional ends but approach configurations evocative of human semblance — a direction marking the most sophisticated node identified across contemporary technico-industrial transformation continuums [6]. To this evolving landscape, sustained academic inquiry attaches itself as a necessity.

3. Swot Analysis of AI-Driven Learning Machine

Differentiation associated primarily with extensive data-content consolidations can be discerned as core fortification in Zuoyebang Learning Machine’s infrastructural viability. Founded upon years of cumulative activity within digital education sectors, its strength finds embodiment within evidence referencing repositories exceeding 800 million questions, together with substantial video lectures by educators renowned in their disciplines, expanded yet again by voluminous records of user activities numbering in the order of hundreds of millions [5]. In systems where individualized pathways anchored by gap mapping derived from unique knowledge graphs direct adaptive instruction, the attribution of “precision learning” powered by artificial intelligence acquires tangible form. Reverse-engineering parity remains markedly nontrivial for hardware producers lacking similarly robust informational backbones.

Instances substantiating technical leadership recur patents situated within fields such as optical character recognition technologies and systems of semantic analysis can be cited as operational proofs. Built into product architecture lie embedded adaptive modules that automate grading while enabling error diagnostics even if assignments exhibit multifaceted or atypical layouts. With the institutionalization of the “AI-Enabled Comprehensive Homework Diagnosis” platform, a domain-specific exclusivity emerges that is reflective of advanced infrastructure dependency. Brand reliability, considerably stabilized through continual exposure to sizeable end-user populations, is transferred as frictional reduction throughout transaction chains, subsequently valorized as intangible market capital, segregating Zuoyebang’s offerings from more generic alternatives.

Nevertheless, diagonally positioned against conglomerates entrenched within consumer electronics—such as BBK and Huawei—vulnerabilities gain clarity. Indications drawn from initial rollouts chronicle gaps encountered in design sophistication, component logistics channels, protocols governing post-manufacture quality assurance, and outreach beyond digital confines—disparities materializing when comparing inventive software strategies with manifest material constraints. Channel allocation patterns render visible a disproportionate dependency on e-commerce outlets, epitomized by Tmall and JD.com, while lower-tier urban consumers articulate tendencies towards tactile, store-based acquisition. Contrasts grow sharper as competitors who leverage populous brick-and-mortar bases. Notably, the prevalent revenue logic favors singular transactional events localized

around discrete units; contemporaneously, subscription-oriented service ecosystems remain underexploited. Limitations thereby arise, restricting life-cycle monetizability traceable per capita.

Space for augmentation externally surfaces also reflectively, especially following regulatory recalibrations—most saliently documented after the promulgation of “Double Reduction”—that enervate extra-school tuition supply and intensify familial pursuit of autonomous educational instrumentation. From such contours, potentiality for substantive market penetration and enhanced uptake of intelligent study devices can thus be inferred.

Observable externally are emergent spaces for expansion traced to regulatory climate shifts, notably post- “Double Reduction” policy enactments diminishing external tutoring provision and amplifying household demand for autonomous study apparatuses. Devices once regarded as niche now approximate essentials, sustained both by rapid category growth rates and advancements in educational-AI models, which enable increasingly granular feedback—from problem-solving elucidation to dialogic guidance functions. These capabilities hint at the incipient evolution toward more interactive ‘learning companion’ archetypes, cleaving open routes for Zuoyebang to exploit preexisting competencies and deepen product distinctiveness. National imperatives around equalizing quality educational distribution lend credence to institutional procurement scenarios: content-rich AI devices find plausible pathways into school lists or government-subsidized family initiatives, especially in regions prioritized for resource reallocation and smart education integration [7].

Yet accentuated have been threats emanating from intensified participant influx spanning legacy hardware entities, tech corporates, and web-first education ventures; signals pointing to acute homogenization spur destructive competition typified by persistent price-cutting and aggressive marketing expenditures, inflating client acquisition overheads. Regulatory oversight tightens visibly, scrutiny extending beyond curricular alignment to psycho-pedagogical concerns regarding potential dependence induction and safety compliance. Changes enacted therein bear direct influence on future device functionalities. Consumer expectations, no longer circumscribed to academic performance enhancement, presently extend into realms of ophthalmic protection, cyber-safety, responsible entertainment access, and personal information security, reflective of expanding evaluative metrics companies must reconcile within new developmental paradigms.

4. Suggestions on the Construction Strategy of Competitiveness Based on the Application of AI Intelligence

On the grounds of SWOT assessment, the sustainable enhancement of Zuoyebang Learning Machine’s competitive posture is seen as necessitating a dynamic mobilization of extant strengths across multidimensional strategic axes. Seen in this light, the organization is impelled to allocate resources systematically for the rectification of internally identified deficiencies and for the neutralization of manifold risks; equally, adaptive strategic visions are compelled by shifting external commercial currents. Emphasis, thus, is placed on artificial intelligence not merely as an auxiliary technological adjunct but as the fulcrum upon which coordinated systemic advancement pivots—namely, across four interlocking dimensions: profundity of technology implementation, iterative ecosystem construction, pathways of market permeation, and frameworks of risk oversight. In such a configuration, the prospect emerges of a robustly stratified competitive defense.

Particular salience attaches itself, within this spectrum, to the intensification of artificial intelligence deployment specifically inside vertically specialized zones of educational activity. To set a paradigmatic example—a benchmark evocative of what may be termed “deep intelligence” in industry discourse—is anticipated through decisive transcendence of prevailing sectoral dependencies on superficial algorithmic pairings (as between discrete query repositories and response outputs). Distinguishable from these conventional methodologies, self-formulated large-scale model architectures underpinning Zuoyebang’s platform aspire towards substantial advances in foundational pedagogical mechanisms. Homework assistance modules, for instance, no longer revolve solely around furnishing correct solutions; their operation extends now toward deconstructing student

cognitive sequences, pinpointing lapses in logical constitution, and thereafter enacting graduated, heuristic scaffolding. Similarly, essay-oriented tutelage finds its domain expanded—from elementary syntax or lexical amendments toward interventionist recommendations inhabiting analysis of thematic unity, textual structure, and argumentative elaboration.

Achievement of such technical sophistication presupposes a persistent infusion of resources into innovative algorithmic research. Not limited, however, to computational schema alone, operational mandates increasingly require contiguous alliances with practitioners in cognitive psychology and discipline-specific education; it can be seen from developments in related fields that embeddings of such interdisciplinary knowledge, when mapped onto AI infrastructural design, considerably reinforce didactic rigor and efficacy — qualities forming protective barriers against easy emulation by market rivals [8]. Corroborative evidence drawn internationally signals further that authoritative deployment of AI in academic contexts demands meticulously calibrated assimilation of learning science tenets, thereby ensuring both operational plausibility and instructional soundness of emergent technologies [9].

An ecosystemic assemblage encompassing software, hardware, and services has been constructed with the intention of decentering from a revenue model predicated exclusively on physical device sales; this shift is evidenced by the designed centrality ascribed to the learning appliance within smart-home educational contexts. Through an architecture unifying user identification mechanisms and communicative protocols of technical nature, integration achieves seamlessness among peripheral devices—examples being printers, exercise compendia, vocabulary indexers, and wearable timepieces tailored for children—thus reconfiguring learning progress data into a trans-device continuum traversing disparate instructional settings, which further undergirds scenario connectivity often lacking in fragmentary approaches. Upon such infrastructural foundations are layered subscription-based service tiers: premium offerings incorporating AI-augmented progression mapping, cognitive calibratory regimens, alongside mentorships facilitated by instructors drawn from highly reputed scholastic institutions. It can be inferred that this ethos organized around continuous orchestration of interconnected products and value-added provisions not only sustains elevated retention metrics and transaction averages among end-users; it furnishes, too, a recurrent revenue scheme divergent from unsustainable single-purchase paradigms, conforming by its trajectory to broader movements characterizing current education technology's orientation toward integrativity and systemization, as attested by recent literature [10].

Expansion efforts extend application domains increasingly into governmental and enterprise environments, a pattern established through deliberate attenuation of previous dependencies upon direct-to-consumer digital pathways. Notably observable is the packaging of technologies—including automated adaptive instruction tools and analytic engines focused on learning outcome diagnostics—within institutionalized solutions comprising after-hours pedagogical programming, digitized rural classrooms, and regionally scoped academic performance tracking structures. Market entry thus unfolds along axes of public sector procurement and partnerships between academia and commerce, yielding streams of revenue insulated from volatility while enabling reputational augmentation derived from official endorsements—a dynamic found, subsequently, to catalyze consumer market activity via credibility transfer. The interplay realized thereby configures mutually-reinforcing feedback loops binding B2B/G and B2C segments, a mechanism posited as instrumental for the advancement of global education digitalization initiatives. Corollary perspectives presented by reports from authorities such as the European Commission identify the prioritization of inclusivity and enhancement of quality outcomes—functions potentially optimized by AI deployment—as benchmarks serving collective societal interests [11].

A strategic nucleus constituted by compliance and ethical stewardship necessitates unwavering observance of regulatory demarcations concomitant with proactive engagement in the delineation and dissemination of normative industry frameworks. Self-policing intensification directed at content management on platforms results in the excision of functionalities prioritizing high-stakes examinations or exacerbating undue academic duress. Institutional participation extends to the co-

development of standards spanning hardware design, information security matrices, and algorithmic governance, wherein commitments to student privacy, compulsive usage mitigation, and procedural fairness are leveraged as distinctive product features solidifying reputational capital. Within operational backdrops marked by “double reduction” reformulations privileging the social welfare function of educational apparatuses, there emerges the cultivation of a reliable technological identity oriented towards sustainable competitive advantage. Discourse originating in international scholarly milieus echoes appeals favouring principled incorporation of human rights doctrines and juridical logic within both developmental and evaluative phases of AI-integrated educational artefacts.

5. Conclusion

Observable transformation and revaluation permeate the educational training sector subsequent to the implementation of the “Double Reduction” policy, where Zuoyebang Learning Machine operates as a vector through successive deployments of advanced technological architectures, curricular resources, and informational capabilities. Analytical lenses provided by PEST and SWOT methodologies indicate that principal strengths derive from capacities to marshal expansive ecosystems of educational data coupled with sophisticated accumulations in the vertical stratifications of artificial intelligence, whereas identifiable lacunae persist concerning command over logistics in hardware fabrication, territorial channel extension outside virtual markets, and generating innovations across commercial models. Competitive endurance appears contingent upon the synthesis of general AI advancements with authentically conceived didactic principles aiming directly at substantive enhancements in students’ capacity formation and literacy development. Anchoring expanded business models and resilient product constellations to this intellectual center alongside ethically nurtured brand identities emerges as indispensable for long-term viability amid polycentric regulatory and marketplace contingencies, at once offering extensible guidance to analogous organizations positioned at junctures of transitional flux. Nonetheless, limitations delimit the scope herein: primary emphases reside singularly on one category of intelligent device, omitting interdependencies contributing to more granular advances in aggregate educational achievement indicators. Data reliance pertains primarily to publicly disclosed documentation rather than proprietary operational analytics. Recommended avenues for continued inquiry might encompass multisector synergistic studies or qualitative deep-dives employing user-centered measures—surveys or interviews—to elucidate intersections between technological affordances and user valuation or satisfaction phenomena.

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