Aligning Education with Industrial Development: A Study on Ethiopia's Education Sector and its Integration with Economic Clusters

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Abstract: *This study investigates how Ethiopia's rapidly expanding education system can more effectively support industrial development in the context of a knowledge-based economy. The research focuses on educational institutions (ISCED 1-8) situated near three agro-industrial parks (Bole-Lemi, Yirgalem, Bulbula) and employs a mixed-methods approach, including document analysis, business case studies, two stakeholder surveys (leaders: n=64; teachers: n=112), and focus group interviews with over 20 policymakers, educators, students, and industry representatives. Stakeholders reported strong institutional climate, reputation, and several transversal competencies, with many institutions fostering an innovation-supportive culture. Nevertheless, respondents identified weak, predominantly recruitment-oriented school-industry relations, limited work-based learning, and significant gaps in foreign language, STEM/STEAM, and digital competencies. These misalignments are exacerbated by limited resources (equipment, connectivity), restricted local curriculum autonomy, and accountability systems that infrequently incorporate graduate outcomes or systematic employer feedback. The findings suggest the need for cluster-level coordination mechanisms to facilitate ongoing collaboration between education providers and industry, co-design of modular curricula with industry partners, expansion of dual/internship pathways, investment in teacher professional development, and enhancement of digital infrastructure at the institutional level. These measures are intended to increase the absorptive capacity and relevance of education in Ethiopia's emerging industrial corridors.*

Keywords: Knowledge-Based Economy, Educational Transformation, Industry-Education Collaboration, Ethiopia

1 Economy - Society - Education in Ethiopia

Education is one of the most effective tools in a nation's economic, social, cultural and technological development [1-3]. Cognizant of this, the Ethiopian government has embarked on a massive expansion of the system at all levels: Kindergarten, Primary, Secondary and Higher education [4-5]. A tremendous achievement was made in ensuring access to education for its citizens, though there is a long way to go in realizing quality and relevance [6]. The education system plays a paramount role in equipping students with the required knowledge, skills, and attitudes to function as productive citizens. There is a shift from an industrial economy to a knowledge-based economy in the global world [7]. The knowledge-intensive economy requires companies, regions and countries to become more dependent on access to new technologies, knowledge and skills [8]. Furthermore, as Sawyer [7] explains, the knowledge economy is driven by the creation of new knowledge – prototypically, technological innovation, but also the creation of new procedures and new organizational forms. Hence, Creativity and ideas are the heart of today's economy [7], and educators' main task is to prepare learners to be creatively involved in an innovative economy [8]. Given this, the education system should strengthen its linkage with the industries.

This study examines the critical role of education in Ethiopia's socio-economic development, with a particular focus on how educational initiatives can be aligned with the demands of a knowledge-based economy. The research aims to explore the determinants of the effectiveness of Ethiopian education, its strengths and weaknesses, opportunities for collaboration between educational institutions and industry, and innovative educational practices.

1.1 The crucial role of education-industry interactions

Ethiopia's education and training policy promotes practice-based learning and closer alignment with industry [9]. However, empirical studies find limited employer participation in curriculum development, skills assessment, and workplace learning. In our fieldwork, business representatives also noted that entry-level employees often lack practical experience and transferable 21st-century competencies [10-11]. Education providers report weak incentives and few channels for systematic collaboration. Strengthening education-industry interaction requires more than individual partnerships, such as internships. It also needs governance arrangements, that make collaboration routine, mutually beneficial and measurable [12-17].

1.2 Accelerating Economic Transformation through Agro-Industrial Parks in Ethiopia

The correlation between economic and social development and industrial sector growth is a global phenomenon, with most nations requiring a solid industrial base to achieve significant development milestones. Ethiopia, a country on the cusp of major transformation, has experienced remarkable economic growth, with an estimated 8.1% growth in FY2023/24 [18]. For this growth to catalyze structural transformation, a strategic shift towards sectors with higher productivity, especially manufacturing, is imperative. Predominantly agrarian, Ethiopia's economy supports 85% of its population and contributes 46% to the nation's GDP [19]. Despite advantageous conditions like favorable climate and abundant arable land, a significant challenge is the lack of integration of smallholder farmers into commercial value chains. This scenario is marked by suboptimal input quality and inefficient collection methods, hindering the agricultural sector's ability to spur agro-industrial development and bolster economic growth. The agro-industrial sector, accounting for just 5% of Ethiopia's GDP, sees the food and beverage sub-sector comprising approximately half of the manufacturing sector's output, making it the most significant contributor to manufactured goods. [20] Notably, Ethiopia's agro-exports are primarily raw and unprocessed, contrasting with the global trend, where processed food exports grow annually at about 10%. [21] This discrepancy underscores significant constraints in agro-industrial development, such as inadequate infrastructure and weak agricultural-industrial linkages. Challenges such as deficient infrastructure for supply chains, limited farmer knowledge of best practices, and intermediary exploitation exacerbate inefficiencies, leading to waste and inflated costs. Integrated Agro-Industrial Parks (IAIPs) have been introduced as a strategic solution [22-23]. These parks are designed to enhance the integration of actors within the agricultural value chain [24-25]. With the ambition of positioning Ethiopia as a manufacturing leader in Africa by 2025, the government is prioritizing the development of IAIPs as a vehicle for structural transformation. Ethiopia's focus on IAIPs represents a strategic move to capitalize on agro-industry potential at this critical point in its economic journey. By tackling existing challenges and fostering improved integration within the agricultural value chain, the country aims to expedite its economic development, achieve its industrialization objectives, and establish itself as a formidable force in the global manufacturing landscape. The successful implementation of these IAIPs is expected to be instrumental in achieving the goals outlined in Ethiopia's Vision 2025.

1.3 Human Resource Development for Economic Growth

This research formed part of a joint Hungarian-Ethiopian program examining education providers near three industrial park sites: Bole-Lemi, Yirgalem, and Bulbula. The study addressed three primary questions: How do stakeholders assess educational effectiveness and organizational operation? What is the strength and nature of external networks, particularly with employers? Which pedagogical, organizational, and technological innovations indicate absorptive capacity and

resilience? The main objective was to identify actionable pathways for aligning human resource development with industrial priorities at the cluster level.

2 The focal point of this research

The concepts of the learning organization and institutional innovation are employed as analytical frameworks to assess readiness for industrial development. Innovation activities, particularly in curricular and STEAM practices [26-28], reflect knowledge development, willingness to experiment, and effective resource utilization [29-31]. The diversity of partners engaged in innovation further demonstrates networking capacity and the extent to which labor-market signals are integrated into educational practice [32-35].

2.1 Research methods and respondents

The empirical study adopted a mixed-methods approach. Initially, national strategies and business cases relevant to industrial park development were reviewed. Subsequently, new primary data were collected through two structured questionnaires and focus group interviews, conducted both on-site (June-July 2022) and online.

Questionnaire surveys were administered to educational institutions across ISCED levels 1-8. Leaders (n=64) responded at the organizational level, while teachers and professors (n=112) responded at the individual level. The instruments addressed perceived effectiveness, organizational conditions, external relations—including employers—and innovation activity. Leaders' items focused on organizational processes, whereas teachers' items addressed classroom practice. Focus groups included over 20 stakeholders, such as policymakers, school leaders, teachers, students, and business managers. These discussions facilitated interpretation and triangulation of survey findings. Responses were anonymous and voluntary. The sample is not statistically representative and should be interpreted as stakeholder perceptions from institutions willing to participate.

2.2 Results

2.2.1 Comprehensive look of the surveyed institutions

Regarding school effectiveness and performance, stakeholders identified several positive aspects; for example, students' competencies in several fields, institutional climate, reputation of the institutions, professional development of staff and dropout prevention were rated highly [36]. However, there were significant differences between school stakeholders and business leaders in some related aspects, such as

developing students' competencies. School leaders and teachers rated their students as successful in various areas, especially in mother tongue communication skills, social and civic competencies, learning to learn, cultural awareness and expression, sports and healthy lifestyles. The least practical student competencies were the communication in foreign languages, mathematics, science, and technology (Table 1). Almost all responding business leaders stressed that employees have serious skill gaps and highlighted the importance of developing 21st-century skills (soft skills) [37-39].

Table 1

Perceived performance of students' learning in the organization compared to similar institutions*

Competence Areas	Leader survey			Teacher survey		
	Mean	SD	N	Mean	SD	N
Communication in the mother tongue	2.55	0.60	58	2.63	0.61	89
Communication in foreign languages	1.45	0.57	58	1.54	0.69	93
Mathematical, science, technology	1.75	0.58	57	1.57	0.58	89
Digital skills	1.77	0.60	57	1.75	0.60	87
Learning to learn	1.88	0.57	57	2.02	0.65	91
Social and civic	2.07	0.68	57	2.08	0.61	89
Initiative and entrepreneurship	1.86	0.72	57	1.73	0.63	90
Cultural awareness and expression	2.04	0.73	57	2.1	0.70	90
Sports and a healthy lifestyle	2.14	0.74	57	2.1	0.58	91

* Question: "Please indicate how your students have performed in the following areas of competence compared to students in schools/departments in a similar situation in the last five years." (Responses: 1: They were less effective; 2: Their effectiveness was average; 3: They were noticeably more effective). The first column lists the questionnaire items' abbreviations.

We identified several factors supporting the pedagogical work, the effectiveness, and the resilience of local schools, such as the appreciation of learning organization operation, the comprehensive practice of teachers' horizontal learning, staff's responsibility for the work done, the frequent presence of distributed leadership, the internal measurements, the value of innovation in teacher evaluation systems, and the relatively considerable overall autonomy of school leaders. These factors are significant features (basis) for future improvements. Regarding barriers, participants highlighted mainly macro-level conditions, such as weak financial resources and inadequate infrastructure (e.g., lack of teaching devices and digital tools, weak internet availability), leaders' insufficient influence on the curriculum

and the lack of teachers, and low digital skills. Besides this, according to the data collected, in teacher-evaluation systems, the workplace effectiveness of graduates and the cooperation with companies are not given sufficient emphasis [36].

Both groups were less optimistic about their relationship with the market, companies and firms, i.e. students' future workplaces (Table 2). In the correlation analysis of the question on the leadership questionnaire, the most substantial relationship was observed between partner satisfaction and relations with local communities (Spearman correlation: r=0562, p=0.000), highlighting the importance of relations with external partners.

Table 2
Estimation of the organization's performance based on leader and teacher databases*

Performance Areas	Leader survey			Teacher survey		
	Mean	SD	N	Mean	SD	N
Professional development	3.2	0.66	59	3.13	0.72	95
Satisfaction of stakeholders	3.02	0.73	59	2.83	0.83	93
Relation to local communities	3.14	0.75	59	2.69	0.89	94
Relation to companies, workplaces	2.75	0.92	59	2.65	0.95	94
School's good reputation and affectation	3.19	0.93	59	3.02	0.83	93
Organizational climate	3.24	0.68	59	3.07	0.79	95

* Question: "Please indicate how you rate your school/department's performance along the following dimensions." Responses: 1: very poor; 2: relatively weak; 3: good; 4: very good). The first column contains the selected and abbreviated list of question block items.

Leaders and teachers also reported that external relations have largely stagnated or deteriorated over the past five years (leaders: 58% and teachers: 86%). Focus groups confirmed that partnerships exist in some cases, especially in higher education and TVET, but they are seldom institutionalized and rarely extend beyond short-term hiring needs.

2.2.2 Innovative practices in education

Most leaders reported an explicit intention to develop their institutions toward learning-organization characteristics, and survey responses suggest an innovation-friendly climate. On average, leaders estimated that about 39% of staff regularly seek new solutions, which is consistent with typical innovator/adopter proportions. Innovations were most frequently reported in ICT use and internal organizational operation; leaders also highlighted competence development, while teachers more

often mentioned strengthening relations with communities and civil partners (Table 3).

Table 3
Specific fields of new solutions tried in the last ten years*

Solutions	Leader survey			Teacher survey		
	Mean	SD	N	Mean	SD	N
More effective development of students' competencies and abilities	2.65	0.91	55	2.33	0.94	85
Use of ICT in education, training	2.64	0.96	56	2.46	0.99	84
Improving/developing internal operation of the organization	2.64	1.03	56	2.42	1.04	85
Tech and I.T. organizational operation and management	2.39	1.02	56	2.27	0.93	85
Strengthening relations with labor market partners	2.53	1.07	55	2.18	1.04	85
Strengthening external relations with partners	2.59	1.01	56	2.48	0.94	81

* Question: "In the last ten years, have you tried a new solution that has improved the effectiveness of one of the areas listed below?" (Responses: 1: No innovation at all; 2: There was innovation, but did not improve the effectiveness; 3: There was innovation, and it improved the area in a small amount; 4: There was innovation, and it improved the area in a high amount). The first column lists the questionnaire items' abbreviations.

Teachers were asked to evaluate the pedagogical methods, tools, and procedures they had used in recent years. According to our data, everyday pedagogical practice has shown a moderated presence of innovative solutions. Information processing techniques in pairs or small groups, including cooperative techniques and traditional assessment methods were popular among respondents but several other procedures were present in respondent teachers' practices. Of the teaching form items listed, the least frequent was cooperation and co-teaching with external partners and companies (e.g., outsourced training opportunities, guest teachers, dual training) (Table 4).

Table 4
Methods used in recent years*

Methods	Teacher survey		
	Mean	SD	N
Information processing in pairs and groups	2.55	0.85	82
Teaching subjects using I.T. tools and the Internet	2.34	0.99	86
Cooperative techniques	2.57	0.91	86
Extracurricular activities	2.45	0.93	85
Project Based Learning	2.41	0.96	83
Interdisciplinary connections	2.49	0.90	85
Out-of-school learning opportunities	2.31	1.08	85
Cooperation with companies	2.12	0.98	85
Traditional knowledge transfer	2.42	0.88	85
Traditional forms of assessment	2.66	0.87	85
Gamification	2.45	0.91	85

*Question: "Please indicate the extent to which the different learning organization methods have characterized your practice over the last few years." (Responses : 1: not typical; 2: rather not typical; 3: more typical; 4: not typical). The first column lists the questionnaire items' abbreviations.

Business leaders at focus group interviews stressed that freshman employees suffer from the lack of practical courses, general knowledge about the world of work, and preparation for real-life experiences, especially those who graduate from universities. Most agree that the current education system cannot prepare the workers of the future (particularly for Industry 4.0).

2.2.3 Implementation of specific innovations

To capture the substance of innovation beyond general attitudes, respondents were asked to describe one significant innovation implemented during the last ten years. Valid descriptions were provided by 21 leaders and 42 teachers, most often referring to pedagogical innovations; fewer cases concerned ICT, organizational mechanisms or explicit networking with industry. Slightly more than half of respondents reported that the selected innovation originated locally rather than being adopted as a ready-made program, suggesting the presence of internal problem-solving capacity. The innovations most frequently targeted classroom activities, extracurricular programs and talent development (Figure 1).

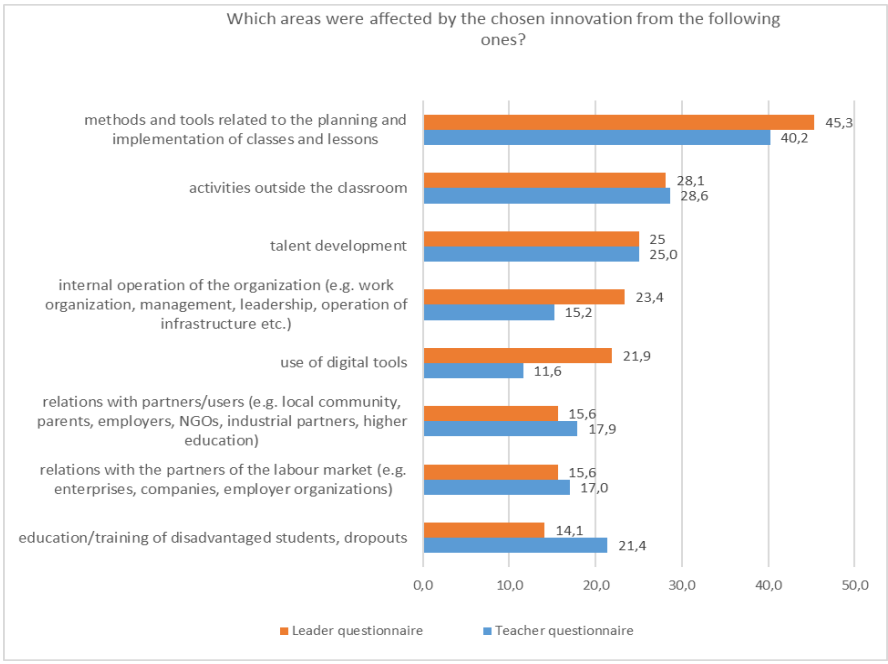

Figure 1
Concerned areas by selected innovations (%, N Leader=64, N Teacher=112, respondents could select more than one response option)

Reported pedagogical innovations most often targeted language-related competences (mother tongue and foreign languages), with STEM-related areas appearing less frequently, despite employers' emphasis on these competences (Figure 2). Innovations primarily affected learners aged 15-25, reflecting the dominance of secondary and higher education respondents.

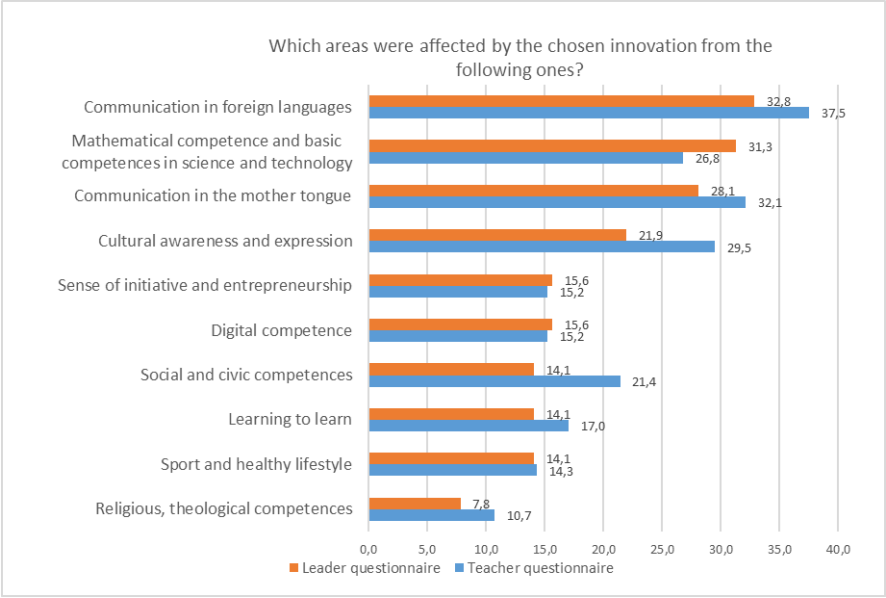

Figure 2
Supporting factors contributing to innovation (%, N_Leader=64 and N_Teacher=63)

The dominant trigger for the selected innovations was problem pressure (changes in student composition, learning difficulties, motivation problems, declining outcomes). External drivers - regulation changes and participation in development programs - were also relevant. Respondents generally perceived positive effects of innovations on student performance and organizational success (Table 5).

Table 5
Implementation and effectiveness of the selected innovation*

Since the innovation the…	**Leader survey**			**Teacher survey**		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**
organization became much more successful	2.84	0.91	44	2.73	0.95	64
measurable student performance has improved	2.86	0.91	44	2.91	1.02	64
non-participating teachers use more methods	2.59	1.12	44	2.70	1.02	64
organization's local community ties improved	2.55	0.90	44	2.36	1.05	64

* Question: In the following, you can read statements about the implementation and effectiveness of the innovation examined here. Please indicate how much you agree with these statements. (Responses: 1: do not agree at all, 2: I do not agree, 3: I somewhat agree, 4: I agree). The first column contains the selected and abbreviated list of question block items.

Despite favorable attitudes toward learning-organization concepts, indicators of routine practice suggest that many institutions have not yet translated these ideas into systematic day-to-day processes. Focus group participants pointed to weak practical guidance and standards, and to workload-related constraints (including burnout risks) as barriers to sustained organizational learning.

2.2.4 Organizations form a development perspective

To synthesize organizational enabling conditions, we conducted a principal component analysis of leaders' items related to factors supporting teaching and learning (KMO=0.805; Bartlett's test, $p<0.001$). Three components were retained, explaining 62.5% of the variance. The components describe:

(1) Climate and culture-oriented institutions

(2) Innovation and development-oriented institutions

(3) Cooperation and collaboration-oriented institutions (Table 6)

These profiles offer a parsimonious framework for targeting capacity-building interventions.

Cluster analysis (N=56) identified 44.6% innovation- and development-oriented, 46.4% cooperation- and collaboration-oriented, and 8.9% climate- and culture-oriented institutions.

Table 6.

Types of institutions according to factors supporting the learning-teaching process (leader questionnaire, rotated matrix)*

Factors	Principal Components		
	Organizational climate & culture- oriented	**Innovation & development-oriented**	**Cooperation & collaboration-oriented**
Students value and actively engage in their learning.	0.75	0.35	0.09
Teachers and staff are responsible for their work and student results.	0.84	-0.08	0.13
Employees welcome feedback and criticism for improvement.	0.52	0.44	-0.09
Leadership inspires innovative learning organization solutions.	0.70	0.06	0.43
Leadership's primary goal is quality learning environments.	0.68	0.18	0.29
The institution's leadership operates as a team.	0.78	0.15	0.10
We conduct internal assessments to evaluate teaching effectiveness.	0.33	0.57	0.45
Innovations, problem-solving, are present in the organization.	0.11	0.84	0.03

Learning from each other is part of the operation of the institution	0.32	0.69	0.25
The broader social environment integrates with learning.	0.09	0.66	0.39
The market environment integrates with learning.	-0.05	0.55	0.43
The institution cooperates with the broader social environment	0.13	0.49	0.53
The institution collaborates with businesses and market players.	0.23	0.47	0.60
The staff take part in the professional activity decisions.	0.16	0.27	0.77
Institution's goals and values are determined by staff consensus.	0.20	0.04	0.78

* The first column lists the questionnaire items' abbreviations.

Using innovation indicators, 70.3% of leader respondents and 59.8% of teachers were classified as operating in innovation-creating contexts. Innovation-creating institutions were more often large primary/secondary providers, and they were disproportionately found in the cooperation- and collaboration-oriented and the innovation- and development-oriented profiles. Importantly, respondents who reported creating innovation reported fewer partnership losses during pandemic closures, suggesting greater resilience. However, even these institutions frequently reported material constraints (digital tools, connectivity) and limited external support, indicating that innovation capacity is present but fragile and contingent on systemic enabling conditions.

3 Conclusions

This study shows that education providers around Ethiopia’s industrial parks, possess meaningful organizational strengths (positive institutional climate, peer learning practices and an openness to innovation), yet their connection to employers remains weak and largely transactional.

This contributes to persistent gaps in STEM/STEAM, digital and foreign-language competencies and limits the system’s ability to support industrial upgrading. Strengthening alignment, therefore, requires coordinated action at the cluster level, coupling capacity development inside institutions with incentives and infrastructure that make industry collaboration routine and valued.

Practical recommendations

Establish cluster-level coordination units (e.g., an education-industry liaison office linked to industrial park management) to broker partnerships, maintain partner databases and convene regular skills councils.

Co-design modular curricula with employers for priority occupations in agro-processing and manufacturing, including explicit competence frameworks for STEM/STEAM, digital skills and workplace soft skills.

Scale work-based learning through structured internships, dual training pilots and industry guest teaching; align assessment with workplace tasks and introduce employer feedback into course evaluation.

Invest in teacher professional development and short industry placements for TVET and higher education instructors; use incentives to retain scarce STEM and ICT teachers.

Introduce simple accountability metrics (graduate destination tracking, employer satisfaction, internship completion) and integrate them into institutional and teacher evaluation, alongside adequate resourcing for digital tools and connectivity.

Limitations and future research

Findings should be interpreted in the scope of three limitations. First, the surveys relied on voluntary participation and self-reported perceptions; results may therefore be affected by self-selection and social desirability bias. Second, the business perspective is based primarily on focus group evidence rather than a large-employer survey, and objective labor-market indicators (e.g., graduate earnings, employment duration, productivity measures) were not available. Third, the design is cross-sectional; causal claims about the effects of specific innovations cannot be made.

Future research should combine longitudinal graduate tracking with larger employer samples and quasi-experimental evaluation of work-based learning and curriculum co-design interventions.

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