Tertiary Education, Equity, and AI Engagement in Arab Countries

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Leila El Sayed

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About the Author

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Executive Summary

This report analyzes access, equity, and AI engagement in higher education across 20 Arab countries. It examines who attends university, how students complete their studies, and how universities apply AI in programs, courses, research, and labs. It also groups countries with similar patterns and offers policy recommendations for each group.

Access to tertiary education in the region is highly unequal. Wealth and location strongly determine who can attend university. Urban and richer students have more opportunities. In most countries, women attend more than men, but in some of the poorest countries, men have higher enrollment. Graduation and completion rates differ greatly: some countries support students effectively until graduation, while others have high dropout rates. Employment outcomes indicate that holding a degree does not always ensure stable employment, and women often face more barriers entering the workforce.

The analysis also shows that AI adoption in universities is uneven, with wealthier countries usually having higher AI integration in university programs, courses, research, and labs. Additionally, private universities often lead in AI programs, while public universities sometimes excel in research output or lab infrastructure. Higher AI engagement also correlates with higher tuition fees.

The clustering analysis identifies three groups of countries:

- **Cluster 1:** Algeria, Egypt, Jordan, Lebanon, Oman, Palestine, Tunisia. These countries show medium access and graduation, significant wealth and gender gaps, high Not in Education, Employment, or Training (NEET) rates, and graduate unemployment.
- **Cluster 2:** Bahrain, Qatar, Saudi Arabia, UAE. These countries have high access and strong AI engagement, but income and location inequalities persist.
- **Cluster 3:** Mauritania, Morocco, Sudan. This group faces the greatest structural challenges, marked by low access, weak AI engagement, and the highest NEET and graduate unemployment. Equity gaps are smaller but reflecting low participation rates.

Policy responses must be tailored to country conditions. In wealthier countries, focus can be on supporting underrepresented groups and linking education to labor market needs. In lower-income countries, measures such as online programs, curriculum improvements, and industry partnerships are recommended. Across all countries, universities can improve employability by updating courses, offering internships, and collaborating with employers.

In conclusion, AI provides new opportunities in the Arab region, but access is uneven. Targeted policies and initiatives are necessary to ensure that all students, regardless of wealth, gender, or location, benefit from higher education and emerging technologies.

Contents

Introduction

Equity and inclusion in education have become key concerns for governments and policymakers as global challenges such as migration, refugee crises, rising income inequalities and climate change are expected to further affect inequality in education (OECD, 2023). The United Nations has highlighted higher education as a priority for its 2030 Sustainable Development Goals (SDGs), recognizing its major role in economic development. However, the right to higher education is still not widely realized, with evidence showing that participation inequalities exist in around 90% of countries worldwide (Atherton, Dumangane, & Whitty, 2016).

At the same time, Artificial intelligence (AI) and other tech developments are changing the way we learn, teach, and engage with knowledge and skills, but it is doing so unequally (UNESCO, 2021). While one-third of the global population remains offline, access to the most advanced AI tools is reserved for those with resources, infrastructure, and linguistic advantage (UNESCO, 2021). This raises the question of whether AI advancement in education is increasing existing disparities in higher education or reducing them.

Countries across the Arab world differ greatly in economic development, institutional capacity, and technological readiness. According to UNESCO's World Bank Inequality Database on Education (WIDE, https://www.education-inequalities.org/), who gets into university often depends on wealth, gender, location, parental education levels, and other factors. This report examines how tertiary education systems across Arab countries are addressing access, equity, and outcomes, and how AI is reshaping these dynamics.

Objectives

The main goal of this report is to understand how higher education systems in the region support fair access, prepare students for the workforce, and respond to the emerging demands of the Fourth Knowledge Revolution.

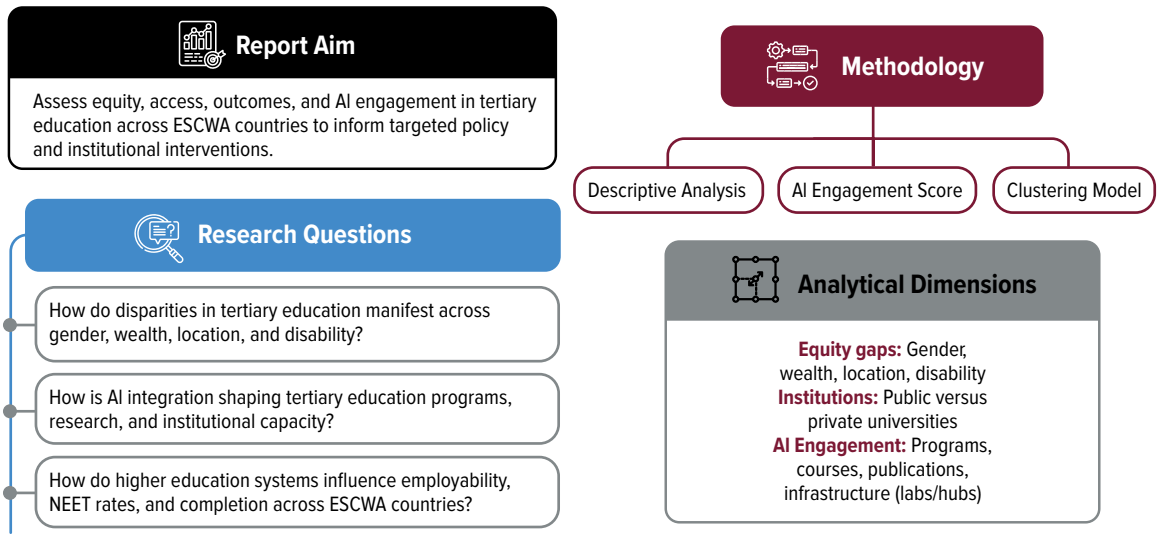
Specifically, the report seeks to:

- Evaluate tertiary education access, equity, and outcomes across countries, gender, wealth groups, and geographic areas;
- Assess AI engagement in higher education, including program offerings, research, and institutional initiatives;
- Compare public and private institutions;
- Group countries using a clustering model to identify shared patterns in equity, AI engagement, and outcomes; and
- Outline policy recommendations for each cluster to enhance inclusion and competitiveness.

Methodology

This report uses descriptive statistics, a custom AI Engagement Score, and K-means clustering to examine differences among countries and types of institutions. It also recommends policies or university initiatives that could help make higher education more inclusive and better aligned with the labor market. Figure 1 summarizes the report's aim, research questions, methodology, and main dimensions.

Figure 1. Report's conceptual framework



Data Sources

The analysis covers 20 Arab countries: Algeria, Bahrain, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen. Publicly available datasets, including the UNESCO Institute for Statistics (UIS), the World Inequality Database on Education (WIDE), and the World Bank Data 360 database, were used. Tuition fees were compiled from official university websites and other publicly available online sources. AI engagement data were collected manually from university websites and scored by the author (see Annex A for methodology). Details of the datasets and indicators used in the analysis are included in Annexes A–C.

Analytical Approach

The analytical approach combines descriptive statistics, the AI Engagement Score, and K-Means clustering to examine multidimensional patterns across countries. Descriptive statistics reveal individual indicators, the AI Engagement Score captures institutional engagement with AI, and clustering identifies groups of countries with similar profiles.

Based on the research questions in Figure 1, the study hypothesizes that:

- High- and middle-income Arab countries demonstrate higher levels of AI integration, whereas low-income countries face significant obstacles, including financial limitations, infrastructure challenges, and unclear policy frameworks (Al-Zahrani & Alasmari, 2025).

- Students from wealthier households or urban areas have higher tertiary education attendance
- Private universities exhibit higher AI engagement than public institutions
- Higher AI integration is associated with better employability or completion outcomes

Data processing, analysis, and visualization were performed using Python (Jupyter Notebook), with key libraries including pandas and NumPy for data handling, scikit-learn for regression analysis, and matplotlib and seaborn for plotting.

AI Engagement Score Construction

To assess the level of AI engagement across higher education institutions, an AI Engagement Score was constructed based on four dimensions: AI programs, AI courses, AI publications, and AI labs or hubs. The four dimensions were selected to reflect both what universities teach and the research resources they have. Each dimension was scored on a scale of 0-3, reflecting the depth and scope of institutional engagement. The total score (0-12) was then used as the AI Engagement Score in the analysis. Details on how the score was calculated, including the thresholds and keywords used for different languages, can be found in Annex A.

Clustering Methodology

A k-means clustering model is applied to identify groups of countries based on their similarity, comparable to the approach used by McIntyre (2023) in examining online learning access across various nations. K-means clustering segments countries into groups by minimizing the distance between each country and its cluster center, ensuring that members of a cluster are more similar to each other than those in other clusters. Unlike descriptive statistics that show individual indicators, this approach reveals multidimensional patterns, highlighting how access, equity, and AI engagement interact across countries.

Indicators were standardized to ensure comparability across countries, and clustering was applied to similar group systems. This approach makes it possible to capture multidimensional patterns across the different indicators.

The model considers the following dimensions:

- Tertiary education access: Attendance rate, graduation rate, ICT and STEM participation;
- Tertiary education outcomes: NEET rate, graduate unemployment;
- AI engagement: Country-level total AI Engagement Score; and
- Equity gaps: Gender, wealth, location

Note that limitations in this model include sensitivity to missing data, standardization methods, and country-specific factors (e.g., policy changes, conflict) that may not be fully captured.

An Overview of Access, Equity, and Outcomes of Tertiary Education in the Arab region

Access and Equity in Tertiary Education

In many developing countries, school attendance is still uneven. Children from poor families and those living in rural areas are the most likely to miss school or attend irregularly, even though overall enrollment rates are improving (UNESCO, 2020). This suggests that progress cannot only be judged by the number of students in school but must also be assessed in terms of who gains access and under what conditions (UNESCO, 2020).

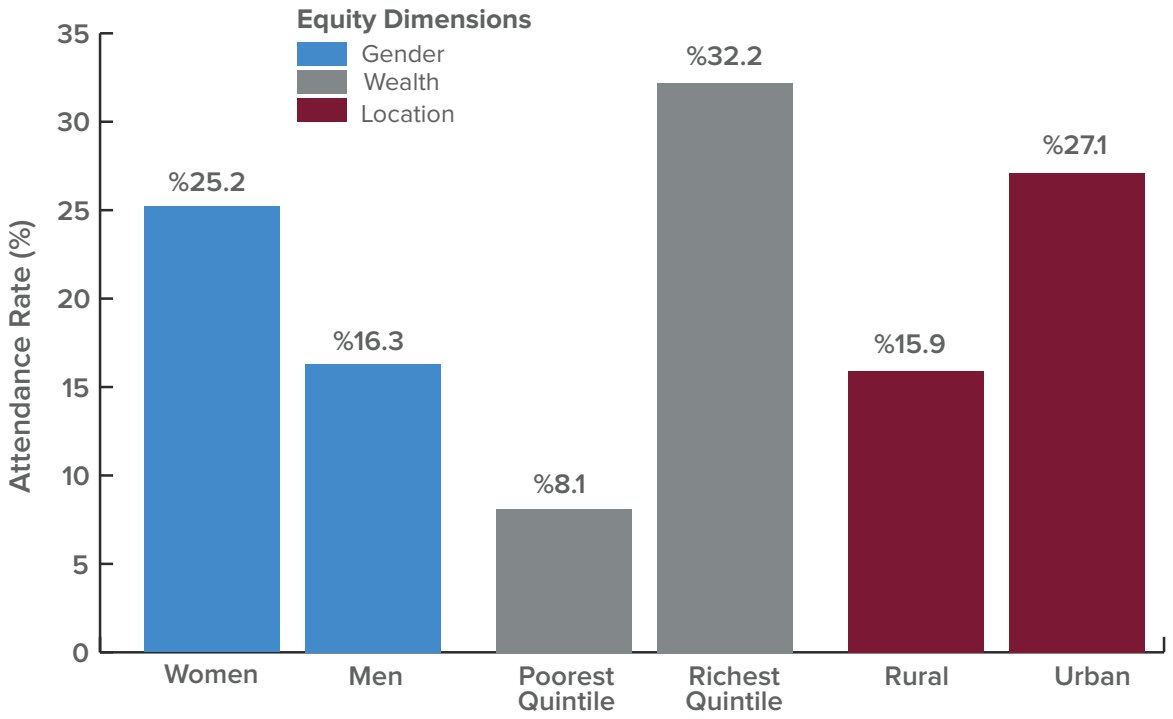
Higher education shows a similar pattern. Participation is not simply about enrollment numbers but is tied to wider social and economic divides. Gender, household income, and geographical location all play a role, and these factors often overlap in ways that create barriers for certain groups (Marginson, 2016). Looking only at total figures hides these differences, and risks giving a misleading impression of equal access.

Access by Equity Dimensions

Drawing on data from WIDE, this section explores disparities in tertiary education attendance across gender, wealth, and location in Arab countries. Higher education attendance refers to the percentage of people aged 18-22 attending higher education institutions. On average, women have higher attendance rates (25.2%) than men (16.3%). However, higher participation among women disappears in low-income contexts such as Yemen and Mauritania. The largest gap is by wealth, with students from the poorest quintile averaging only 8.1% attendance compared with 32.2% among the richest, with Sudan and Yemen showing the widest disparities. Location adds another layer of inequality given that urban students (27.1%) are nearly twice as likely to attend as rural students (15.9%), with Sudan, Egypt, and Yemen recording the largest rural–urban divides. Students with disabilities average 21% attendance[1], close to the regional mean, though data are limited (**Data source:** WIDE, latest available year).

1 Data available for Algeria and Iraq only.

Figure 2. Higher education attendance rates within the different equity dimensions



Data source: WIDE, latest available year.

While attendance rates capture the overall level of participation, the Gender Parity Index (GPI) provides a relative measure comparing female to male enrollment. GPI values above 1 indicate higher female enrollment, while values below 1 indicate higher male enrollment. Across Arab countries, GPI values are above parity in most Gulf and North African countries, including Qatar (1.8), Kuwait (1.4), and Oman (1.4). On the other hand, poorer countries such as Djibouti (0.7), Mauritania (0.6), and Yemen (0.4) display low female participation. This broadly mirrors gender differences in attendance rates, where both indicate higher female participation in tertiary education except in poor countries where male participation is higher.

Data source: World Bank Data 360 database, latest available year.

Affordability in Tertiary Education

The proportion of students enrolled in public versus private universities varies widely across the Arab region. Private universities account for the majority of student enrollment in Palestine (82%), the UAE (70%), and Lebanon (64%), while public universities remain the primary option in Algeria (~100%), Mauritania (97%), Syria (97%), Egypt (92%), and Saudi Arabia (93%).

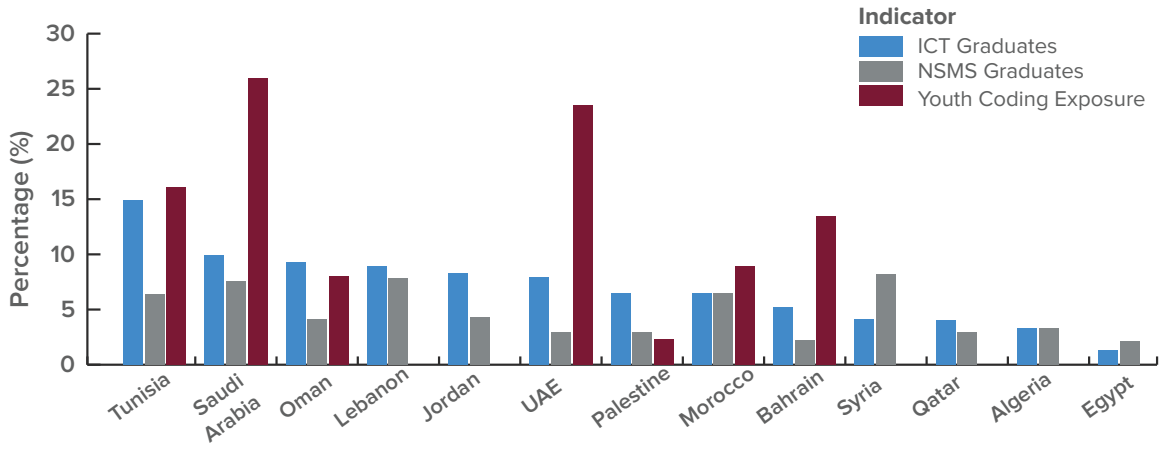
These patterns affect who can access higher education, since tuition and quality differ so sharply between institution type. Public universities generally charge modest fees, often between USD 300 and 1,000 annually, but private universities can cost much more. In Egypt, Kuwait, and Morocco, for example, private tuition is more than twenty times higher than that of public fees. Even in countries like Jordan, Lebanon, and Palestine, where the gap is smaller, it still reaches five to ten times the public rate. It seems that the growth of private higher education is creating more opportunities for enrollment, but it may also reinforce financial and social barriers where public options are limited (**Data sources:** UIS; tuition fees compiled from official university websites and other publicly available online sources, accessed August 2025).

STEM Readiness and Foundational Skills

Across Arab countries, the share of tertiary graduates in Information and Communication Technologies (ICT) and Natural Sciences, Mathematics, and Statistics (NSMS) is roughly similar to global graduation averages (ICT ~8%, NSMS ~7%), with some countries even exceeding them. For example, Tunisia (14.9%) and Saudi Arabia (9.9%) record relatively high shares of ICT graduates.

Interest in coding and programming is also rising among young people, especially in Gulf countries such as Saudi Arabia (26%) and the UAE (23.5%), where female participation is close to that of males. Still, the challenge is not only about how many students graduate, but whether their skills match the needs of the labor market and open STEM opportunities more widely (McGuinness, Pouliakas, & Redmond, 2018).

Figure 3. Tertiary ICT and NSMS graduates and youth coding experience by country

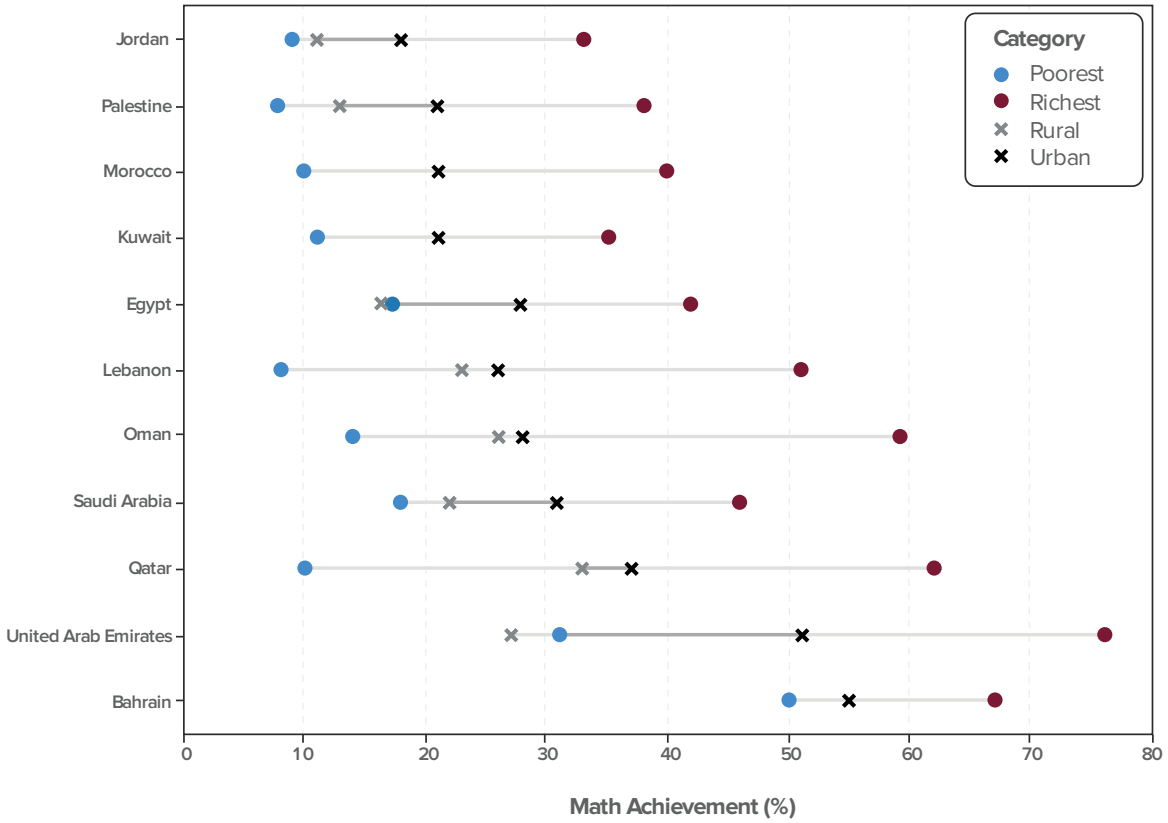


Data source: UIS, latest available year.

Mathematics achievement at the lower secondary level2 provides an early indication of preparedness for STEM fields in tertiary education. Performance at this stage already reflects broader patterns of inequality, where socioeconomic background and gender shape learning outcomes much as they do access to higher education. Top performers include Bahrain, the UAE, and Qatar, despite high wealth inequality in Qatar (62% for the richest quintile versus only 10% for the poorest one) and location inequality in the UAE (51% in urban versus 27% in rural populations). Overall, gender performance is mixed, with females outperforming males in some countries (e.g., Oman, Palestine, and Jordan) and males leading in others (e.g., Saudi Arabia, Kuwait and Morocco). These patterns point to the need for targeted policies that not only raise overall achievement but also specifically address wealth- and gender-based disparities (**Data sources:** UIS and WIDE, latest available year).

2 Calculated as the percentage of youth of upper secondary school age taking part in a mathematics assessment passing four levels of increasing difficulty.

Figure 4. Math achievement disparities across countries



Data source: WIDE, latest available year.

Educational and Labor Market Outcomes

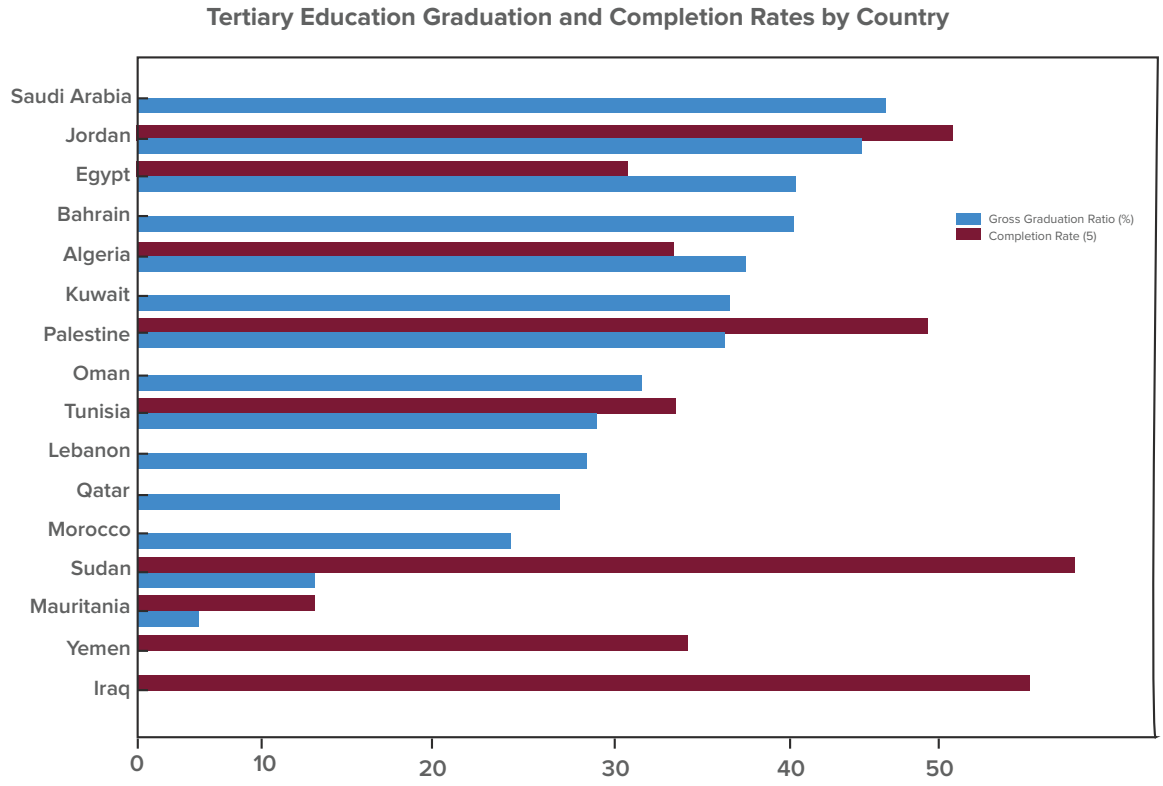
Educational attainment is only one side of the story; earning a degree does not always lead to stable or meaningful employment. Globally, graduates leave university with qualifications that do not fully align with the skills employers need, particularly in rapidly changing economies (McGuinness, Pouliakas, & Redmond, 2018). As a result, some countries continue to face high rates of graduate unemployment and higher education no longer guarantees an easier path into the workforce. Gender adds another layer of complexity, as women who succeed academically frequently encounter barriers that limit their participation in the workforce.

Graduation and Completion Rates

This section examines how students across Arab countries progress through and complete tertiary education. It does so by looking at two related but distinct indicators. The gross graduation ratio measures the number of students who finish first-degree programs (ISCED 6 and 7) each year, expressed as a share of the population at the typical graduation age (UIS). The completion rate, on the other hand, shows the percentage of young adults aged 25–29 or 30–34 who have completed at least two or four years of higher education (WIDE). While the graduation ratio captures outcomes within the education system at the point of graduation, the completion rate reflects longer-term attainment among the wider population.

When comparing countries, Saudi Arabia, Jordan, and Egypt show relatively high gross graduation ratios, reflecting strong enrollment and graduation among their youth, while Sudan and Mauritania rank at the bottom, showing very limited access to higher education. A different picture emerges when looking at completion rates: students who do enroll in Sudan, Yemen, and Iraq tend to finish at high rates, whereas Mauritania and Egypt face more challenges in retaining and graduating students. This contrast shows that high enrollment does not automatically lead to high completion, and conversely, limited access can correspond to strong persistence among those who are able to attend.

Figure 5. Gross graduation versus completion rates



Data sources: UIS and WIDE, latest available year.

Analyzing gender differences shows distinct patterns. In terms of gross graduation ratios, women are ahead of men in several countries, including Saudi Arabia (60.3% vs 28.7%) and Jordan (49.4% vs 36.7%). In countries where overall enrollment is very low, such as Sudan (11.5% female vs 9.8% male) and Mauritania (2.3% female vs 5.3% male), the gap is much smaller, and in some cases, men are slightly ahead.

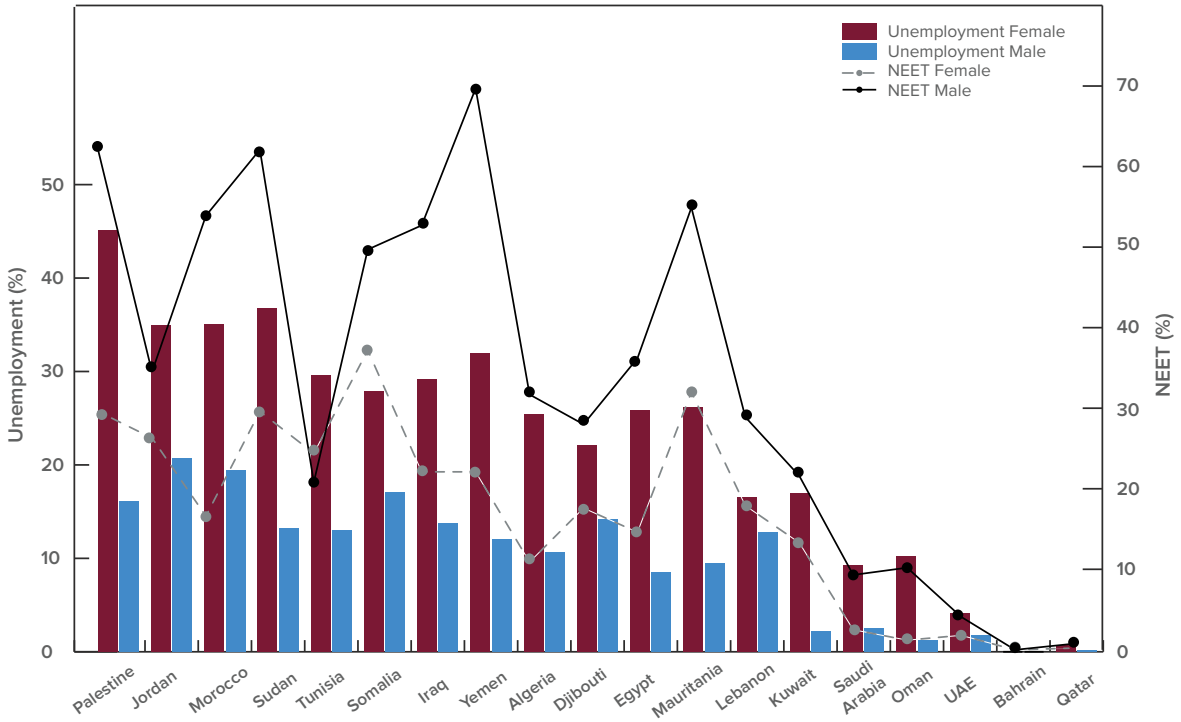
When looking at completion rates, however, women tend to outperform men across nearly all countries. In Sudan, for example, female completion reaches 66% compared with 41% for males, and in Palestine, 55% versus 40%. The numbers suggest that once women get into higher education, they tend to finish at higher rates than men, even in countries where their chances to enroll are more limited. In low-enrollment settings, men sometimes appear to have better access, but women often do better at completing once admitted (**Data sources:** UIS and WIDE, latest available year).

Unemployment with Advanced Education and NEET Rates

Looking at the unemployment rate among the population with advanced education,[3] Palestine stands out with the highest rate overall, particularly for females, suggesting challenges in integrating even highly educated graduates into the labor market. At the other end, Gulf countries record the lowest rates overall and show the largest gender disparities. This is the case particularly for Oman, Saudi Arabia, Qatar, and Kuwait. In some countries, unemployment among graduates is high for both genders, while in the Gulf, overall rates may appear low, but female unemployment remains higher than that of males (as shown in Figure 6).

Not in Education, Employment, or Training (NEET) rates vary considerably across countries and between genders. The highest rates are observed in Sudan, Yemen, Mauritania, Somalia, and Iraq, where young women are particularly affected. For instance, nearly 70% of females are NEET in Yemen compared with only 22% of males. In contrast, Gulf countries like the UAE and Saudi Arabia have much lower overall NEET rates, yet women remain more likely than men to be out of education or work.

Figure 6. Labor market outcome indicators by gender



Data source: World Bank Data 360 database, latest available year.

3 Unemployment among those with advanced education refers to the share of the labor force with short-cycle tertiary, bachelor's, master's, or doctoral education (ISCED 2011) who are unemployed.

AI Engagement Analysis

The results in Table 1 reveal that private universities score higher in Lebanon, Morocco, Kuwait, and Egypt, mainly due to more extensive programs and course offerings. Public universities perform better in Bahrain, Oman, Libya, and Palestine, often because of research output, publications, and AI labs. These results highlight the role of government-supported research infrastructure in shaping AI engagement.

Table 1. AI Engagement Score averages by country and institution type

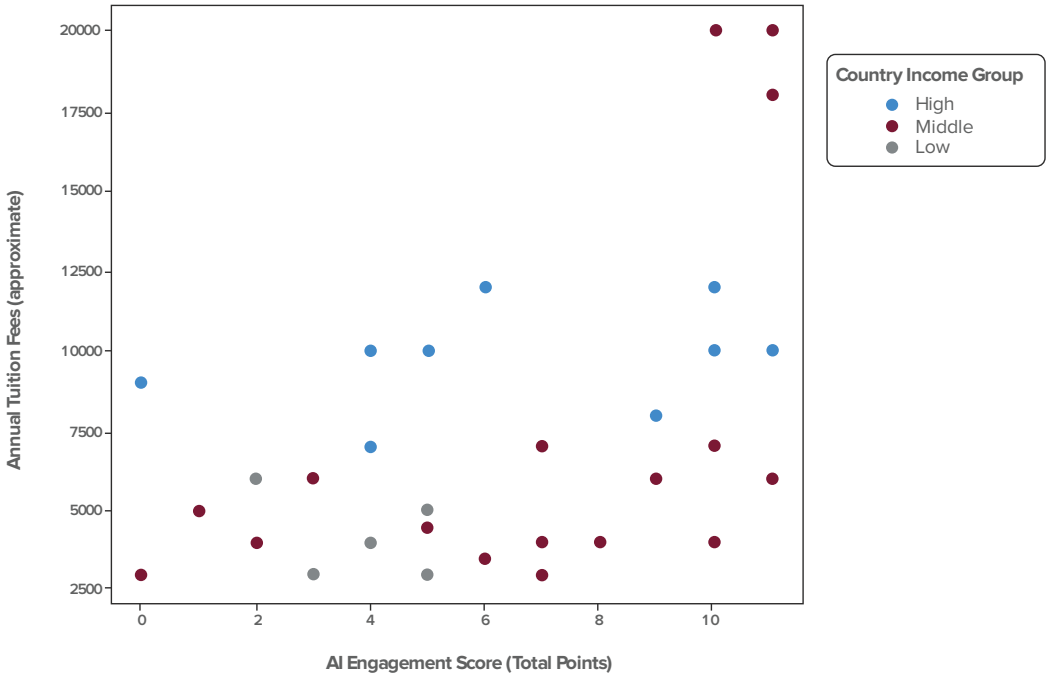
Country	Overall Average	Programs score	Courses score	Publications score	Labs/Hubs score	Public Universities	Private Universities
United Arab Emirates	10.4	2.6	2.8	2.4	2.6	12.0	10.0
Saudi Arabia	9.1	2.1	2.4	3.0	1.6	9.1	-
Qatar	9.0	2.0	1.0	3.0	3.0	9.0	-
Kuwait	9.0	1.5	2.5	2.5	2.5	8.0	10.0
Egypt	8.0	2.1	2.2	2.1	1.6	7.3	8.7
Jordan	8.0	2.0	1.8	2.8	1.5	9.0	7.0
Morocco	8.0	1.8	1.8	2.6	1.8	7.5	10.0
Tunisia	7.0	2.0	2.5	1.0	1.5	7.0	7.0
Lebanon	7.0	1.9	2.3	1.6	1.3	4.0	7.4
Palestine	7.0	2.0	2.3	1.0	1.8	10.0	6.0
Syria	6.3	2.0	2.0	1.0	1.3	6.3	-
Oman	6.0	1.3	1.0	2.0	1.7	10.0	4.0
Sudan	5.7	1.3	2.0	1.0	1.3	6.0	5.0
Algeria	5.1	1.2	1.4	1.7	0.8	5.1	-
Bahrain	5.0	1.2	1.2	1.4	1.2	10.0	3.8
Iraq	4.8	0.8	1.1	2.2	0.7	5.7	3.5
Yemen	4.5	1.0	1.5	1.5	0.5	4.5	-
Mauritania	3.0	1.0	1.0	1.0	0.0	3.0	-
Libya	0.7	0.0	0.0	0.7	0.0	1.0	0.0
Djibouti	0.0	0.0	0.0	0.0	0.0	0.0	-

Data source: Author's calculations based on primary data collection (see Annex A).

Economic context clearly plays a role: high-income countries tend to show smaller gaps in AI engagement between public and private universities, whereas middle-income countries show more pronounced differences. In low-income countries, where overall AI engagement is lowest, public and private institutions display minimal variation. The below scatter plot also indicates that high AI engagement in private universities is likely associated with higher tuition fees,[4] a trend particularly evident in middle-income countries.

4 Tuition fees are compiled from official university websites and other publicly available online sources (accessed August 2025).

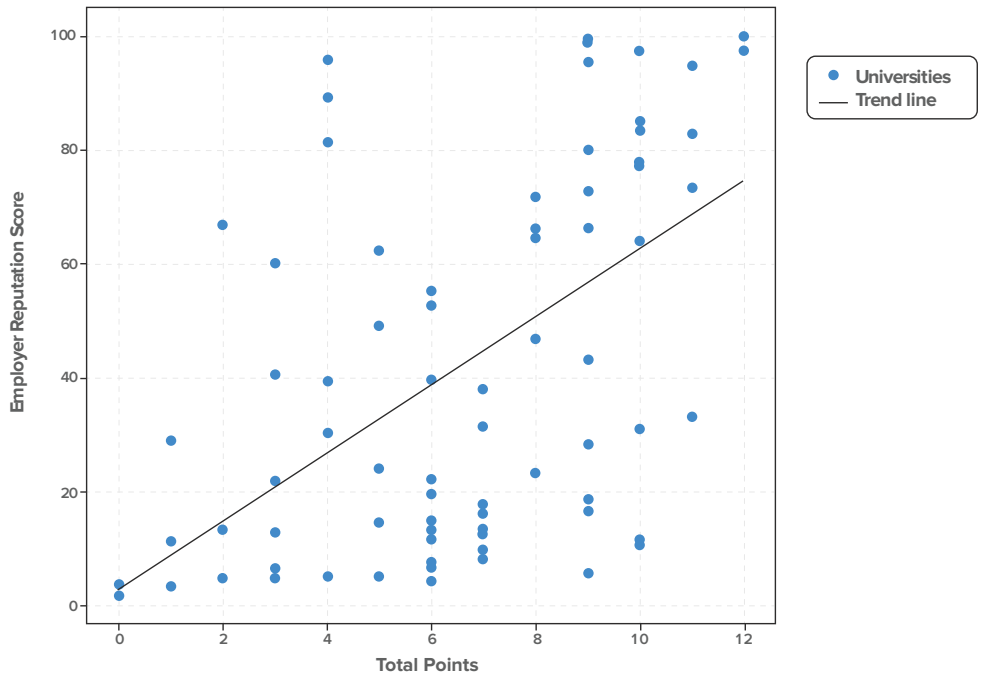
Figure 7. AI engagement versus tuition fees by country income group in private universities[5]



Data source: Author's calculations based on primary data collection (see Annex A).

Beyond tuition and institutional resources, AI engagement appears linked to employer reputation, a QS Arab Rankings metric based on employer surveys of graduate quality. Employer reputation shows a moderate positive correlation with total AI Engagement Scores (Pearson $r = 0.55$, Spearman $\rho = 0.57$, $p < 0.001$), suggesting that institutions recognized by employers tend to have stronger AI programs and resources.

Figure 8. Relationship between AI Engagement Score and employer reputation



Data source: Extracted from QS Arab Region University Rankings 2025
Note: Regression line fitted using NumPy polyfit and plotted with matplotlib.pyplot.

5 Each dot represents an estimated tuition fee at the university level, labelled by the corresponding country income group

Clustering Analysis

To understand how countries compare in tertiary education, AI engagement, and equity, a multidimensional approach is applied. The objective of this clustering analysis is to identify patterns in these dimensions to inform tailored policy interventions across country groups. Clustering groups countries that are similar in areas such as gender, wealth, and location gaps, as well as access to tertiary education and AI Engagement Scores.

Cluster Profiles

Three distinct clusters emerged, reflecting differing levels of tertiary access, outcomes, equity and AI engagement. Each cluster was examined to highlight key strengths and challenges, which form the basis for policy recommendations presented in Section 5.

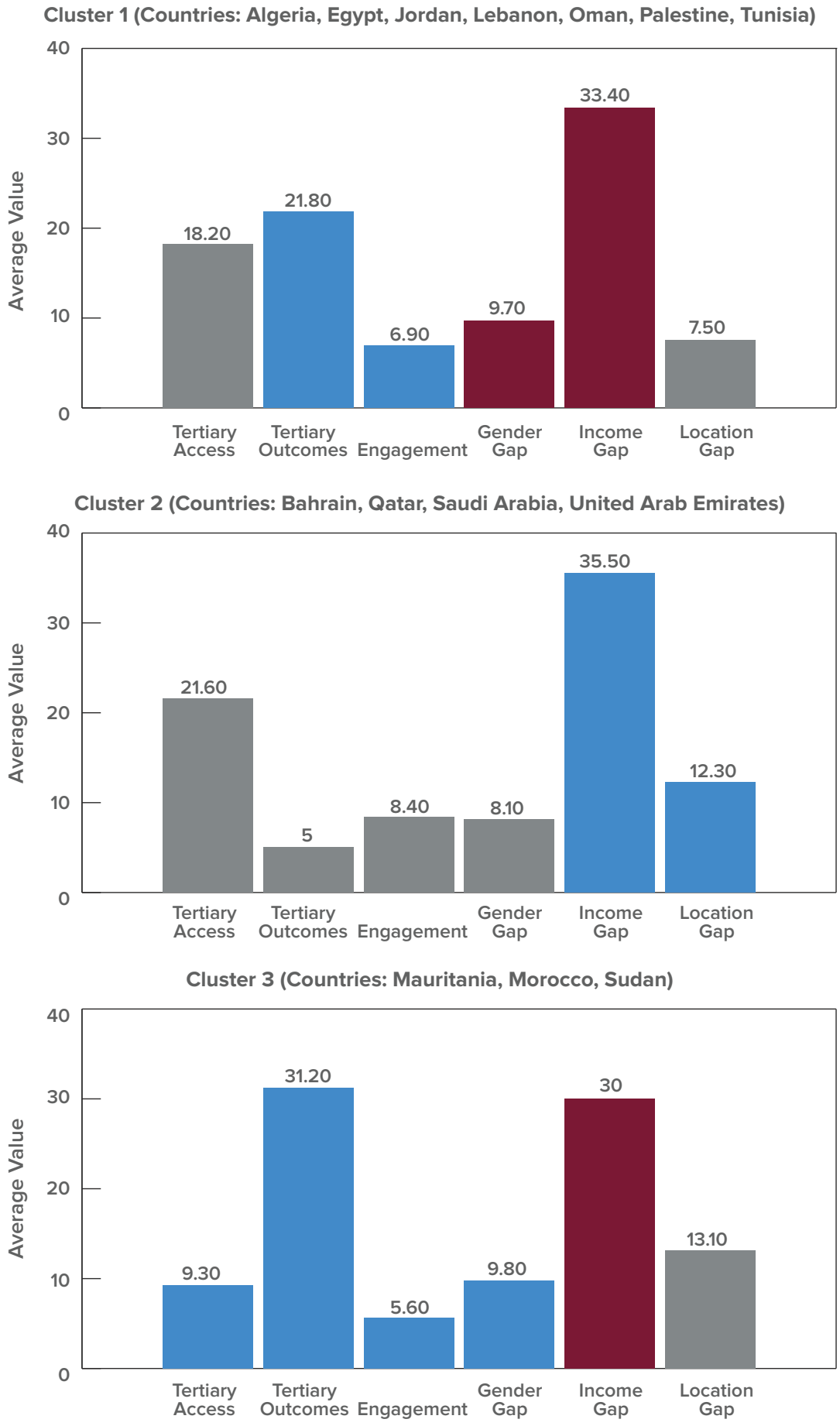
Cluster 1 (Algeria, Egypt, Jordan, Lebanon, Oman, Palestine, and Tunisia) shows solid but uneven performance with the biggest number of countries. Despite high attendance and graduation rates, NEET and graduate unemployment rates remain relatively high, reflecting difficulties in turning education into opportunities. Also, in this cluster, wealth and gender disparities remain notable.

Cluster 2 (Bahrain, Qatar, Saudi Arabia, and UAE) shows strong performance in tertiary education access and AI engagement. Tertiary access and outcome are good, and AI engagement is the highest among all clusters, but wealth and location disparities remain high. This shows persistent inequalities despite strong overall performance.

Cluster 3 (Mauritania, Morocco, and Sudan) faces the most significant challenges. NEET rates and graduate unemployment are the highest among all clusters. Attendance and graduation rates are also the lowest, and fewer students are enrolled in ICT and STEM programs. Some of the equity gaps are relatively small, which is expected given the overall low development indicators. AI engagement and private university enrollment are low, indicating a system that struggles to provide broad access and positive outcomes.

Detailed information on data preprocessing, indicator construction, missing value treatment, and the clustering algorithm is provided in Annex B

Figure 9. Arab country clusters by tertiary education, equity, and AI engagement



Implications for Policy

Policies can be implemented at the national or institutional level to address the challenges faced by tertiary students, whether related to equity, digital and AI skills, or employability. These policies will depend on the country and institutional context as well as on the key challenges faced. For example, Singapore's higher education system has pursued both technological advancement and equity through national initiatives. Programs such as the SkillsFuture initiative include subsidized courses for underrepresented groups (Ministry of Education, Singapore, 2015). Universities are encouraged to partner with industry to provide mentorship, internships, and real-world projects. These programs would also benefit from labor market information systems to support alignment between education programs and workforce needs. For lower-income countries, the African Virtual University (AVU) provides an example of how a network of universities can provide online and blended learning programs in STEM, ICT, and emerging technologies (World Bank, 2004). Designed for African countries, AVU focuses on low-cost, scalable solutions that extend access to students in rural areas, women, and other underserved populations (World Bank, 2004).

The descriptive and clustering analysis show different patterns in higher education across the countries. While some countries achieve high graduation and completion rates, others face high NEET or graduate unemployment rates. Strengthening weaker areas, supporting underrepresented groups, and investing in institutional capacity may help ensure that higher education contributes more effectively and equitably to labor market readiness.

Table 2. Targeted higher education interventions across country clusters

Cluster	Countries	Key Challenges	Policy Recommendations
1	Algeria, Egypt, Jordan, Lebanon, Oman, Palestine, Tunisia	o Relatively high NEET and graduate unemployment rates o Notable income disparities o Large gender gap	o Encourage private universities to collaborate with public institutions on research and development projects. With this, targeted academic support can be provided to disadvantaged students o Support the establishment of innovation hubs o Develop AI-focused programs and courses to build capacity in this field o Encourage female participation in STEM/ICT
2	Bahrain, Qatar, Saudi Arabia, UAE	o High income disparity o Moderate location gap o Persistent NEET in some countries	o Expand scholarships and financial aid targeted at low-income students o Revise university curricula to strengthen practical skills and competencies aligned with labor market needs o Establish distance learning and accessible options to reach rural and marginalized students
3	Mauritania, Morocco, Sudan	o Low tertiary and weak ICT/NSMS participation o Low AI engagement o Highest NEET rates o Large gender gap	o Strengthen partnerships between universities and the industry to expand work-integrated learning programs o Invest in faculty development to improve teaching and learning quality o Introduce foundation AI and digital literacy courses o Implement outreach initiatives within universities to support underrepresented groups (particularly women) o Expand online learning programs as a cost-effective way to increase access

Conclusion

The report shows large differences across countries in the Arab region regarding tertiary education access, equity, AI engagement, and labor market outcomes. Access to higher education often depends on wealth, and students in cities tend to have more advantages than those in rural areas. Female participation exceeds that of males in most countries, but not in the poorest ones. Overall, STEM and foundational skills among university students fare well on average across the region, but gaps between rich and poor students remain. Even when men and women enroll at similar rates, women often end up with worse outcomes. For example, they are more likely to be NEET or unemployed after graduation. Getting into university is not enough. Wealth, gender, and location gaps still need to be addressed.

AI use in universities is uneven across Arab countries. Richer countries usually include more AI courses, programs, research, and labs. Poorer countries often struggle with limited resources and weak infrastructure. Private universities mainly take the lead in innovative courses and programs, while public universities sometimes do better in research or AI labs. Higher AI engagement is also linked to higher tuition fees and stronger reputations with employers. This suggests that strategies to improve AI use should consider both resources and cost and be adapted to each institution. It is important to note that the analysis relies on available institutional data, so informal learning or short-term programs may not have been included.

When it comes to policy reform, grouping countries in the clustering model makes it easier to suggest policies that fit each group's situation. In wealthier countries, the focus could be on helping underrepresented groups and linking studies more to real jobs. In lower-income countries, low-cost solutions like online programs, curriculum updates, and industry partnerships can make a big difference. Universities can also improve employability by updating courses, offering internships, and working with employers.

Future research should look at how AI affects jobs and fairness over time and see which interventions work in different countries. Policies and programs need to keep changing with the labor market and technology. Universities and governments should stay flexible and learn from what works elsewhere to give all students a fair chance.

Annexes

The annexes provide a brief on how the analysis was carried out. Annex A sets out how universities were selected and how the AI Engagement Score was calculated. Annex B explains the clustering approach used to group countries by their education and labor market indicators. Finally, Annex C lists the data sources and indicators used in the report.

Annex A - AI Engagement Scoring Methodology

University Selection

Universities included in the analysis were selected from the QS Arab University Rankings to ensure coverage of leading institutions in the region. Selection criteria included:

- Coverage across Arab countries
- Representation of both public and private universities
- Availability of AI-related programs, courses, publications, and labs/hubs data
- Adequate student sample size for statistical validity

Sample Representativeness Check

To make sure the universities selected reflect the wider student population in each country, a set of criteria was applied. Countries were grouped by population size into small (under 5 million), medium (5–30 million), and large (over 30 million). For each group, the sample of universities needed to represent a minimum share of total tertiary enrollment is as follows: at least 30% for large countries, 20% for medium, and 15% for small. The share of students in private universities was also compared against national UIS data, and only samples with a gap of 10% or less were accepted, except in a few cases where private enrollment figures were limited. These steps help ensure that the analysis accurately reflects the distribution of students across institutions in each country.

AI Engagement Scoring

The following table outlines the scoring methodology per university across the dimensions of programs, courses, publications and labs/hubs. The total AI Engagement Score is then summed to give an overall score.

Dimension	Score: 3	Score: 2	Score: 1	Score: 0
Programs	More than two AI programs	One AI-focused program	AI mentioned in a concentration/module	No clear AI programs
Courses	More than 4 AI-related courses	2-3 AI-related courses	1 AI-related course	No AI courses visible
Publications*	300+ AI-tagged publications	75-299 publications	10-74 publications	<10 publications
Labs/Hubs	Dedicated AI lab/hub	Small lab or AI project inside larger lab	Tech lab with AI mention	No labs/hubs

with OpenAlex search over the last 10 years

To ensure that the scoring and search are not biased toward English-dominant universities, the search incorporates the keywords listed below in the three primary working and/or official languages of the region.

English	Arabic	French
Artificial Intelligence	الذكاء الاصطناعي	Intelligence artificielle
Machine Learning	تعلم الآلة	Apprentissage automatique
Data Science	علم البيانات	Science des données
Deep Learning	التعلم العميق	Apprentissage profond
Robotics	الروبوتات	Robotique
Natural Language Processing (NLP)	معالجة اللغة الطبيعية	Traitement automatique du langage naturel

Annex B - K-Means Clustering

Data preparation

The dataset used for the clustering model includes country-level indicators on tertiary education access, outcomes, equity gaps, and AI engagement (full list in Table 3). Countries with less than 60% coverage of key indicators were excluded to ensure the reliability of the analysis.[6] For the remaining 14 countries, missing values were estimated using the nearest (kNN) imputation approach with k = 5, which imputes missing entries based on the most similar countries.

Indicators where higher values reflect worse performance, such as NEET and graduate unemployment, were inverted so that higher values would consistently indicate better performance in the model. Equity related measures were also transformed into gap measures: male/female, richest/poorest, urban/rural.

Standardization

Because the indicators are measured in different units, they were standardized using the z-score normalization. This ensures comparability and that no single indicator dominates the clustering results.

Clustering

K-Means clustering was applied to a sub-group of countries that passed the minimal data coverage check. The clustering was applied based on their similarity of four constructed indices: (1) Tertiary Access, (2) Tertiary Outcomes, (3) AI Engagement, and (4) Equity Gaps. The algorithm was configured with three clusters (k=3) to balance interpretability and heterogeneity, 50 random initializations to avoid local optima, and a fixed random seed (42) to ensure stability and reproducibility of the results.

6 Countries excluded were Kuwait, Iraq, Libya, Syria, Yemen, and Djibouti.

Table 3 lists all indicators included in the clustering model, along with their variable names and units.

Table 3. Indicators Included in the K-Means Clustering Model

	Indicator Description	Variable Name	Unit/Type
1	School enrollment, tertiary (gross), gender parity index (GPI)	enrol_gpi	ratio
2	Higher education attendance	attend	%
3	Higher education attendance (female - male)	attend_fm	percentage points
4	Higher education attendance (richest - poorest)	attend_rp	percentage points
5	Higher education attendance (urban - rural)	attend_ur	percentage points
6	Percentage of graduates from tertiary education graduating from ICT programmes	grad_ict	%
7	Percentage of graduates from tertiary education graduating from ICT programmes (female - male)	grad_ict_fm	percentage points
8	Percentage of graduates from tertiary education graduating from NSMS programmes	grad_nsms	%
9	Percentage of graduates from tertiary education graduating from NSMS programmes (female - male)	grad_nsms_fm	percentage points
10	Proportion of youth and adults that programmed or coded in digital environments	coding_rate	%
11	Learning achievement in mathematics	math_achieve	score
12	Learning achievement in mathematics (female - male)	math_fm	score difference
13	Learning achievement in mathematics (richest - poorest)	math_rp	score difference
14	Learning achievement in mathematics (urban - rural)	math_ur	score difference
15	Gross graduation ratio (%)	grad_ratio	%
16	Gross graduation ratio (%) (female - male)	grad_ratio_fm	percentage points
17	Tertiary completion rate	completion	%
18	NEET	neet	%
19	NEET (female - male)	neet_fm	percentage points
20	Unemployment with advanced education	unemp_adv	%
21	Unemployment with advanced education (female - male)	unemp_adv_fm	percentage points
22	Country average points by total	avg_total_points	points

Annex C - Data Sources

The table below summarizes all available indicators used in the analysis, including their dimensions, number of countries with available data, and source. Only available indicators are listed.

Table 4. Indicators and data sources

Data Point	Dimension	Number of Countries	Source
Higher education attendance	Aggregate	7	WIDE
Higher education attendance	Gender	7	WIDE
Higher education attendance	Income group	6	WIDE
Higher education attendance	Rural/urban	7	WIDE
Higher education attendance	Disability	2	WIDE
Tertiary completion rate	Aggregate	8	WIDE
Tertiary completion rate	Gender	8	WIDE
Tertiary completion rate	Income group	8	WIDE
Tertiary completion rate	Rural/urban	8	WIDE
Tertiary completion rate	Disability	2	WIDE
Learning achievement in mathematics	Aggregate	11	WIDE
Learning achievement in mathematics	Gender	11	WIDE
Learning achievement in mathematics	Income group	11	WIDE
Learning achievement in mathematics	Rural/urban	11	WIDE
Gross graduation ratio from first degree programmes	Aggregate	8	UIS
Gross graduation ratio from first degree programmes	Gender	8	UIS
Percentage of graduates from ICT programmes	Aggregate	10	UIS
Percentage of graduates from ICT programmes	Gender	9	UIS
Percentage of graduates from NSMS programmes	Aggregate	10	UIS
Percentage of graduates from NSMS programmes	Gender	9	UIS

Percentage of enrollment in private institutions	Aggregate	10	UIS
Proportion of youth and adults that programmed or coded	Aggregate	9	UIS
Proportion of youth and adults that programmed or coded	Gender	7	UIS
Proportion of youth and adults that programmed or coded	Rural/urban	3	UIS
Initial government funding per tertiary student	Aggregate	8	UIS
Initial household funding per tertiary student	Aggregate	3	UIS
School enrollment, tertiary (gross) GPI	Aggregate	18	Data 360
Share of youth not in education, employment, or training	Aggregate	16	Data 360
Share of youth not in education, employment, or training	Gender	16	Data 360
Unemployment with advanced education	Aggregate	19	Data 360
Unemployment with advanced education	Gender	18	Data 360

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