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ALGORITHMIC GLOBAL VALUE CHAINS AND HIGHER EDUCATION TRANSFORMATION: RE-ENGINEERING INTERNATIONAL BUSINESS PEDAGOGY IN THE ERA OF AUTONOMOUS INTELLIGENCE

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Abstract: The rapid emergence of autonomous artificial intelligence agents, predictive supply chain orchestration, and real-time cross-border regulatory analytics is fundamentally transforming how multinational enterprises (MNEs) govern global value chains (GVCs) and enter foreign markets. Yet International Business (IB) higher education remains largely tethered to twentieth-century pedagogical paradigms—relying on static international trade models, retrospective written case studies, and essentialist cultural heuristics that fail to prepare graduates for algorithmically mediated global commerce. Moving beyond surface-level classroom adoption of generative chatbots, this study develops a comprehensive theoretical and operational framework for re-engineering International Business education through the lenses of Global Value Chain Governance Theory, Activity Theory, and Metacognitive Scaffolding. We argue that the defining competency for next-generation IB professionals is Algorithmic Value-Chain Orchestration—the ability to align predictive and generative AI systems with cross-jurisdictional institutional realities, geopolitical risks, and culturally grounded human judgment. To operationalize this capability, the paper introduces a Three-Horizon Curricular Transformation Architecture alongside a Synthetic Global Commerce Laboratory that immerses students in dynamic multi-tier supply chain disruptions, automated customs and rules-of-origin auditing, and cross-cultural digital platform governance. Drawing upon longitudinal pedagogical implementations across undergraduate and postgraduate IB cohorts, we demonstrate significant gains in students' systemic risk reasoning, critical verification of algorithmic outputs, and cross-border strategic adaptability. Finally, the study examines structural challenges—including cognitive atrophy, Western-centric training data biases, and cross-border data compliance—and establishes an institutional governance charter for sustainable business school transformation.
Keywords: Algorithmic global value chains; International Business pedagogy; Autonomous intelligence; Higher education transformation; Activity Theory; Metacognitive scaffolding

1 INTRODUCTION

1.1 The Rise of Algorithmic Global Value Chains

For several decades, Global Value Chain (GVC) has been used to describe the process of splitting production, research and distribution processes across different geographical locations in order to achieve comparative and competitive advantages [1]. Traditionally, the process of managing distributed processes required a large amount of human intervention, such as regional purchasing departments, manual customs brokerage, regular audits of suppliers, and sequential market entry strategies. Recently, however, the combination of machine learning, foundation language models and live trade telemetry has led to the emergence of Algorithmic Global Value Chains [2].
Currently, AI systems work autonomously and semi-autonomously to manage important processes across borders. Predictive neural networks autonomously redirect maritime and air cargo due to geopolitical straits and severe weather; automated compliance systems automatically identify Harmonized System (HS) codes and Rules of Origin (ROO) of different regional trade agreements; and generative multi-modal systems simultaneously localize product user interfaces, IP registration, and customer engagement across dozens of languages [3]. Even micro-multinationals can now leverage cloud AI systems to compete with conglomerates in international markets [4]. With cross-border analysis and administrative processes increasingly automated, the comparative advantage of International Business graduates lies in problem formulation, algorithm auditing, institutional interpretation and high trust cross-cultural negotiations [5].

1.2 The Structural Disconnect in Contemporary IB Higher Education

Although the current business practice has been significantly transformed, the IB curriculum in most universities still lags behind. Although many business schools offer electives on “Business Analytics” or provide some syllabus allowances for generative AI to assist in writing, the IB curriculum has not been significantly transformed [6].
There are three main gaps in the current IB curriculum. Firstly, there is a lack of time flexibility as most IB courses use historical cases to teach students about cross-border expansion as a linear and predictable process, but in reality, the current geoeconomics and digital trade are non-linear and volatile [7]. Secondly, there is a lack of integration in

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disciplines as students learn international trade policy, quantitative supply chain analysis, and cross-cultural management separately, and thus, they are unable to combine algorithmic analysis with qualitative institutional analysis. Thirdly, there is a lack of experience as most of the class activities do not allow students to experience cross-border friction, such as different extraterritorial data privacy regulations, abrupt export controls and implicit socio-linguistic breakdowns of virtual global teams, and thus, they are not ready to make executive decisions in the real world [8].

1.3 Research Purpose and Contributions

This paper aims to explore one of the main issues in pedagogy, namely, how to transform IB curriculum, pedagogy and institutional setup around autonomous and generative AI. Instead of viewing AI as an add-on, we view AI as a structural mediating tool that transforms the epistemology of international business and the cognition of students [9].
Specifically, this study offers three distinct contributions to IB educational scholarship and practice:
It integrates Global Value Chain Governance Theory, Cultural-Historical Activity Theory (CHAT) and Metacognitive Scaffolding to propose Algorithmic Value-Chain Orchestration as the graduate capability in the intelligent world.
It introduces a Three-Horizon Curriculum Transformation Design to connect first principles economic analysis with human-AI co-piloting and industry micro-modules.
A Synthetically Global Commerce Laboratory (empirical cases of GVC resilience, cross-border digital platform regulation and international M&A diligence) and an institutional governance system on algorithmic bias, intellectual honesty and data control.

2 THEORETICAL FOUNDATIONS: RE-ENGINEERING IB COMPETENCY

2.1 Global Value Chain Governance in an Algorithmic Era

The framework by Gereffi, Humphrey, and Sturgeon (2005) defines the range of GVC governance from market to integrative in terms of transaction complexity, codifiability of information and supplier capability [10]. AI changes the second factor of codifiability of information. Large language models and predictive modeling help the leading firm to codify and share design requirements, ESG measures and demand signals complexly across borders quickly [11].
At the same time, it introduces new risks of algorithmic blind spots, over-optimization fragility and regulatory challenges across different sovereigns. Thus, modern IB practitioners should be able to perform Algorithmic Value-Chain Orchestration, i.e., not only to use AI to orchestrate global suppliers and digital platforms, but also to interrupt the algorithmic optimization and use redundancy, local political acceptance and trust in the supply chain [12].

2.2 Cultural-Historical Activity Theory (CHAT) and Mediated Learning

CHAT is a theory of human learning proposed by Vygotsky and developed by Engeström. It views learning as an activity system directed towards a goal with mediating tools, community norms, rules and division of labour [13]. When intelligent technology is used in an IB class, it does not just make the tasks faster; rather, it changes the activity system [14].
In a conventional IB class, the mediating tools are textbooks and spreadsheets and the division of labour is that only the teacher is a source of knowledge. In an AI-mediated IB activity system, AI agents grounded in the domain are mediating artefacts that can mimic foreign regulators, customs and foreign consumers. Hence, the student becomes an orchestrator of a human-machine cognitive system and needs to pay attention to new rules of the class such as prompt honesty, source checking and ethical responsibility [15].

2.3 Metacognitive Scaffolding and Productive Cognitive Friction

One of the commonly observed issues in educational technologies is that the helpful AI removes the desirable difficulties for schema development [16]. Therefore, when AI can generate a well-formatted report on market entry easily, novices have illusion of competence without having intuitive understanding.
To avoid cognitive degeneration, metacognitive scaffolding and productive cognitive friction should be included in the design [17]. Instead of having AI provide ready answers, the design of the class should make AI an adversarial Socratic interrogator that uncovers the underlying assumptions in students' strategies, introducing sudden regulatory or currency shocks, and students should check the algorithmic results against authoritative empirical data before making strategic decisions [18].

3 DIAGNOSING STRUCTURAL BOTTLENECKS IN TRADITIONAL IB PEDAGOGY

A systematic review of existing International Business programs reveals four entrenched pedagogical bottlenecks that limit graduate readiness in an algorithmically mediated global economy:

3.1 Static Modeling of Dynamic Geoeconomic Systems

Conventional IB classes make international market analysis as country risk ratings and PESTEL checklists [19]. However, the current global value chains function in a dynamic geoeconomic landscape with dynamic interactions of

semiconductor export restrictions, carbon border adjustment and digital services tax across different jurisdictions. Conventional class activities do not help students to develop systems thinking in identifying second and third order effects across global value chains.

3.2 Over-Reliance on Macro-Cultural Stereotypes

Aggregated national culture scores are typically used in cross-cultural management classes [20]. Although they can serve as a starting point for heuristic purposes, uncritical use of static cultural dimensions promotes essentialist stereotyping and students are not equipped to handle the micro-pragmatics of working across borders, e.g., indirect disagreement in high-context virtual settings, multilingual AI communication, and auditing socio-religious taboos in local marketing campaigns [21].

3.3 The "Two-Worlds" Split Between Data Science and Strategy

In most business programs, quantitative analysis (e.g., econometric trade models, inventory) is taught in a rote manner without connection to other topics, while international strategy is taught via qualitative case. Thus, students do not have the ability to translate between data teams and leadership (e.g., by uncritically following the output of fluent AI despite data bias – automation bias or ignoring analytics and relying on intuition) [22].

3.4 Obsolescence of Summative Essay Assessments

Take-home country reports, literature reviews, and case studies were originally intended for a time when information was limited. Since foundation models can produce fluent analytical writing in seconds, take-home written assignments are no longer a valid measure of understanding and critical thinking by students [23]. Prohibiting the use of AI does not solve this issue and students are not given any opportunity to be trained in human-AI collaboration ethically.

4 ARCHITECTURAL BLUEPRINT: THREE-HORIZON CURRICULUM AND SYNTHETIC COMMERCE LAB

This research suggests a two-pronged approach to solve these issues through a Three-Horizon Curriculum Transformation Architecture and a Synthetic Global Commerce Laboratory.

4.1 Pillar One: The Three-Horizon Curricular Transformation Architecture

Rather than treating curriculum renewal as a static, multi-year administrative overhaul, the program is structured across three interlocking developmental horizons:
Horizon 1: Epistemic Knowledge and First Principles Reasoning (AI-Free Area) Students are first taught the basics of international trade, FDI, balance of payments, international commercial law, and comparative institutions in an AI-free environment to develop trade models, read financial statements and reason out arguments without any AI assistance [24].
Horizon 2: Human-AI Co-Piloting in Functional Areas (Guided AI Assistance Area) In functional areas of Global Supply Chain Management, International Marketing, International Finance, and Cross Border E-Commerce, students are taught to use AI in their respective fields for decision-making. The learning content includes NLP for sentiment analysis of consumers in multilingual settings, predictive analysis for currency and inventory risks, and generative prototyping for market entry in local markets with mandatory disclosure of prompt and source [25].
Horizon 3: Agile Studios and Regulation in Capstone (Autonomous AI Area) Twenty five percent of credits in capstone are allocated to agile, semi-annual refreshable studio classes with industry co-designed. The studios focus on current issues in cross-border settings, e.g., AI-Driven Customs and FTA Rules-of-Origin Optimization, Extraterritorial Data Governance and Algorithmic Auditing, and Generative Localization in Cross Border Digital Platforms.

4.2 Pillar Two: The Synthetic Global Commerce Laboratory

Supporting this curricular progression requires dedicated pedagogical infrastructure organized into four functional modules within a Synthetic Global Commerce Laboratory:
A: RAG Regulatory Oracles for Domain Specific Legal Citation and Trade Data Hallucination To avoid hallucination of legal citations and trade data, the laboratory uses RAG assistants from credible sources such as WTO dispute settlement decisions, regional FTA legal documents, bilateral investment treaties and central bank reports [26].
Module B: Multi-Agent GVC Disruption Wargaming Module Students operate virtual multi-national supply chains in a simulation sandbox with AI agents of host nation ministries of industry, customs, port authorities, trade unions, and competitors. Students' strategic shifts are reacted to by the AI agents in the sandbox when macro shocks (e.g., tariff hikes or maritime chokepoint blockades) are introduced by the instructor during the quarters of the simulation.
Module C: Culturally Sensitive Negotiation and Pragmatic Clinics Students negotiate commercially in voice and text with AI conversational agents having different socio-linguistic backgrounds, institutional limitations, and reservation

prices. Students' cultural sensitivity, concession rate, and risk regarding contracts are automatically analyzed by pragmatic dashboards after each round [27].
Module D: Enterprise Data Sandboxes with No Retention Students have access to institutional AI sandboxes with no retention in collaboration with export manufacturers, logistics companies, and cross-border e-commerce companies. Anonymous data of companies (e.g., past customs declarations, overseas warehouse stock information, and multilingual customer opinions) are used by students to address current commercial challenges without exposing any commercial data [28].

5 EMPIRICAL PRACTICE IMPLEMENTATIONS ACROSS CORE IB COURSES

We present four case studies of the application of this design in regular teaching practices in undergraduate and postgraduate level International Business courses.

5.1 Practice One: Multi-Tier GVC Resilience Wargaming in Global Supply Chain Management

Objective: To learn about systemic risks and adaptability in dealing with algorithmically synchronized global supply chains.
Process: Students work in teams as Global Operations Committee of a multinational medical device company that sources precision parts from East Asia, assembles the devices in Southeast Asia, and sells to North America and Europe. During four rounds of the simulation, the instructor imposes increasing levels of disruptions such as unexpected export license restriction on vital sub-assemblies, port backlog, and new requirement of disclosing carbon footprint. Students apply predictive cost modeling and LLM planners to analyze reshoring, nearshoring ("China plus one") and dual sourcing options. AI agents of customs and first-tier suppliers negotiate lead times and pricing.
Outcome: Students went beyond the Economic Order Quantity (EOQ) and analyzed the trade-offs in terms of cost effectiveness and geopolitical stability.

5.2 Practice Two: Automated FTA Rules-of-Origin Auditing in International Trade Operations

Objective: To learn about HS tariff classification and Rules of Origin (ROO) optimization with RAG-based regulatory AI.
Process: Multinational exporters often fail to obtain zero tariff treatment due to mistakes in recording RVC and CTC in the contract (e.g., RCEP, CPTPP) [29]. Students are given BOMs of multiple components of smart consumer goods. After computing manually the origin baseline without the help of AI, students apply the Trade Compliance AI Workbench of the laboratory to analyze fifty sub-components and find substitutions to obtain preferential tariff. Importantly, the instructor introduces specific legal pitfalls (e.g., de minimis exceptions for certain products) that students have to identify and correct AI's understanding of tariff footnotes.
Outcome: Students learned valuable skills in operational compliance and were highly skeptical of AI's legal information that was not verified.

5.3 Practice Three: Cross-Border M&A Institutional Due Diligence in International Corporate Strategy

Objective: To combine algorithmic financial modeling with regulatory and cultural polycentric due diligence.
Implementation: Students play the role of cross-border acquirer in assessing a mid-sized European industrial automation company. Students employ AI-driven data pipelines in the sandbox to assess financial statements, patents, and media sentiment of the target. Students then present their deal design to an Adversarial AI Regulatory Panel (Foreign Direct Investment (FDI) National Security Screener, European Works Council Labor Representative, Cross-Border Antitrust Counsel). Students are questioned on valuation, technology transfer limitations, and cultural integration after the deal, and they have to change their governance terms on the spot.
Impact: The deliverables showed a greater degree of incorporating financial valuation into the host country institutional limitations as compared to static case study.

5.4 Practice Four: Multilingual Consumer Sentiment Forensics in International Marketing

Learning Objective: Large-scale multilingual NLP sentiment mining and culturally informed creative audit.
Implementation: Students assess vernacular consumer reviews and social media posts of thousands of consumers in target emerging markets while working on real-time expansion briefs of regional exporters. Students employ AI-driven Python to conduct aspect-based sentiment mining to identify local product pain points (e.g., weather resistance, packaging, payment trust). Students then prototype local brand messaging through multimodal generative AI, and they must go through a Cultural Harm and Compliance Audit to avoid "translationese", religious offense, and local ad law violations [30].
Impact: Corporate executives complimented the level of detail in students' recommendations for implementation in their commercial ventures and have implemented some of the students' packaging and messaging changes in launching their products internationally.

6 ASSESSMENT REDESIGN AND LONGITUDINAL PRACTICE EVALUATION

6.1 Triangulated Process-Centric Assessment Framework

To ensure valid competency evaluation in an AI-pervasive learning environment, static term papers were replaced with a Triangulated Process-Centric Assessment Framework:
Epistemic Audit & Hallucination Forensics (40%): Students provide an annotated log of human-AI interaction for each project deliverable including prompt iteration, hallucinated stats and Western bias detection, cross-checking with primary source databases (e.g., UN Comtrade, WTO, IMF), and rationale for human strategic override.
Dynamic Simulation & Adaptation (30%): Qualitative and quantitative assessment of students' decision consistency, compliance, and adaptability in multi-round GVC and negotiation simulations.
Unassisted Live Boardroom Defense (30%): Students present in an AI-free setting in boardroom format and are interrogated by instructors and industry professionals to assess their mastery of the subject and ability to present convincingly.

6.2 Empirical Insights Across Multi-Semester Cohorts

Longitudinal evaluations across multiple undergraduate and master's cohorts—incorporating pre/post-course diagnostic assessments, rubric-scored portfolio audits, and employer internship feedback—revealed four consistent outcomes:
From Macro Descriptive to Causal System Reasoning: Students' deliverables shifted from a macro description of a country to a more detailed causal system reasoning of how tariffs, currency fluctuations, and institutional credibility impact unit economics of a firm.
Increased Critical Verification: Since students' assessment was given points for detecting the pre-planted AI mistakes, students quickly stopped passively using generative AI and instead showed greater degree of verification.
Increased Participation of Multilingual Students: Asynchronous AI clinics for negotiation and multilingual brainstorming prompts decreased anxiety for non-English speakers and showed increased participation in live boardroom defense.
Faster Time to Work: Corporate internship mentors noted that students in this ecosystem take less time to get up to speed in gathering overseas market information, conducting cross-border e-commerce, and trade documentation.

7 STRUCTURAL RISKS AND INSTITUTIONAL GOVERNANCE SAFEGUARDS

Implementing AI in International Business education brings with it several structural challenges that need to be managed by the institution instead of being managed on a case-by-case basis in the classroom.

7.1 Mitigating Algorithmic Monoculture and Western-Centric Bias

The foundation models are largely trained on Anglophone, Western-oriented datasets [31]. Uncontrolled use of AI in International Business education can lead to algorithmic monoculture, i.e., implicitly defaulting to Western management approach as the only way of doing things while stereotyping or even erasing differences of institutions in Asia, Africa, Latin America, and the Middle East.
Institutional mitigation: Require epistemic and linguistic diversity by using regionally trained multilingual AI models along with global models, primary source local regulatory and academic repositories for RAG, and include Algorithmic Bias and Digital Sovereignty as part of International Business Ethics curriculum.

7.2 Preventing Premature Skill Atrophy and Cognitive Offloading

Using generative AI can lead to cognitive offloading whereby students offload critical analysis, financial approximation, and structure to algorithms before they have any understanding of the domain [32].
Institutional mitigation: Require developmental gating throughout the degree. Year one and two require strict AI-free analysis standards whereby students need to demonstrate understanding of first principles before being allowed access to fully AI-studio environments.

7.3 Ensuring Cross-Border Data Privacy and Intellectual Property Compliance

IB projects require transfer of data across borders, company proprietary supply chain data, and consumer data of other countries. By uploading confidential partner data to commercial public AI, the university and the partner company can be held liable for breach of privacy laws (extraterritorial, e.g., EU GDPR) and data security laws [33].
Institutional mitigation: Implement Zero Retention Institutional AI Infrastructure under university-enterprise data agreements. All live data from companies needs to be anonymized before being fed to the AI and run only in privately hosted or enterprise contracted sandbox with contractual assurance of no external training of the model.

7.4 Bridging the Faculty Digital Divide and Resource Disparities

Pedagogical change cannot happen without confidence in technology by the faculty, time to develop, and institutional support. Additionally, there is a risk of increasing disparity in education between research universities and regional [34]. Institutional mitigation: Interdisciplinary Curriculum Innovation Studios should be created where IB faculty can collaborate with instructional technologists and graduate researchers to co-develop reusable simulation agents. AI pedagogical development should be recognized in workload, tenure, and promotion requirements. At a larger scale, international consortiums should have open access verified IB simulation agents and synthetic trade data to allow for global access.

8 CONCLUSION

The advent of Algorithmic Global Value Chains and autonomous intelligence represents a pivotal moment in International Business education. Simple modifications to existing syllabi are not enough as intelligent systems are changing how global companies orchestrate production, regulatory friction, and cross-cultural communication. For IB education to be relevant, institutions need to redesign their curriculum around a purpose, i.e., to train boundary spanning global leaders to orchestrate Algorithmic Value-Chains.

With the proposed Three Horizon Curricular Transformation and Synthetic Global Commerce Lab, the gap between algorithmic competency and institutional, legal, and cultural judgment can be addressed systematically. Experiences in the classroom with multi-tier GVC wargaming, automated FTA rules of origin auditing, cross-border M&A regulatory panels, and multilingual consumer sentiment forensics show that with AI used as a metacognitive and simulation tool, students are able to have better causal understanding, critical thinking, and cross-cultural understanding.

AI in International Business education should not be about automating human intelligence but rather enhancing human agency in a socio-technical system. With first principles understanding, ethical, and cross-cultural understanding, education can enable the next generation of global business leaders to effectively lead an intelligent global economy.

COMPETING INTERESTS

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