IRBEJ **International Research-Based Education Journal**
Volume 8 No 2, 2026
Available online at IRBEJ website: https://journal-fip.um.ac.id/index.php/irbej

The Skill Mismatch and Economic Returns of STEM vs. Non-STEM Degrees in Cambodia

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Abstract: This article examines the relationship between skill mismatch and the economic returns to science, technology, engineering, and mathematics (STEM) versus non-STEM degrees in Cambodia. Using an integrative literature review grounded in human capital theory, signaling theory, and the assignment model, it synthesizes evidence from national labor surveys, international development reports, and emerging Cambodian scholarship. The review finds that STEM graduates earn a modest wage premium in formal employment, but that a large informal sector, a narrow industrial base, and weak quality assurance compress this premium well below theoretical predictions. Non-STEM graduates, especially in education, law, and the social sciences, face severe overeducation and horizontal mismatch yet continue to enroll. The article concludes that reform must simultaneously address graduate supply and the economy's absorptive capacity, and offers recommendations for the Ministry of Education, Youth and Sport, universities, and private-sector stakeholders.

Keywords: collaborative learning; STEM Education; integrative learning

INTRODUCTION

For more than half a century, the relationship between educational credentials and what happens in the labor market has kept economists, sociologists, and policy analysts busy. From Becker's (1964) original statement of human capital theory through the vast literature on returns to schooling (Card, 1999; Mincer, 1974; Psacharopoulos & Patrinos, 2018), the headline finding has held up: education raises productivity and productivity raises earnings. But that headline hides enormous variation—across fields of study, countries, and institutions. In developing economies where labor markets are shallow, information is patchy, and formal

jobs are the exception rather than the rule, the tidy assumption that more education means proportionally higher wages tends to fall apart.

Cambodia is an especially instructive case since the higher education system was rebuilt in the 1980s, after the Khmer Rouge years left it in ruins. The country has seen a staggering expansion in the number of universities and students. Tertiary enrollment climbed from roughly 17,000 students in 2000 to more than 260,000 by 2022 and the number of institutions grew from a handful of state universities to over 120 public and private ones (Ministry of Education, Youth and Sport [MoEYS], 2023; UNESCO Institute for Statistics, 2023). Several forces drove it. Households were reaching higher and the government wanted to move Cambodia away from a low-income economy built on garments and agriculture toward a middle-income, knowledge-intensive one by 2030 also because public provision fell short, the private market stayed wide open.

Quantity has outrun quality, though it has surpassed the economic diversification that might have absorbed better-educated workers (Asian Development Bank [ADB], 2020; World Bank, 2022a). So a swelling cohort of graduates, many holding non-STEM degrees in social science, business, and law, now walks into a labor market that can not employ them at the level they trained for. Employers in manufacturing, financial services, and information and communications technology (ICT) keep saying they can not fill technical and analytical posts while arts and humanities graduates are unable to find relevant work (International Labour Organization [ILO], 2020; HRINC Cambodia, 2013). In a sentence, that is skill mismatch: graduates bring one set of knowledge, skills, and competencies into the market, but employers want another.

Why should we care that mismatch differs from one field to another, and that this difference shapes what graduates earn?

For individuals, the choice between a STEM and a non-STEM program is among the most consequential decisions they will make, and it deserves to rest on realistic evidence about outcomes rather than on prestige or habit. For institutions, program mix and curriculum should answer both aggregate demand and the specific competency gaps employers flag. The government's decision about how to allocate resources across public universities, scholarships, and industry partnerships depends on knowing where human capital investment yields the highest social return.

Three connected questions organize the article. How severe is skill mismatch among Cambodian graduates, and does its incidence differ systematically between STEM and non-STEM fields? What are the private returns to STEM versus non-STEM degrees, and how do

they vary by gender, region, and employment sector? And which structural and institutional factors sit between credentials, field of study, and labor market outcomes in a small, open, developing economy? To get at these, the article reviews the theoretical and empirical literature, sets out the higher education landscape in Cambodia, presents and interprets the available evidence on mismatch and returns, and closes with policy-relevant discussion.

LITERATURE REVIEW

Theoretical Framework

Three complementary traditions shape the analysis. The first, human capital theory (Becker, 1964; Mincer, 1974; Schultz, 1961), frames schooling as a deliberate investment that builds a person's capacity to produce. As workers accumulate knowledge and skill, their output rises, and a competitive labor market rewards that added output with higher pay. On this reasoning, STEM fields ought to yield higher returns, since they equip graduates with technical competencies that are scarce and readily applied across a broad range of industries. For Cambodia the implication is direct: if the country intends to complete its planned industrial transition, technical education must deliver both private wage premiums and social returns through technology adoption and productivity growth (Hanushek & Woessmann, 2012).

The second tradition, signaling theory (Riley, 2001; Spence, 1973), shifts attention from what education imparts to what it conveys. Because an employer cannot observe a candidate's productivity at the point of hiring, qualifications serve as a stand-in for it. Seen this way, a field of study matters less for the content it teaches than for what it advertises about a program's selectivity, the student's drive, and the cognitive effort needed to complete it. In Cambodia, where employers tend to distrust university quality (ADB, 2014), this signal probably carries extra weight: a degree from a respected institution, or from a field regarded as technically demanding, may convey value regardless of the skills actually acquired.

The third tradition, the assignment model (Sattinger, 1993; Teulings & Gautier, 2004), is about matching workers to jobs where pure human capital theory stops; the assignment model carries on: the return to a given level or type of education hinges on whether a suitable job even exists. When the supply of graduates overtakes the supply of graduate-level jobs—reasonably, Cambodia's situation—some graduates get rationed into work beneath their qualifications. This "overeducation" carries an earnings penalty relative to well-matched peers (Duncan & Hoffman, 1981; McGuinness, 2006), even when the overeducated worker still out-earns a less-educated colleague in the same role. The ORU (overeducation, required education, undereducation) framework, formalized by Duncan and Hoffman (1981) and later refined by Verdugo and Verdugo (1989) and Hartog (2000), provides a way to measure those penalties.

Put together, the three yield testable expectations. Human capital theory says STEM graduates should out-earn non-STEM graduates on the strength of higher technical productivity. Signaling theory says institutional and program reputation will matter on their own, apart from skills acquired. Moreover, the assignment model says that in a constrained market, a sizable share of both STEM and non-STEM graduates will be mismatched but that the wage and satisfaction consequences will differ by field because occupational specificity, sectoral demand, and skill transferability differ (Nordin et al., 2010; Robst, 2007).

Table 1 summarizes the three frameworks and the predictions each generates for the Cambodian case.

Table 1. Theoretical frameworks and their predictions for the Cambodian case

Framework	**Core proposition**	**Prediction for Cambodia**
Human capital theory (Becker, 1964; Mincer, 1974)	Education raises productivity, which raises wages.	STEM fields yield higher returns through scarce, productive technical skills.
Signaling theory (Spence, 1973; Riley, 2001)	Credentials signal unobserved ability rather than certify skill.	Institutional reputation and field prestige matter independently of skills gained.
Assignment model (Sattinger, 1993; Teulings & Gautier, 2004)	Returns depend on whether suitable jobs exist to match workers.	A narrow formal sector rations graduates into mismatched jobs, compressing returns.

Note. Compiled by the author from the cited theoretical literature.

Figure 1 integrates these three lenses into the conceptual framework that organizes the analysis. It treats field-of-study choice as the entry point, skill mismatch as the intermediate outcome, and economic returns as the terminal outcome, with the structural and institutional context of a developing economy moderating each link.

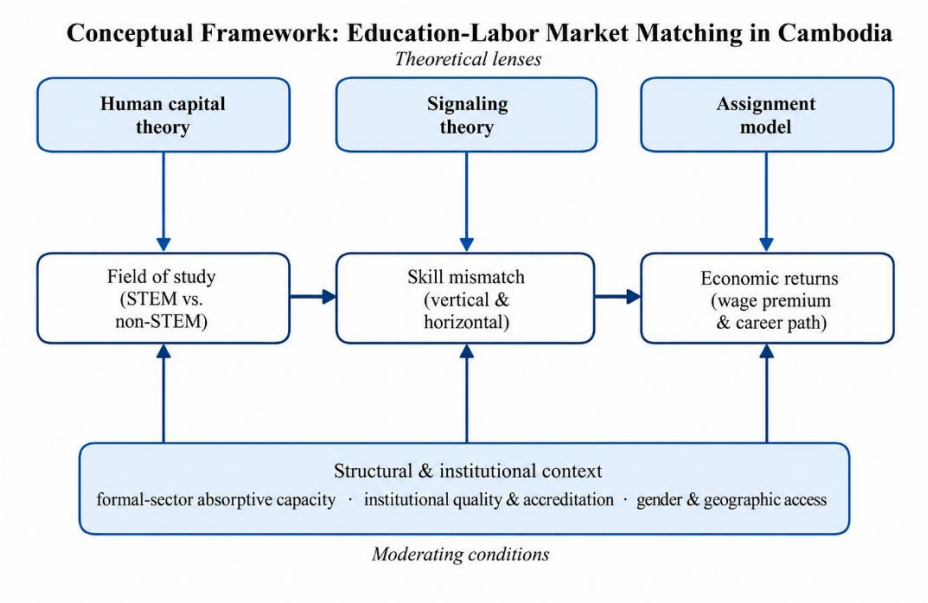


Figure 1. Conceptual framework linking theories of education–labor market matching to skill mismatch and economic returns in Cambodia. Source: developed by the author.

Returns to STEM Education: Global Evidence

The global literature mostly backs the idea of a STEM wage premium, although its size swings widely by country, labor market institution, and discipline. In the United States, Altonji et al. (2016) traced wide earnings gaps across college majors, with engineering, computer science, and economics paying far more than social work, education, and the arts; the same pattern of large major-specific earnings gaps emerges in Altonji et al.'s (2012) analysis of how high school curriculum and college major shape later careers. Noonan (2017) found STEM workers earning a median premium of about 29% over non-STEM workers even after holding occupation, sector, and experience constant. Looking at Chinese graduates, Ge and Yang (2014) found a STEM wage advantage that widened over the first decade of careers—consistent with learning-by-doing mattering more in technical fields. More recent Chinese evidence links major–job mismatch directly to weaker earnings growth, job stability, and promotion prospects (Jiang & Guo, 2022).

Southeast Asian evidence is thinner and more mixed. Patrinos (2016), synthesizing regional rates of return, found tertiary returns generally positive but the field-of-study premium compressible in economies with large informal sectors where wages track sectoral affiliation as much as individual human capital. Xue and Larson (2015) flagged a STEM pipeline worry in fast-industrializing economies, where a sharp shortage of STEM-qualified workers drives up wages and can distort occupational choices. Lowell (2009) and Marginson et al. (2013) stressed STEM's strategic role in national innovation capacity, placing field-of-study returns

inside the broader story of knowledge-economy transition which Cambodia has openly embraced in its Industrial Development Policy 2015–2025.

Some scholars have pushed back on blanket STEM cheerleading. Chevalier (2003) showed that a good share of UK science graduates were "apparently overeducated"—in jobs that nominally did not need a degree but still earned a premium over non-graduates in the same roles, which suggests STEM credentials keep their signal value even when mismatched. Reviewing two decades of overeducation research, McGuinness (2006) concluded that separating vertical mismatch (overqualification) from horizontal mismatch (field-of-study mismatch) is essential for policy, and that horizontal mismatch in STEM can be exclusively costly, since technical skills are often occupation-specific and do not transfer easily.

Skill Mismatch: Concepts and Measurement

Skill mismatch is multidimensional, and the literature distinguishes at least three forms (Leuven & Oosterbeek, 2011). Vertical mismatch, or overqualification, arises when a worker holds more education than the post calls for; it is usually gauged by setting an individual's schooling against the level customary for their occupation (Duncan & Hoffman, 1981; Verdugo & Verdugo, 1989). Horizontal mismatch describes a different situation, in which the qualification level fits the job but the field of study does not (Robst, 2007; Sloane et al., 1999). A third variant, skills mismatch in the narrow sense, is the gap between the competencies a worker actually holds and those the employer needs; it is detected through employer and employee surveys rather than through qualification codes (OECD, 2016). Recent evidence further ties overeducation to lower job satisfaction and stronger intentions to quit (Pan et al., 2025).

All three turn up in developing countries where fast-growing education systems have often left behind the structural transformation of their economies. Brunello and Rocco (2017) found that overeducation is more common where labor markets are inflexible, confirming that institutional rigidities pile on top of plain supply-demand mismatch. In Southeast Asia, the ILO (2020) documented youth overeducation rising sharply after the COVID-19 pandemic across Cambodia, Vietnam, and the Philippines, as new graduate cohorts hit a shrunken formal labor market.

Table 2 sets out the three forms of mismatch distinguished in this literature.

Table 2. Forms of skill mismatch

Form	**Definition**	**Most affected group in Cambodia**

Vertical mismatch (overqualification)	The worker's qualification level exceeds what the job requires.	Non-STEM graduates (business, law, social science)
Horizontal mismatch	Qualification level fits, but field of study does not match the job.	STEM graduates in non-technical roles
Skills mismatch (narrow sense)	Specific competencies held differ from those the employer needs.	Graduates across fields, per employer surveys

Note. Adapted from Leuven and Oosterbeek (2011), Robst (2007), and OECD (2016).

Evidence from Cambodia

Research zeroed higher education in Cambodia about labor market relations is young but growing. The foundational accounts of higher education reconstruction—Clayton (2006) and Chet (2009) above all—show how rebuilding universities after the conflict prioritized access and institutional variety ahead of teaching quality, setting up what Pellini (2005) called a supply-driven credentialist culture. Those early choices still shape enrollment today: business administration, law, and management stay over-enrolled relative to demand, while engineering, applied science, and ICT remain under-subscribed (MoEYS, 2023; UNESCO, 2021). Recent Cambodian scholarship reaches similar conclusions, identifying skills mismatch as a central challenge for the sector (Chuon, 2023; Heng & Sol, 2023).

The HRINC Cambodia (2013) labor market assessment—among the most thorough surveys of Cambodian employers found that 67% of firms reported trouble filling technical vacancies while reporting none filling non-technical ones. That asymmetry points to STEM skill gaps that are both quantitative, with too few graduates, and qualitative, with too little depth. The ADB (2019) skills gap analysis supports this, estimating that Cambodia would need to lift annual STEM graduate output by roughly 40% by 2025 to meet projected demand from expanding special economic zones, digital services, and manufacturing diversification.

On returns, the direct Cambodian evidence is thin, hemmed in by data problems: nationally representative tracer studies are rare, informal wages go underreported, and field-of-study coding in household surveys is inconsistent. The Cambodia Socio-Economic Survey (CSES), conducted every two years, lets you break earnings down by education level but does not systematically code fields of study. World Bank (2022b) researchers analyzing the 2019 CSES found a tertiary premium of about 32% over upper secondary—an estimate that lumps all fields together. Indirect evidence from the World Bank (2020) occupational wage data points to

technical-qualification positions (engineering, ICT, health sciences) commanding 30 to 60% premiums over administrative and social science positions with comparable educational requirements, implying a sizable STEM advantage in formal work.

RESEARCH METHODOLOGY

This article employs an integrative literature review, an approach suited to synthesizing diverse theoretical and empirical evidence on a topic that is conceptually mature but empirically fragmented (Torraco, 2005; Whittemore & Knafl, 2005). Unlike a systematic review, which typically tests a narrow hypothesis against a homogeneous body of studies, an integrative review allows quantitative and qualitative evidence from heterogeneous sources—peer-reviewed studies, national statistics, and policy reports—to be combined into a coherent account. This design fits the Cambodian case, where rigorous field-specific data are scarce and must be read alongside regional and global evidence. The review was guided by three questions concerning the incidence of skill mismatch, the private returns to STEM versus non-STEM degrees, and the structural and institutional factors that mediate both.

Search Strategy

Literature was identified through structured searches of Scopus, Web of Science, ScienceDirect, JSTOR, and Google Scholar, complemented by targeted searches of the institutional repositories of the Asian Development Bank, the World Bank, the International Labour Organization, UNESCO, the Cambodia Development Resource Institute, and the Ministry of Education, Youth and Sport. Search strings combined three concept blocks using Boolean operators: (a) education terms ("higher education" OR "tertiary education" OR "graduate" OR "field of study" OR "STEM"); (b) labor-market terms ("skill mismatch" OR "overeducation" OR "horizontal mismatch" OR "returns to education" OR "wage premium" OR "employability"); and (c) geographic terms ("Cambodia" OR "Southeast Asia" OR "developing economies"). The search prioritized literature published between 2000 and 2025, with particular attention to studies from 2021 onward, while retaining foundational theoretical works that remain standard references in the economics of education. English-language sources were included, supplemented by Khmer-language government statistics where official English versions were unavailable. Reference lists of key sources were hand-searched to locate additional studies (backward citation tracking).

Inclusion and Exclusion Criteria

Sources were retained when they (a) addressed skill mismatch, field-of-study returns, or the structure of higher education and the labor market; (b) were relevant to Cambodia, to comparable Southeast Asian economies, or to the general theory of education–labor market

matching; and (c) were issued by peer-reviewed journals, university presses, or recognized international and governmental agencies. Sources were excluded when they were neither peer-reviewed nor institutionally authoritative, addressed unrelated education levels or sectors, or merely duplicated evidence already captured by a more authoritative source. Where several sources reported on the same indicator, preference was given to the most recent and most representative.

Synthesis and Treatment of Numerical Estimates

Evidence was organized thematically around three established frameworks—human capital theory, signaling theory, and the assignment model—together with the overeducation, required education, and undereducation (ORU) approach to measuring mismatch. Findings from Cambodian sources were compared against regional comparators, principally Vietnam and Thailand, and against global evidence on STEM and non-STEM wage premiums. Because nationally representative, field-specific graduate tracer data for Cambodia remain limited, the synthesis triangulates across multiple partial sources rather than relying on a single dataset. To preserve transparency, every numerical estimate in the findings is attributed to its source at the point of use; where an estimate was derived by reconciling more than one partial source, it is identified as the author's triangulated synthesis and reported as an indicative range rather than a precise point estimate. This data limitation is revisited in the discussion.

SYNTHESIZED FINDINGS

The synthesis yields three sets of findings: the structural context of Cambodian higher education, the patterns and determinants of skill mismatch, and the economic returns to STEM versus non-STEM degrees.

Higher Education Landscape in Cambodia: Context and Structural Constraints

Any reading on graduate labor market outcomes has to start with the structures that produce them. Three features of the higher education system in Cambodia bear most directly on the mismatch-and-returns story: rapid, uneven expansion; persistent quality heterogeneity; and a formal sector that stays narrow next to the supply of graduates.

Rapid and Uneven Expansion

The sector has grown rapidly since 2000, but that growth has not been evenly distributed across fields. Business and management programs have absorbed the largest share of new enrolments. They need little physical infrastructure, they fit social ideas about white collar prestige, and they charge some of the lowest tuition in the private sector (Pit & Ford, 2004; Chea, 2019). By contrast, engineering and ICT demand laboratories, specialized faculty, and equipment that many private institutions won't or can't fund at affordable prices. So Cambodia

now produces graduates whose distribution sits structurally out of step with where the country's Industrial Development Policy wants to go. MoEYS (2023) data show that in 2022–2023, about 38% of enrolled students were in business and economics programs, compared with approximately 14% in engineering and technology and 8% in natural sciences. Education and social sciences took another 22%. This mix has held broadly steady for over a decade despite repeated government calls to rebalance toward STEM—a sign that enrollment tracks individual preferences and institutional incentives far more than national labor market projections do. Table 3 reports the distribution of enrollment across broad fields of study.

Table 3. Distribution of higher-education enrollment by field, 2022–2023

Field of study	Share of enrollment (%)
Business and economics	38
Education and social sciences	22
Engineering and technology	14
Natural sciences	8
Other fields	18

Note. From MoEYS (2023). "Other fields" is the residual implied by the reported shares and should be confirmed against the source table.

Quality Heterogeneity and Institutional Capacity

Teaching quality across Cambodian institutions varies enormously, and the variation may matter as much for graduate outcomes as the field of study does. Ear (2013) argued that private universities multiplying without matching oversight produced a "diploma mill" dynamic with credentials handed out absent real learning gains. The Accreditation Committee of Cambodia (ACC), established in 2003, has made improvements in establishing minimum standards, but its coverage remains incomplete, and employer confidence in the signaling value of Cambodian degrees from newer private institutions remains limited (Hawkins et al., 2019; UNESCO, 2021).

Faculty quality is a related worry. Cambodian universities lean heavily on part-time staff who hold full-time government or private jobs and teach in the evenings—a setup that limits pedagogical engagement, dampens research, and stunts curriculum development (Clayton, 2006; Kelsall & Heng, 2014). Expressively in STEM, the scarcity of research-active faculty means students often absorb theoretical content without engaging in applied problem-solving, lab technique, or current industry practice, and exactly the competencies STEM-intensive

employers are after. Recent work documents how limited research engagement among Cambodian academics constrains the applied, inquiry-based teaching that technical fields require (Heng et al., 2022).

Economic Structure and Formal Sector Absorptive Capacity

Cambodia's economy runs on a dual structure: a formal sector clustered in garment manufacturing, tourism, construction, and a small but growing finance-and-services segment, alongside a large informal sector of smallholder agriculture, petty trade, and informal urban services. The formal sector accounts for about 30–35% of total employment, and an even smaller slice of rural employment (ILO, 2020; World Bank, 2022a). For graduates, the relevant market is overwhelmingly urban and formal but the formal sector's appetite for graduate-level labor has not kept pace with graduate output.

Special Economic Zones (SEZs) and the growing ICT sector are the liveliest pockets of formal job growth, yet they cluster in Phnom Penh and Sihanoukville and are not yet big enough to create broad-based demand for university-educated workers (ADB, 2020; Cambodia Development Resource Institute [CDRI], 2021). Tourism, hammered by the pandemic, had once absorbed large numbers of non-STEM graduates into hospitality and management roles, but its recovery has been slow and intermittent (Ear & Sotharith, 2022). In a market like this, even STEM graduates with strong credentials can end up competing for a thin slice of suitable jobs, which tempers the premium their qualifications would fetch in a more diversified economy.

Skill Mismatch Among Cambodian University Graduates: Patterns and Determinants

Incidence and Forms of Mismatch

Pulling the survey evidence together, vertical mismatch—overqualification appears to affect between 30 and 45% of Cambodian graduates in their first five years in the labor market, with the rate varying by field, institution, and location. That range broadly squares with the ILO's (2020) regional analysis of youth overeducation and with HRINC Cambodia (2013), though direct comparison is limited by differing methods for pinning down required qualification levels.

Non-STEM graduates seem to carry higher vertical-mismatch rates. Crowded into business, law, and social science, and facing a formal service sector that can not absorb large numbers of management and legal professionals, they form a structural surplus. The World Bank (2022b) estimates that Cambodia produces roughly three times as many business administration graduates each year as the economy creates suitable openings in business management, financial services, and related work. Law graduates hit a similar wall, partly

because bar membership rules limit the profession in numbers far below total law-graduate output.

STEM graduates more often run into horizontal mismatch—jobs that require a degree but not necessarily a technical one—than into vertical mismatch. An engineering graduate working as a project coordinator at a construction firm is not formally overqualified, but the fit between training and daily tasks is loose. The distinction matters: horizontal mismatch in STEM may hurt long-term earnings less than vertical mismatch in non-STEM, because STEM graduates can carry their analytical and problem-solving training into a range of roles even when the specific disciplinary content goes unused (Nordin et al., 2010; Robst, 2007).

Gender Dimensions of Mismatch

Gender cuts across the field of study, shaping mismatches that stand out in Cambodia. Women cluster disproportionately in non-STEM programs such as education, social work, languages, arts, and run into extra barriers to formal employment from family responsibilities, mobility limits, as well as persistent occupational discrimination (Brickell, 2011; CDRI, 2021). Female STEM graduates, few as they are, seem to fare better in the labor market than female non-STEM graduates, and they earn wages somewhat closer to those of their male STEM peers than women do in many regional comparators (ILO, 2020). But the conduit to female STEM graduation narrows as early as secondary school, where far fewer rural girls take mathematics and science which points to a gender gap that reflects access as much as preference (UNESCO, 2021). Across rounds of the HRINC Cambodia (2013) employer survey and the ADB (2019) skills assessment, Cambodian employers kept naming the same gap between formal qualifications and practical competence in four clusters: technical and scientific problem-solving; digital literacy and ICT application; professional communication in English and Khmer; and workplace adaptability and team-based project management.

The gap bites hardest in technical fields. Employers in engineering and manufacturing said graduates of Cambodian engineering programs typically need 12 to 18 months of on the job training before they are functional—a much longer runway than employers in Vietnam and Thailand report for their engineering graduates (ADB, 2020). They trace it to the heavily theoretical bent of Cambodian STEM curricula, too little lab and workshop time, and limited industry exposure among faculty. In non-STEM fields, the complaints differ but cut just as deep: business graduates were seen as short on analytical rigor and decision-making confidence, and law graduates as strong in rote knowledge of legislation but weak in applied legal reasoning.

These perceptions change who gets hired. A growing number of formal-sector employers, such as multinationals in finance, ICT, and manufacturing, have addressed perceived quality gaps by recruiting internationally or hiring graduates of Vietnamese and Thai universities for technical posts (Kelsall & Heng, 2014; World Bank, 2022a). The effect is to internalize the mismatch nationally: Cambodian graduates compete with one another for lower-tier jobs while a subset of technically demanding roles goes to non-Cambodian workers.

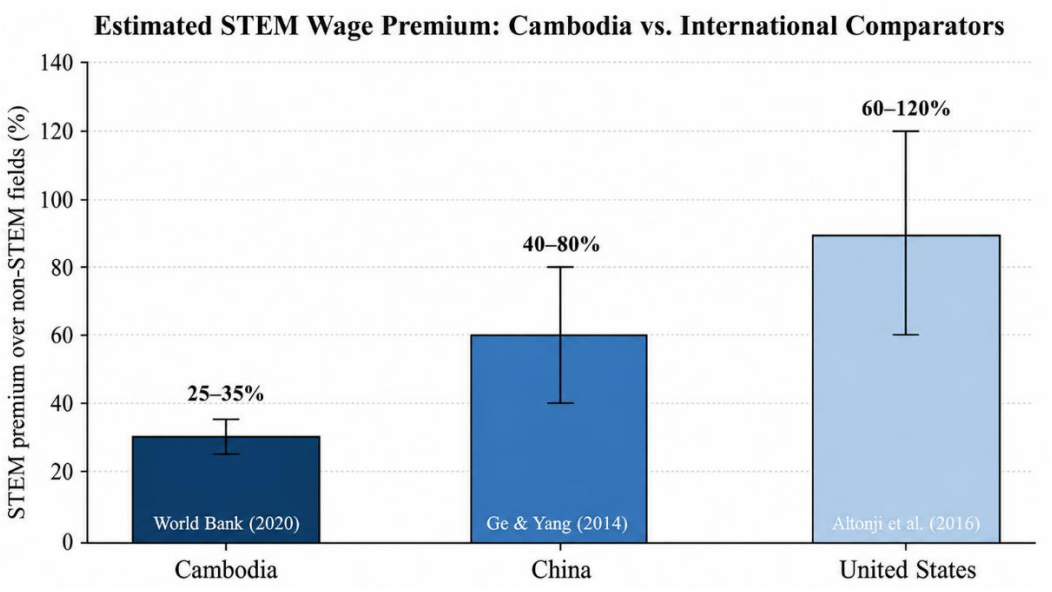
Economic Returns to STEM versus Non-STEM Degrees in Cambodia

Private Returns: Wage Differentials

Sticking down the private returns to specific fields in Cambodia is hard given the data, but several lines of evidence point in the same direction. The most direct wage figures come from World Bank (2020) occupational wage surveys of urban formal-sector workers in Phnom Penh, rounded out by sectoral data from the Cambodian Labor Force Survey (National Institute of Statistics [NIS], 2022) and field-specific salary benchmarks that HRINC Cambodia compiles for its annual compensation and benefits survey. Together, they point to a real STEM premium in the formal sector. Among recent graduates with one to five years of experience in formal jobs, those in engineering and ICT earn roughly 25 to 35% more a month than business administration and social science graduates with comparable experience, and about 50 to 70% more than graduates in education and the arts. Health science graduates like pharmacy and medicine which sit STEM adjacent, command some of the highest starting wages of any field, reflecting both an acute shortage of qualified health professionals and a licensing structure that limits supply.

It is worth highlighting that these premiums are heavily compressed against what STEM commands in richer economies, where field-of-study earnings gaps are far wider (Altonji et al., 2016; Ge & Yang, 2014). Illustrative estimates place the STEM premium on the order of 60 to 120% over arts and humanities in the United States and 40 to 80% in China (author's synthesis; see Figure 2). Cambodia's compression appears to stem from the narrowness of its formal sector—the market for STEM skills is not large enough to bid wages up strongly—and from garment-sector minimum wage legislation that sets a floor, pulling up low skill formal wages and squeezing the education differential (ILO, 2020; World Bank, 2022a).

Figure 2 illustrates this compression by setting the Cambodian STEM premium against estimates for China and the United States.



Bars show midpoints; whiskers show the indicative range Values are the author's synthesis of the cited sources.

Figure 2. Estimated STEM wage premium over non-STEM fields in Cambodia compared with China and the United States. Bars show midpoint estimates and whiskers the indicative range. Values are the author's synthesis of occupational and field-of-study wage data: Cambodia from World Bank (2020); China from Ge and Yang (2014); and the United States from Altonji et al. (2016). The cross-country figures are illustrative rather than directly comparable point estimates, as the underlying studies use different samples, periods, and reference categories.

Returns Across the Career Cycle

How returns evolve over a career differ between the two groups in telling ways. In economies with developed internal labor markets and merit-based promotion, you would expect STEM graduates to widen their lead over time as technical skills appreciate and experience pays. In Cambodia, the picture is mixed. STEM graduates who land in formal ICT, financial services, or construction do seem to see accelerating wage growth across their first decade, in line with human capital theory's experience-based productivity gains (Becker, 1964; Mincer, 1974). Alternatively, a sizable share, especially from lower-tier institutions, wind up in informal or semi-formal work where wages are not systematically tied to credentials and the STEM premium evaporates.

Non-STEM graduates in the formal sector trace a different arc. Business and management graduates may start below their STEM peers but build general managerial experience that brings fairly steady wage growth, predominantly in hospitality, real estate, and trade, where

sectoral know-how rather than technical skill drives productivity. Although, education graduates enter public-school teaching on a civil service pay scale that has long sat low against private alternatives, with promotion ladders that move slowly and reward seniority over performance (MoEYS, 2023; Pellini, 2005).

Informal Sector and Self-Employment Returns

Many Cambodian graduates, STEM ones included, land in informal jobs or self-employment. So if we measure field-of-study returns by formal wages alone, we miss a big chunk of the income distribution. Self-employed graduates in technical fields like construction, IT consultancy, and applied sciences report wide income swings. The successful entrepreneurs earn several times what formal STEM jobs pay but they also take on far more risk and far less security. The Cambodia Socioeconomic Survey backs this up (NIS, 2022). It shows that self-employed people with technical tertiary degrees earn 15 to 20% more on average than those with non-technical degrees. Still, incomes scatter widely around that average. In other words, non-STEM graduates in self-employment tend to gather in trade, retail, and personal services, where a university credential buys much less than a secondary education does. That fits the assignment model's prediction that returns to education materialize only when graduates land in roles that use their qualifications, and that where such roles are scarce, graduates fall back on lower skill self-employment with the lower returns to match (Sattinger, 1993; Teulings & Gautier, 2004).

The Role of Institutional Quality in Mediating Returns

One dimension of graduate returns gets too little attention in Cambodia: how much the return to any given field depends on the quality and reputation of the institution behind it. Signaling theory (Spence, 1973) holds that labor market returns moderately reflect what a credential says about the holder's ability and preparation, not just what it certifies in knowledge. In Cambodia, with its wide spread of institutional quality and limited employer familiarity with rankings, the signaling is imperfect but real.

Graduates of the Royal University of Phnom Penh, the Institute of Technology of Cambodia, the National University of Management, and a few other established institutions command a measurable premium over graduates of newer, lower-reputation private universities even within the same field. HRINC Cambodia (2013) data show that employers actively sort by institutional tier in recruitment, with the STEM premium markedly larger for graduates of recognized technical institutions than for STEM graduates of less established ones. The implication is pointed: expanding STEM enrollment without lifting institutional quality may not deliver the labor market payoff people expect.

DISCUSSION

Reconciling Theory and Cambodian Evidence

The Cambodian evidence broadly supports the three frameworks with important caveats. Human capital theory's prediction of a STEM wage premium holds but the premium runs much smaller than theory would expect in a well-functioning market with strong STEM demand. The compression traces to demand-side limits of a narrow formal sector to institutional quality heterogeneity that blurs the productive gap between STEM and non-STEM graduates, and to the large informal sector where credential returns are generally low. Signaling theory adds an institutional twist: unable to judge the quality of a Cambodian degree from field-of-study labels alone, employers fall back on institutional reputation and direct competency checks rather than treating the field as a reliable signal.

The assignment model is probably the sharpest lens for Cambodia because it puts the absorptive capacity constraint which is the heart of the country's mismatch problem—front and center. Returns to STEM fields are held down not by a shortage of technical skills (real as the quality concerns are) but by the limited number of formal-sector jobs that actually use them. Pushing up STEM enrollment without growing the economy's capacity to employ STEM graduates in relevant roles risks producing a fresh wave of technically trained but horizontally mismatched workers, the mirror image of today's glut of business and law graduates.

The Credentialist Trap

A theme that keeps surfacing in the Cambodian literature is what we might call the credentialist trap: households investing in university mainly for the credential—a marker of status and a ticket to formal employment rather than for the skills it builds (Ear, 2013; Kelsall & Heng, 2014). This is reflected in continued enrollment in low-cost, lower-quality non-STEM programs that confer degrees at modest cost while building comparatively little human capital.

The trap feeds itself. If credentials rather than skills open the door to formal work, institutions have little reason to invest in teaching quality since enrollment rides on credential supply, not graduate competence. Additionally, students have less reason to chase programs that build real technical capability when a cheaper non-STEM credential opens the same accessible corners of the labor market. Breaking the cycle means making genuine skill differences visible and rewarded through competency certification, employer involvement in curriculum design, and graduate tracer systems that put field-specific outcomes on the public record.

Gender Equity and STEM Access

The gender side of field choice and returns deserves its own policy focus. Female students in Cambodia get steered toward non-STEM fields back at the secondary level through cultural norms about which jobs suit women, over the clustering of STEM-heavy secondary schools in urban areas far from many girls' homes, and because the science stream carries a heavier academic load that disadvantages students from under-resourced rural schools (Brickell, 2011; UNESCO, 2021). The result: women are over represented in exactly the fields with the lowest returns and highest mismatch.

Closing that gap is not only about equity; it is about efficiency. By funnelling female human capital into low-return, high-mismatch fields, Cambodia is leaving the productive contributions of half its population on the table. Targeted moves such female STEM scholarships, rural science infrastructure, gender-responsive career counselling have been piloted with encouraging early signs, but they stay small against the scale of the imbalance (MoEYS, 2023; United Nations Development Programme [UNDP], 2020).

Implications for Regional Competitiveness

Cambodia's mismatch problem is not just a domestic welfare question but it shapes the country's place in regional and global value chains. As multinationals deepen their footprint in Southeast Asian manufacturing and services, they choose locations partly on the supply of qualified technical labor. Cambodia's shot at higher-value investment such electronics assembly, precision manufacturing, digital services rests on showing a credible supply of workers whose STEM competencies meet international standards (ADB, 2020; World Bank, 2022a). Cambodia's comparatively limited internationalization of higher education further constrains this positioning (Sok & Bunry, 2021).

Vietnam and Thailand, Cambodia's nearest rivals for manufacturing investment, have both poured money into improving the quality of STEM education over the past decade. The National University system in Vietnam has drawn heavy state investment in engineering and ICT and regional employers gradually seek out Vietnamese STEM graduates (Marginson et al., 2013). Addressing this STEM quality-and-quantity deficit therefore appears important for competitiveness. Should it remain unaddressed, Cambodia may find it harder to attract higher-value investment and could remain concentrated in lower-technology manufacturing, where it competes largely on wages with lower-cost countries—an outcome that would sit uneasily with the government's 2030 middle-income ambitions.

CONCLUSION

This article has examined what skill mismatch across STEM and non-STEM fields looks like in Cambodia and what it costs, drawing on human capital theory, signaling theory, and the

assignment model, and synthesizing the available evidence on graduate outcomes. A few conclusions stand out.

First, mismatch runs right through the Cambodian graduate labor market, affecting a large share of graduates across fields—but it takes different forms. Non-STEM graduates, especially in business, law, and the social sciences, face acute vertical mismatch, working well below their qualification level. STEM graduates, fewer in number, face horizontal mismatch and quality-related competency gaps that keep them from commanding the premiums their credentials should, in theory, earn.

Second, STEM graduates do enjoy a formal-sector wage premium, but a heavily compressed one against what models and international evidence predict. The compressing forces are structural: a narrow formal sector with limited room for technical graduates, wide institutional quality differences that erode the signaling value of STEM credentials from weaker institutions, and an economy still early in the industrial transition that would generate lasting STEM-intensive job growth.

Third, no supply-side fix alone will be enough without matching demand-side development—not expanding STEM enrollment, not improving curricula, not reforming governance. Cambodia faces two problems at once: on the supply side, graduates lack quality and cluster in the wrong fields; on the demand side, the economy hasn't yet generated the variety of high-skill jobs it needs to put a growing graduate population to productive use.

Fourth, gender and geographic equity sit at the heart of the mismatch challenge, not off to the side. The system funnels female students and rural students into the lowest-return, highest-mismatch fields, partly because their choices narrow long before university, back in secondary school. To change that, we have to intervene upstream of university enrollment.

The stakes are high. Cambodia's path over the next decade turns substantially on whether it can convert a growing graduate population into genuine productive human capital or whether it ends up with a credentialled but mismatched workforce whose education yields low social returns. The framework and evidence gathered here suggest the answer lies in a coherent, sustained, multi-actor strategy that addresses supply composition, quality, information, and demand simultaneously—an undertaking commensurate with the ambition of the country's middle-income transition.

SUGGESTIONS AND RECOMMENDATIONS

The evidence here supports a set of recommendations for the main players in higher education and labor market system in Cambodia grouped under four themes: aligning supply with demand, improving quality, generating better information, and addressing equity.

Aligning Graduate Supply with Labor Market Demand

The most basic fix is shifting the graduate mix away from today's over-representation of non-STEM fields toward fields with real labor market demand. The government can push this without ingenuously capping non-STEM enrollment: weighting scholarships toward STEM, tying public tuition subsidies to alignment with the Industrial Development Policy, and funding institutions partly on the strength of their graduate employment outcomes in priority fields. These are standard tools in countries that have rebalanced their graduate supply, such as South Korea in the 1970s and 1980s and Vietnam more recently, among them (Hanushek & Woessmann, 2012; World Bank, 2022a).

Demand-side moves matter just as much. Widening the capacity of the formal sector to absorb STEM graduates calls for sustained investment attraction, ICT sector development, and deliberate industrial upgrading in manufacturing. Skip those, and expanding STEM enrollment just manufactures new categories of mismatched graduates instead of shrinking the problem.

Improving Teaching and Curriculum Quality

Rebalancing supply will not help if graduates can not do what employers need. Both the ADB (2019) and the World Bank (2022b) advocated competency-based curriculum frameworks that place greater emphasis on work-based learning, industry mentorship, and applied research. In STEM specifically, closing the gap between theory and applied skill takes real investment in lab infrastructure, faculty development, and industry-academia partnerships. The Institute of Technology of Cambodia has already piloted models worth copying, which co-invest in labs with private firms and design curricula jointly with technology companies and these could serve as a template for the wider sector.

Non-STEM programs face a different but no less pressing task. Business and law curricula need redesigning around analytical reasoning, data literacy, and evidence-based decision-making rather than rote content. Those are the very competencies employers flag as missing—and the ones that would make non-STEM graduates more versatile and more valuable across a range of roles.

Generating Better Labor Market Information

Good decisions about what to study need accessible, field-specific, institution-specific information on graduate outcomes. Cambodia has no systematic national tracer system and the data that exist are scattered across institutional surveys of uneven quality. A national graduate tracer system run by MoEYS with the NIS, modeled on Vietnam's and the Philippines' would give both individual career guidance and institutional accountability something to stand on. Publishing outcome data broken down by field, institution, and sector, and putting it in front

of prospective students through digital platforms, would considerably sharpen the information behind field-of-study choices.

Equity-Focused Interventions

Finally, the geographic and gender sides of STEM access require targeted equity work. Scholarships designed to help female and rural students pursue STEM at urban universities could modestly but meaningfully shift the pipeline's composition. Investing in secondary-school science infrastructure in low-participation provinces is a longer game but a high-return one: improving the quality of secondary science teaching is the single most effective upstream move to widen the pool of students ready and willing to pursue STEM at university (UNESCO, 2021; UNDP, 2020).

ACKNOWLEDGMENT

I, Lay Sam Ean, would like to thank the editor and the anonymous reviewers of the International Research-Based Education Journal for their constructive feedback, which improved the quality of this article.

Funding. This research received no external funding.

Conflict of Interest. The author declares no conflict of interest.

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