TALENT ECOSYSTEM FOR DIGITAL TRANSFORMATION

Insight Report on ICT in Higher Education and TVET in the Middle East and Pakistan
TALENT ECOSYSTEM
FOR DIGITAL TRANSFORMATION

Insight Report on ICT in Higher Education and TVET in the Middle East and Pakistan

2022
UNESCO Institute for Information Technologies in Education

Editors: Svetlana Knyazeva, Nabi Bux Jumani,
Denis Kapelyushnik, Ekaterina Pushkareva

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<tbody>
<tr>
<td>ACTVET</td>
<td>Abu Dhabi Centre for Technical and Vocational Education and Training</td>
</tr>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
</tr>
<tr>
<td>ADSL</td>
<td>Asymmetric digital subscriber line</td>
</tr>
<tr>
<td>ADVETI</td>
<td>Abu Dhabi Vocational Education &amp; Training Institute</td>
</tr>
<tr>
<td>AGYA</td>
<td>Arab-German Young Academy of Sciences and Humanities</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial intelligence</td>
</tr>
<tr>
<td>AIOU</td>
<td>Allama Iqbal Open University</td>
</tr>
<tr>
<td>ANSO</td>
<td>Alliance of International Science Organizations</td>
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<tr>
<td>AOU</td>
<td>Arab Open University</td>
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<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>AQACHEI</td>
<td>Accreditation and Quality Assurance Commission for Higher Education Institutions (Jordan)</td>
</tr>
<tr>
<td>AR</td>
<td>Augmented reality</td>
</tr>
<tr>
<td>AUM</td>
<td>American University of the Middle East</td>
</tr>
<tr>
<td>AWS</td>
<td>Amazon Web Services</td>
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<tr>
<td>BAU</td>
<td>Al-Balqa’ Applied University</td>
</tr>
<tr>
<td>BMZ</td>
<td>German Federal Ministry for Economic Cooperation and Development</td>
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<tr>
<td>BP</td>
<td><em>Brevet Professional</em>, vocational intermediate level professional diploma (Lebanon)</td>
</tr>
<tr>
<td>BQA</td>
<td>Education and Training Quality Authority (Bahrain)</td>
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<tr>
<td>BT</td>
<td><em>Baccalauréat Technique</em>, technical baccalaureate certificate (Lebanon)</td>
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<tr>
<td>BTEs</td>
<td>Boards of Technical Education (Pakistan)</td>
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<td>BTI</td>
<td>Bahrain Training Institute</td>
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<tr>
<td>CAA</td>
<td>Commission for Academic Accreditation (UAE)</td>
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<td>CAD</td>
<td>Computer-aided design</td>
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<td>CAIT</td>
<td>Central Agency for Information Technology (Kuwait)</td>
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<tr>
<td>CAM</td>
<td>Computer-aided manufacturing</td>
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<td>CAQA</td>
<td>Centre for Accreditation and Quality Assurance (Jordan)</td>
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<tr>
<td>CAS</td>
<td>Chinese Academy of Sciences</td>
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<tr>
<td>CBT&amp;A</td>
<td>Competency-based Training &amp; Assessment</td>
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<tr>
<td>CC</td>
<td>Creative Commons</td>
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<td>CERF</td>
<td>Central Emergency Response Fund</td>
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<td>CITRA</td>
<td>Communication and Information Technology Regulatory Authority (Kuwait)</td>
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<td>CMS</td>
<td>Correspondence Management System (Bahrain)</td>
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<tr>
<td>CMS</td>
<td>Content management system (Iraq)</td>
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<tr>
<td>CMS</td>
<td>Campus Management System (Pakistan)</td>
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<td>CNA-Q</td>
<td>College of the North Atlantic — Qatar</td>
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<td>CNC</td>
<td>Computer numerical control</td>
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<td>COHE</td>
<td>Council of Higher Education (Jordan)</td>
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<td>CoVE</td>
<td>Centre of Vocational Excellence (Iraq)</td>
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<tr>
<td>CPJRC</td>
<td>China-Pakistan Joint Research Centre on Earth Sciences</td>
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<tr>
<td>CRBC</td>
<td>China Road and Bridge Corporation</td>
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<td>CRF</td>
<td>Cybersecurity Regulatory Framework (Saudi Arabia)</td>
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<td>CSB</td>
<td>Central Statistical Bureau (Kuwait)</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>CSO</td>
<td>Central Statistical Organisation (Iraq)</td>
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<tr>
<td>DAI</td>
<td>Degree Awarding Institution</td>
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<tr>
<td>DeCAIR</td>
<td>Developing Curricula for Artificial Intelligence and Robotics Application</td>
</tr>
<tr>
<td>DFAT</td>
<td>Department of Foreign Affairs and Trade (Australia)</td>
</tr>
<tr>
<td>DFID</td>
<td>UK Department for International Development</td>
</tr>
<tr>
<td>DGHE</td>
<td>Directorate General of Higher Education</td>
</tr>
<tr>
<td>DGTVF</td>
<td>Directorate General of Technical and Vocational Education</td>
</tr>
<tr>
<td>DS</td>
<td><em>Dual System</em> secondary education diploma, combination of apprenticeships and vocational education (Lebanon)</td>
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<tr>
<td>EDICT</td>
<td>Engineering, Design and Information &amp; Communications Technology</td>
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<tr>
<td>EFE</td>
<td>Education for Employment</td>
</tr>
<tr>
<td>E-TVET</td>
<td>Employment — Technical and Vocational Education and Training</td>
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<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FCDO</td>
<td>Foreign, Commonwealth and Development Office of the Government of the United Kingdom</td>
</tr>
<tr>
<td>FCSC</td>
<td>Federal Competitiveness and Statistics Center (UAE)</td>
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<tr>
<td>FDP</td>
<td>Five-Year Development Plan (Oman)</td>
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<tr>
<td>FOSS</td>
<td>Free and Open-Source Software</td>
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<td>FTE</td>
<td>Foundation of Technical Education</td>
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<tr>
<td>FTTH</td>
<td>Fibre to the Home</td>
</tr>
<tr>
<td>GAC</td>
<td>Global Affairs Canada</td>
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<tr>
<td>GCC</td>
<td>Gulf Cooperation Council</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GER</td>
<td>Gross Enrolment Ratio</td>
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<tr>
<td>GIZ</td>
<td><em>Deutsche Gesellschaft für Internationale Zusammenarbeit</em> (German Agency for International Cooperation)</td>
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<td>GOI</td>
<td>Government of Iraq</td>
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<tr>
<td>GSM</td>
<td>Global System for Mobile Communications</td>
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<td>GUST</td>
<td>Gulf University for Science and Technology</td>
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<td>HBKU</td>
<td>Hamad bin Khalifa University</td>
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<td>HCT</td>
<td>Higher Colleges of Technology (UAE)</td>
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<td>HDI</td>
<td>Human Development Index</td>
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<td>HE</td>
<td>Higher Education</td>
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<td>Higher Education Accreditation Commission (Jordan)</td>
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<td>Higher Education Council (Bahrain)</td>
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<td>Higher Education Commission (Pakistan)</td>
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<td>Higher Education Institution</td>
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<td>HRDF</td>
<td>Human Resource Development Fund</td>
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<tr>
<td>IBRD</td>
<td>International Bank for Reconstruction and Development</td>
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<td>ICT</td>
<td>Information and Communications Technology</td>
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<td>ILO</td>
<td>International Labour Organization</td>
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<td>IMF</td>
<td>International Monetary Fund</td>
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<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>IREX</td>
<td>International Research &amp; Exchanges Board</td>
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<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>ITeS</td>
<td>Information Technology Enabled Services</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
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<tr>
<td>JEI</td>
<td>Jordan Education Initiative</td>
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<tr>
<td>JESP</td>
<td>Jordan Economic Growth Plan</td>
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<tr>
<td>JICA</td>
<td>Japan International Cooperation Agency</td>
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<tr>
<td>JUST</td>
<td>Jordan University of Science &amp; Technology</td>
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<tr>
<td>K-12</td>
<td>Primary and secondary education (upon kindergarten to 12th grade)</td>
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<tr>
<td>KASIT</td>
<td>King Abdullah II School of Information Technology</td>
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<td>KAUST</td>
<td>King Abdullah University for Science and Technology</td>
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<tr>
<td>KFAS</td>
<td>Kuwait Foundation for the Advancement of Sciences</td>
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<td>KfW</td>
<td><a href="https://www.kfw.de">Kreditanstalt für Wiederaufbau</a> — German state-owned investment and development bank</td>
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<tr>
<td>KHDA</td>
<td>Knowledge and Human Development Authority</td>
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<td>Kuwait Institute of Scientific Research</td>
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<tr>
<td>KOICA</td>
<td>Korea International Cooperation Agency</td>
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<td>KRG</td>
<td>Kurdistan Regional Government</td>
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<tr>
<td>KRI</td>
<td>Kurdistan Region of Iraq</td>
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<tr>
<td>KSA</td>
<td>Kingdom of Saudi Arabia</td>
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<tr>
<td>ktech</td>
<td>Kuwait Technical College</td>
</tr>
<tr>
<td>LET</td>
<td><a href="https://www.let.net.lb">Licence d'Enseignement Technique</a>, technical educational bachelor certificate (Lebanon)</td>
</tr>
<tr>
<td>LFD</td>
<td>Lateral flow device</td>
</tr>
<tr>
<td>LIRA</td>
<td>Lebanese Industrial Research Achievements</td>
</tr>
<tr>
<td>LMS</td>
<td>Learning management system</td>
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<tr>
<td>LP</td>
<td><a href="https://www.let.net.lb">Lycée Professionnel</a>, a vocational secondary certificate (Lebanon)</td>
</tr>
<tr>
<td>LTE</td>
<td>Long Term Evolution</td>
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<tr>
<td>LTUC</td>
<td>Luminus Technical University College</td>
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<td>LUMS</td>
<td>Lahore University of Management Sciences</td>
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<tr>
<td>MCIT</td>
<td>Ministry of Communications and Information Technology (Saudi Arabia)</td>
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<tr>
<td>MOEHE</td>
<td>Ministry of Education and Higher Education (Lebanon, Qatar)</td>
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<tr>
<td>MENA</td>
<td>Middle East and North Africa</td>
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<td>MoDEE</td>
<td>Ministry of Digital Economy and Entrepreneurship (Jordan)</td>
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<td>MoE/MOE</td>
<td>Ministry of Education</td>
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<td>MoF/MOF</td>
<td>Ministry of Finance</td>
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<td>MOHE</td>
<td>Ministry of Higher Education and Scientific Research (Iraq, Kuwait)</td>
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<td>Ministry of Higher Education and Scientific Research (Jordan)</td>
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<td>Ministry of Higher Education, Research and Innovation (Oman)</td>
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<td>Ministry of Higher Education and Scientific Research (Iraq)</td>
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<td>MoLSA</td>
<td>Ministry of Labour and Social Affairs (Iraq)</td>
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<td>Ministry of Labour and Social Development (Bahrain)</td>
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<tr>
<td>MOOC</td>
<td>Massive open online course</td>
</tr>
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<td>MOTC</td>
<td>Ministry of Transport and Communications (Qatar)</td>
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<tr>
<td>MoU</td>
<td>Memorandum of understanding</td>
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<td>MSc</td>
<td>Master of Science</td>
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<td>MSIT</td>
<td>Ministry of State for Investments and Technology (Lebanon)</td>
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<td>MTCIT</td>
<td>Ministry of Transport, Communications and Information Technology (Oman)</td>
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<tr>
<td>NAVTTTC</td>
<td>National Vocational and Technical Training Commission</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>NBAQ</td>
<td>National Bureau for Academic Accreditation and Education Quality Assurance (Kuwait)</td>
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<td>NBN</td>
<td>National Broadband Network</td>
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<tr>
<td>NCSI</td>
<td>Oman National Center for Statistics and Information</td>
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<td>NGO</td>
<td>Non-governmental organization</td>
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<td>National Qualifications Authority (UAE)</td>
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<td>National Qualifications Framework</td>
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<td>NSHRD</td>
<td>National Strategy for Human Resource Development (Jordan)</td>
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<td>NUST</td>
<td>National University of Sciences &amp; Technology</td>
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<td>National Vocational Qualifications Framework (Pakistan)</td>
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<td>OAAA</td>
<td>Oman Authority for Academic Accreditation and Quality Assurance of Education</td>
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<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OMREN</td>
<td>Oman Research and Education Network</td>
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<td>ONSAR</td>
<td>Office of the Minister of State for Administrative Reform (Lebanon)</td>
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<td>OQF</td>
<td>Oman Qualifications Framework</td>
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<td>OTF</td>
<td>Oman Technology Fund</td>
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<td>PAAET</td>
<td>Public Authority for Applied Technology and Training (Kuwait)</td>
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<tr>
<td>PhD</td>
<td>Doctor of Philosophy</td>
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<td>Planning and Statistics Authority (Qatar)</td>
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<td>Private Universities Council</td>
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<td>QAD</td>
<td>Qualifications and Awards in Dubai</td>
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<td>Qatar Career Development Center</td>
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<td>QF</td>
<td>Qatar Foundation</td>
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<td>QRDI</td>
<td>Qatar Research, Development and Innovation Council</td>
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<td>QRF</td>
<td>Queen Rania Foundation</td>
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<td>QSTP</td>
<td>Qatar Science and Technology Park</td>
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<td>QU</td>
<td>Qatar University</td>
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<td>R&amp;D</td>
<td>Research and development</td>
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<td>RAS</td>
<td>Reimbursable Advisory Services (Kuwait)</td>
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<td>REXNet</td>
<td>Remote Experimentation Network</td>
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<td>RPA</td>
<td>Robotic process automation</td>
</tr>
<tr>
<td>RTP</td>
<td>Registered Training Provider</td>
</tr>
<tr>
<td>SDAIA</td>
<td>Saudi Data and Artificial Intelligence Authority</td>
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<tr>
<td>SDGs</td>
<td>Sustainable Development Goals</td>
</tr>
<tr>
<td>SEO</td>
<td>Search engine optimization</td>
</tr>
<tr>
<td>SESIP</td>
<td>Skills for Employment and Social Inclusion Programme</td>
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<tr>
<td>SEU</td>
<td>Saudi Electronic University</td>
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<tr>
<td>SIS</td>
<td>Student Information System</td>
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<tr>
<td>SME</td>
<td>Small and medium-sized enterprises</td>
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<tr>
<td>SMM</td>
<td>Social media marketing</td>
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<tr>
<td>SQU</td>
<td>Sultan Qaboos University</td>
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<tr>
<td>SSS</td>
<td>Saudi Skills Standards</td>
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<tr>
<td>STEM</td>
<td>Science, Technology, Engineering and Mathematics</td>
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<tr>
<td>STEP</td>
<td>Saudi Talent Enabling Programme</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>STI</td>
<td>Science, Technology and Innovation</td>
</tr>
<tr>
<td>STP</td>
<td>Software Technology Parks</td>
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<td>TDRA</td>
<td>Telecommunications and Digital Government Regulatory Authority</td>
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<td>TEVTAs</td>
<td>Technical Education and Vocational Training Authorities (Pakistan)</td>
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<td>TRA</td>
<td>Telecommunications Regulatory Authority</td>
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<td>TS</td>
<td><em>Technicien Supérieur</em>, superior technician certificate (Lebanon)</td>
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<td>TTBs</td>
<td>Trade Testing Boards (Pakistan)</td>
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<tr>
<td>TTC</td>
<td>Technical Training Centre</td>
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<td>TVET</td>
<td>Technical and Vocational Education and Training</td>
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<td>Technical and Vocational Qualifications Framework</td>
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<td>United Arab Emirates</td>
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<td>UIS</td>
<td>UNESCO Institute for Statistics</td>
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<td>UN</td>
<td>United Nations</td>
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<td>UN OCHA</td>
<td>United Nations Office for the Coordination of Humanitarian Affairs</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<tr>
<td>UNESCO-UNEVOC</td>
<td>International Centre for Technical and Vocational Education and Training of UNESCO</td>
</tr>
<tr>
<td>UNHCR</td>
<td>United Nations High Commissioner for Refugees</td>
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<tr>
<td>UNICEF</td>
<td>United Nations International Children's Emergency Fund</td>
</tr>
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<td>UNIDO</td>
<td>United Nations Industrial Development Organization</td>
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<tr>
<td>UNPF</td>
<td>United Nations Population Fund</td>
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<tr>
<td>UNRWA</td>
<td>United Nations Relief and Work Agency for Palestinians Refugees</td>
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<td>United Nations Trust Fund for Human Security</td>
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<tr>
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<td>University of Bahrain</td>
</tr>
<tr>
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<td>United States Agency for International Development</td>
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<td>University of Technology and Applied Sciences</td>
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<td>VU</td>
<td>Virtual University of Pakistan</td>
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<td>W3C</td>
<td>World-Wide Web Consortium</td>
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<td>WCAG</td>
<td>Web Content Accessibility Guidelines</td>
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</table>
Preface by UNESCO IITE

It is my great pleasure to present the Insight Report on ICT in Higher Education and TVET in the Middle East and Pakistan “Talent Ecosystem for Digital Transformation” issued by the UNESCO Institute for Information Technologies in Education (UNESCO IITE).

Information and communications technologies (ICT) have advanced rapidly over the past decades leading to the emergence of such sophisticated technologies as AI, 5G, cloud computing, etc. ICT demonstrated high potential for transformative changes on the way towards sustainable development. As the COVID-19 pandemic ravaged the world, which resulted in social and economic disruption, the role of ICT has become even more prominent.

To benefit from ICT as a tool for accelerating progress towards Sustainable Development Goal 4 (SDG 4) which places high priority on equitable access to quality education for all, the Report aims particularly to contribute to the achievement of some SDG 4 outcome targets such as: equal access to technical, vocational and university education (SDG 4.3); relevant skills for decent work (SDG 4.4); gender equality and inclusion (SDG 4.5).

The Insight Report explores various aspects related to digital transformation in ten selected countries — Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Pakistan, Qatar, Saudi Arabia and the United Arab Emirates. It outlines national policies and strategies for higher education and TVET, especially the ones concerned with the use of ICT in education. Innovative initiatives and collaboration projects, including those aimed to cope with education disruption due to COVID-19 pandemic, are considered. The research revealed the importance of developing ICT talents and creating relevant ecosystems to enhance ICT skills of youth and adults, both women and men, and to expand their access to career opportunities in the digital world. Considerable achievements in ICT talent development and key challenges to be addressed are summarized. The Report is concluded by a compilation of case studies and recommendations on cultivating talents for national digital economies.

UNESCO IITE appreciates the support of Huawei Technologies and its strong commitment to bridging the digital divide and promoting equal access to educational opportunities worldwide.

This joint publication is intended to provide evidence to decision-makers and other stakeholders about the capacities for ICT talent development and recommendations on strengthening digital skills required for employability in the digital era labour market.

Tao Zhan  
Director of UNESCO IITE
Acknowledgements

This Report is a collaborative effort accomplished by UNESCO IITE, Huawei Technologies and national experts. UNESCO IITE and Huawei Technologies developed the concept, structure and research plan of the study. Mr. Li Xiangyu, Mr. Wang Shunli and Mr. Jiang Haohao provided meaningful contribution to shaping the research project. UNESCO IITE revised the case studies developed by the national experts and compiled the Report.

UNESCO IITE would like to use this opportunity to acknowledge the contribution of the national experts: Mr. Riadh Ksantini (Kingdom of Bahrain), Mr. Belal Ismael Khalil (Republic of Iraq), Mr. Razwan Mohmed Salah Najimaldeen (Republic of Iraq), Mr. Ibrahim Mithgal Mustafa Aljarah (Hashemite Kingdom of Jordan), Mr. Mohammad Habib Samkari (Hashemite Kingdom of Jordan), Mr. Fayiz Aldhafeeri (State of Kuwait), Ms. Rima Malek (Lebanese Republic), Mr. Yaqoob Juma Yaqoob Al Raisi (Sultanate of Oman), Mr. Nabi Bux Jumani (Islamic Republic of Pakistan), Mr. Aiman Mohmood Erbad (State of Qatar), Ms. Alhanoof Abdullah Althnian (Kingdom of Saudi Arabia) and Mr. Wathiq Mansoor (United Arab Emirates).

UNESCO IITE sincerely appreciates the recommendations on the candidatures of the experts provided by the Permanent Delegations to UNESCO and the National Commissions for UNESCO of Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Pakistan, Qatar, Saudi Arabia and the UAE. The Institute is also thankful to the UNESCO Regional Offices in Beirut and Doha, and the UNESCO Office in Amman. UNESCO IITE extends special thanks to the Commonwealth of Learning.

The Report benefited much from the extensive experience of Mr. Nabi Bux Jumani in the regional ‘ICT in education’ landscape at the stages of developing a case study on Pakistan and drafting the introduction, synthesis report and conclusions. External review of the case studies was completed by Mr. Diogo Amaro De Paula, his valuable recommendations are much appreciated.

The implementation of this research project and the development of the Report has become possible thanks to generous support of Huawei Technologies.
In order to lay the foundation for the future ICT talent development programmes, the UNESCO Institute for Information Technology in Education (UNESCO IITE) critically reviewed the status of ICT-related higher education and technical and vocational training in ten countries — Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Pakistan, Qatar, Saudi Arabia and the United Arab Emirates. Some of the countries consider ICT as a promising way to diversify their economies, while the others attempt to use it as a means for economic recovery.

In gathering data for this publication, a dual-track approach was adopted: desk research and the development of a series of case studies based on the responses to the questionnaire provided by national experts. All case studies contain a brief introduction on the country context, the outline of the technological and education context, the main national policies developed to enhance ICT use, initiatives implemented by HE and TVET institutions providing ICT training, technical cooperation and partnership programmes. The countries were clustered based on the collected data as well as using pre-defined geopolitical groups, e.g., “Mashriq (Mashreq)”, “the Gulf (GCC) countries”, “Levant”, and economic classification based on the level of income. Country-specific characteristics were analysed in correlation with economic and demographic trends, ICT-related indicators, rankings of the countries in international indices, etc. to evaluate the advancement on the way towards digital transformation.

The synthesis report provides an overview of ICT in Higher Education and TVET in the Middle East and Pakistan summarising the information presented in the country case studies.

Each of the selected countries seeks to improve digital government services and to increase the engagement of citizens through national government portals that are one of the first steps towards digital transformation, which contributes to establishing transparent regulatory systems and building an effective partnership between public and private sectors. National authorities use the portals to enable the 24/7 access to bureaucratic procedures and to share open data collected by various government agencies.

ICT is one of the major pillars for the implementation of the fundamental national policies or frameworks for the economic development, and digital transformation is a priority for the countries. In addition to universal strategies and plans, most of these countries have adopted context-specific policies, regulations and guidelines on ethics and personal data privacy and protection concerned with the issues related to the emergence of new technologies.

The surveyed countries acknowledge the importance of higher education and technical and vocational education and training (TVET) for digital transformation and make efforts to improve the quality of education, especially science and technology education. In order to equip the workforce with the skills requested in the modern labour market, the importance of TVET as a means to enable career opportunities is recognised across all the countries. Specialised higher education institutions for graduate and postgraduate technical and vocational training are being established as an alternative to traditional programmes of higher education institutions (HEI). HEI contribute to technical training through delivering vocational courses by means of available ICT infrastructure.
Common challenges for successful talent development in the surveyed countries are shortage of skilled teaching staff, strict government regulation of private education, high dropout rate in secondary and higher education, negative perception towards TVET as a valid career enabler, competition with overseas HEI. Labour market challenges vary from country to country, though underrepresentation of female workers is common. Expatriate labour flows, efforts to reorient local labour force towards private sector careers rather than working in the public sector, influx of refugees are notable characteristics observed in different subgroups of the surveyed countries.

As the demand for ICT talents is ever increasing, HE and TVET institutions continue expanding the range of relevant courses and revise ICT-related curricula and programmes to align them with the demands of the labour market. Institutions are expanding the use of ICT solutions for instruction and for delivering various services to students. Hybrid or blended-learning programmes become adopted across all the surveyed countries, though they are still less frequent than traditional on-site or fully online programmes.

Computer science and engineering are among the most popular ICT-related majors. The current trend in a number of HEI in the surveyed region is to unbundle generic ICT majors into more specific ones (data science, artificial intelligence, cyber security, etc.), especially at Master’s level. Though TVET colleges often focus on core ICT competencies, such as using office software or search engines, some of the programmes, e.g., electronics engineering or web design, equip students with more advanced ICT skills. By launching numerous ICT-related programmes, higher education and TVET institutions attempt to respond to ubiquitous penetration of digital technologies and to satisfy the increased market demand for personnel equipped with ICT skills. In-demand occupations at the labour market include specialists in big data, machine learning and computer science, game developers, data scientists, cloud computing, cloud infrastructure, virtualization and IoT engineers, IT project managers, etc.

Cooperation programmes in the surveyed countries vary significantly and mainly depend on the national context. While some countries rely on the support of foreign and international development agencies that help to overcome financial and other constraints through capacity building projects and scholarship programmes for HE and TVET, the others host well-funded universities that are oriented towards partnerships with world-class universities. A common ground to establish partnership networks is the language of instruction and research, e.g., Arabic, English or French.

Particular importance is given to partnership with businesses operating in the target countries. Several international corporations and IT companies opened ICT training centres and academies at local educational institutions and sponsor annual ICT competitions to encourage talented students. These companies often support the provision of critical infrastructure, e.g., data centres or 5G network services. Peer networks of universities and colleges are established to share resources and infrastructure as well.

Digital transformation of education was catalysed by the COVID-19 pandemic, as most countries in the region had to seize onsite education and intensify using various digital tools to ensure the continuity of education. The crisis forced educational institutions to employ digital technologies and invest much more resources into the upgrade or expanding of the digital infrastructure. In some countries, the pandemic aggravated digital divide, either because of inadequate infrastructure or the lack of appropriate skills among students and educators. During the recent shift to distance learning, it has become evident that
teachers and instructors need additional training to strengthen their ICT skills. Improving the ICT skills of those at the forefront of education has become more important than ever. As case studies provide country-specific recommendations on future actions, the conclusions attempt to generalise them for the clusters of surveyed countries, the region and beyond. The following actions are suggested as a basis for development programmes to be implemented in the future:

1. Intensify the partnership of higher education and TVET institutions with the private sector to align education outcomes and employers’ expectations.

2. Update the TVET system with the elements of lifelong learning and ensuring that students, who opt for a vocational track, could get their learning achievements recognised in order to pursue higher education in the future.

3. Benchmark national qualifications with regional and international frameworks to harmonise and modernise national education systems and increase their competitiveness in the global labour market.

4. In addition to ensuring access of female students to ICT education, enhance their employment opportunities to enable them to find proper jobs in private or public sector.

5. Organise pre-service and in-service training of educators focusing on ICT skills and establish e-learning units that would supervise the development, management and use of digital content, including open educational resources.
Introduction

The information and communication technology has been hailed worldwide for providing exemplary services in all spheres of human activity and laying the basis for further development opportunities. ICT catalyses changes across various sectors of the economy and encourages competition in the digital world. ICT sector is at the core of digital economy; thus, ICT becomes a main driver for social development, sustainable economic growth and better governance. ICT has vital significance for improving the governance and facilitating the engagement of citizens through the provision of e-government services. Some countries of the region consider ICT as a promising way to diversify their economies ‘beyond oil’, while for the others digital transformation is a real opportunity for economic recovery. To this end, the governments of the surveyed countries have developed laws and policies, including education development plans aimed to accelerate digital transformation.

ICT is one of the pillars to improve quality, equity and inclusion of education. In most countries, the use of digital technologies expands, though the level of advancement might vary depending on economic conditions of each particular country. The governments invest not only in the upgrade of ICT infrastructure for educational institutions but also boost ICT talent development systems to equip citizens with relevant digital skills.

Currently, higher education and TVET institutions are promoting the utilization of ICT for education delivery and producing manpower with ICT-related skills and knowledge. Most of the educational institutions in the region show progress in using digital technologies and services, such as LMS, video conferencing tools, MOOC platforms, distance learning infrastructure, cloud platforms, etc.

Penetration of digital technologies in all sectors has become an impetus for higher education and TVET institutions to launch numerous ICT-related programmes in order to satisfy the increased market demand for personnel equipped with ICT skills. In-demand occupations at the labour market include specialists in big data, machine learning and computer science, game developers, data scientists, cloud computing, cloud infrastructure, virtualization and IoT engineers, IT project managers, etc. The most frequent ICT-related majors offered by educational institutions are computer science, information technology, information systems, software, telecommunications and computer engineering. The major challenge for the region is a mismatch between skills required in the labour market and skills obtained by graduates, though certain institutions train ICT professionals who meet the national needs and are able to compete in the international labour market. Collaboration between universities and enterprises also contributes to ensuring the balance between learning outcomes and labour market requirements by focusing on vocational education and training, as well as developing lifelong learning opportunities.

The race of digital transformation of all sectors, including education, was accelerated by the COVID-19 pandemic. Most countries of the region had to close schools and universities. To prevent education disruption, various non-traditional educational tools, e.g., messengers, video hosting and cloud storage services, have been extensively used. In some countries the pandemic aggravated digital divide: either the infrastructure was insufficient to support learning at distance, or necessary technology was available but distance learning was not offered due to the lack of appropriate skills.
Transformation of the education system for the digital economy and teaching with the use of ICT suggests regular revision of curricula as well as improving the skills of teachers and offering new training opportunities to them. In addition, partnerships with the private sector, support for innovative research and provision of lifelong learning opportunities would serve as key factors contributing to the nourishment of talents, in particular, in the field of ICT.

Gender imbalance is observed in ICT workforce both in developed and developing countries, women are underrepresented at all levels in the ICT sector, especially in decision-making positions. This trend can be reversed through expanding the access of girls and women to education in STEM and ICT with wider use of digital tools and technologies.

National development agencies and intergovernmental organisations implement numerous programmes supporting the advancement of HE and TVET in the surveyed countries. Development agencies and governments of developed countries award scholarships for overseas university and college studies for young people from the region.

This Insight Report summarises the results of the research project aimed to exhibit the status quo of ICT in higher education and TVET in the Middle East and Pakistan. The Report covers ten selected West and South Asia countries: Gulf countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates), Levant countries (Jordan and Lebanon), Iraq and Pakistan.

The Report addresses the following major issues for the selected countries:

- trends in digital transformation
- major ICT-related policies and strategies aimed at digitalization of HE and TVET
- innovative ICT practices in HE and TVET
- international collaboration and partnership programmes
- initiatives aimed to cope with education disruption caused by COVID-19
Methodology and Structure of the Insight Report

This project “Middle East and Pakistan: ICT in Higher Education and TVET” that resulted in the Insight Report was implemented between November 2020 and November 2021.

To achieve the project objective “to lay the foundation for further ICT talent development programmes”, the research addressed ICT, including 5G/AI/cloud technologies, in higher education and TVET. The Report juxtaposed ten West and South Asia countries: nine Middle East Arab countries (Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and the United Arab Emirates) and Pakistan to investigate the efforts they took to promote ICT talent ecosystems, as well as challenges they faced and opportunities to overcome those challenges. All the countries, except for Pakistan, belong to the geographical region of Middle East and Northern Africa (MENA). These nine countries are a part of the Mashriq (Mashreq) region: Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and the UAE. Six states — Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE — are Gulf countries, which used to be the members of the Gulf Cooperation Council (GCC). Two countries (Jordan and Lebanon) belong to the Levant region. Iraq’s affiliation to the Levant is under question, the country is often referred to as belonging to Mesopotamia. Whenever relevant, these groups of countries are mentioned in accordance with their attribution to the appropriate cluster.

This study relied on extensive desk research that involved collecting the most recent statistical data and reviewing relevant secondary data from open international and national sources:

- reports and databases of intergovernmental organizations, e.g., The World Bank, IMF, UNSD, UIS, UNDP, ITU, UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training
- official documents and data published by national authorities and educational institutions
- the World Higher Education Database by the International Association of Universities, QS World University Rankings, the Times Higher Education (THE) World University Rankings and the Shanghai Ranking Consultancy’s Academic Ranking of World Universities

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1 MENA countries: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, the United Arab Emirates and Yemen.
2 Mashriq countries: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syria, the United Arab Emirates and Yemen.
3 Levant countries: Israel, Jordan, Palestine, Lebanon, Syria and most of Turkey.
5 International Monetary Fund. 2021. World Economic Outlook Database.
9 International Telecommunication Union. 2020. The Digital Development Dashboard Reports.
• the Global Inclusive Internet Index, the E-Government Development Index, the E-Participation Index, the Network Readiness Index, the Global Talent Competitiveness Index, the Government AI Readiness Index

• publications: an exhaustive list of materials used to prepare the Insight Report is presented in footnotes and References (for the synthesis report and each case study)

Though the governments of most of the surveyed countries are quite consistent in implementing the open data policies, one of the major challenges was data gaps (no single data source contained up-to-date quantitative indicators covering all ten countries) and data inconsistencies (databases contained different and sometimes contradictory information). In the case of data discrepancy, data from the databases of intergovernmental organisations were selected. In the case of missing information, open national data portals or reports by national ministries of finance were used.

In parallel to the desk research, a survey was conducted using a structured questionnaire developed by UNESCO IITE and distributed through a network of national experts recommended by the Permanent Delegations for UNESCO or National Commissions for UNESCO of the selected countries, UNESCO Regional Offices in Beirut and Doha, UNESCO Office in Amman, as well as other partnering organizations. The experts verified the pre-collected data and completed the questionnaire.

Based on the desk research materials and the feedback received from the experts, case studies were compiled for each of the ten countries. The case studies completed in mid-October represent snapshots of the situation of each particular country context and contain the latest data that was available by that time. The case study results are not usually generalisable outside their context, but they help identify topics or other avenues of enquiry. Only limited generalisations are admitted to showcase similarities and differences within certain clusters of countries. Upon the in-depth analysis of the desk research results and the case studies, a synthesis report was developed.

The Insight Report includes the introduction, synthesis report and conclusion, where main challenges and prospects for the ICT talent ecosystem as applied to higher education and TVET were summarised and recommendations are formulated. There are two annexes: 10 case studies and the questionnaire used for the survey. The country case studies are customized to the available quantitative and qualitative data; however, most of the case studies contain a brief introduction on the country context with particular focus on their technological and education context, an overview of the main national policies developed to enhance ICT use, in particular, in education, key figures on access to technology and learning, description of initiatives implemented by HE and TVET institutions providing ICT training, examples of technical cooperation and partnership programmes, as well as conclusions and recommendations on future actions.

An Overview of ICT in Higher Education and TVET in the Middle East and Pakistan: Synthesis Report

Since digital transformation has been accelerated by the COVID-19 crisis, countries intensified their efforts in modernizing their industries and workforce. Ensuring competitiveness, complying with the changing labour market landscape and overcoming the mismatch between skills and technical knowledge and the requirements of the digital economy necessitates the development of ICT talent ecosystem. At this critical juncture, digital transformation presents a unique opportunity to help address the most imminent challenges throughout the world. The Mashriq countries are witnessing several social and economic challenges as well as the impact of conflicts, which impede their progress towards sustainable growth. On the other hand, the countries have many advantages to leverage digital transformation, including strategic geographic position, the high education level of university graduates, multilingualism of population and high penetration of social media and smart devices.

While discussing various aspects concerned with the challenges faced by the surveyed countries on their way towards digital transformation, one should keep in mind certain commonalities and distinctions within the clusters of the surveyed countries. People of most of the countries speak the Arabic language and share the same values, traditions and practices. Countries often have common priorities that are highlighted in their national strategies. However, geopolitical, social and economic conditions (e.g., territory, abundance or scarcity of natural resources, number and composition of population, stability or instability of economic and political situation, etc.) differ considerably, which impacts the effectiveness of interventions oriented towards digital transformation.

The World Bank classifies six of the countries as “high income” (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE), three countries as “upper middle income” (Iraq, Jordan and Lebanon) and one as “lower middle-income” country (Pakistan) [1]. Among the surveyed countries, the highest GDP is 700.12 billion USD and the lowest amounts to 31.74 billion USD, while the highest GDP per capita is up to 50,000 USD and the lowest amounts to about 1,200 USD.

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP, billion, current US$, 2020</th>
<th>GDP per capita, current US$, 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>34.73</td>
<td>20,409.95</td>
</tr>
<tr>
<td>Iraq</td>
<td>166.76</td>
<td>4,145.86</td>
</tr>
<tr>
<td>Jordan</td>
<td>43.70</td>
<td>4,282.77</td>
</tr>
<tr>
<td>Kuwait</td>
<td>105.96</td>
<td>24,811.77</td>
</tr>
<tr>
<td>Lebanon</td>
<td>31.74</td>
<td>4,649.55</td>
</tr>
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<td>Oman</td>
<td>64.65</td>
<td>12,659.72</td>
</tr>
<tr>
<td>Pakistan</td>
<td>262.61</td>
<td>1,188.86</td>
</tr>
<tr>
<td>Qatar</td>
<td>144.41</td>
<td>50,124.39</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>700.12</td>
<td>20,110.32</td>
</tr>
<tr>
<td>UAE</td>
<td>358.90</td>
<td>36,284.50</td>
</tr>
</tbody>
</table>

Macroeconomic Trends

The wealth of the Gulf countries depends on oil and other natural resources; industrial sectors are a larger part of their economies as well. Drop in oil prices between 2016 and 2020 resulted in challenging macroeconomic conditions for the Gulf countries, but subsequent improvement in the prices promises revival in economic activities. The prospects for the wealthiest GCC countries — Qatar, the UAE and Kuwait — estimated in October 2021 by the World Bank state that there are explicit signs of recovery [2]. Qatar is on a clear recovery path due to resilient demand for gas, extensive business environment reforms and tourism sector geared for 2022 World Cup. Upon a contraction in GDP in 2020 caused by pandemic related disruptions, the UAE shows the signs of recovery in 2021 upon successful vaccination programme and a reduction in OPEC+ oil production cuts. Furthermore, improvement of global conditions and spill-overs in the oil markers have strengthened medium-term outlook. Though Kuwait’s economy contracted sharply in 2020 and the fiscal deficit reached an all-time high due to the fallout from the pandemic and OPEC+ oil production cuts, the recovery is expected to gather pace in 2021. These three countries make up a subcluster within the region — their efforts to diversify economies ‘beyond oil’ were more consistent.

The prospects for the other three members are as follows: Bahrain’s economy will see a return to moderate growth, though the debt-to-GDP ratio will remain above 130%; due to the fact that the spread of the pandemic is under control and the vaccination has made significant progress, the Saudi Arabian economy is on a recovery path as well; Oman’s economy is expected to recover gradually after a difficult 2020 with projected rebounding of oil- and non-oil GDP growth [2].

Due to the shortage of natural resources, Jordan and Lebanon used to rely on tourism, which amounted to about one fifth of their GDP [3] — the COVID-19 pandemic had adverse effect on this sector. The governments of these countries have prioritised the ICT sector and established dedicated ministries for digital economy to design ambitious national digital transformation programmes. Another trend that sets Jordan and Lebanon apart from the Gulf countries is rising remittances: people from Levant seek employment in neighbouring Gulf countries and worldwide, thus the remittances have contributed to the growth of GDP. However, the fiscal outlook for Levant is complex: government borrowing load is equal or has exceeded GDP in 2019. For Jordan, given the increasing public debt burden and widening deficits, economic outlook — particularly over the medium term — is still surrounded by a high level of uncertainty [4]. For Lebanon, the World Bank projected the real GDP to decline by 10.5% in 2021, on the back of a 21.4% contraction in 2020 [5].

The recurrent crisis deteriorated by the war echoes, severe water shortages and widespread electricity cuts after the historically low rainfall are the reasons of the political, social and economic challenges faced by Iraq [6]. Two years of steady recovery were reversed by oil price volatility and COVID-19; thus, domestic and fiscal risks require accelerated economic reform. The economy is forecast by the World Bank to gradually recover on the back of rising oil prices and OPEC+ production quotas, as oil GDP will be the main driver of growth in the medium term. Non-oil GDP growth is forecast to recover but remain under 3% on average in 2021–2023, due to the impact of the new COVID strains and infection waves, compounded by water and electricity shortages which effect agriculture and industries [7]. As a result, the fiscal balance is forecast to remain in surplus in the medium term leading the debt-to-GDP ratio to steadily improve [8]. Still Iraq relies greatly on international humanitarian aid [9].
Recently Pakistan has seemingly reversed the declining economic situation but its economy still poising on the brink of crisis. Despite slowing from 10.7% in 2020 to 8.9% in 2021, headline consumer price inflation remained elevated. The current account deficit narrowed from 1.7% of GDP in 2020 to 0.6% in 2021 as robust remittance inflows offset a wider trade deficit. Bolstered by the recovery in the industry and services sectors and resultant off-farm employment opportunities, poverty incidence is expected to decline from 5.3% in 2020 to 4.8% in 2021. Output growth is therefore to ease to 3.4% in 2022 but strengthen thereafter to 4.0 percent in 2023 with the implementation of key structural reforms, particularly those aimed at sustaining macroeconomic stability, increasing competitiveness and improving financial viability of the energy sector. Pakistan is on a high growth path and invests a lot in economic and social development though steadily high population growth rates that decelerate the progress. Poverty is expected to continue declining, reaching 4.0% by 2023 [10].

**Demographic Trends**

The most populated among the surveyed countries are Pakistan (over 220 million people), Iraq (over 40 million) and Saudi Arabia (over 34 million).

<table>
<thead>
<tr>
<th>Country</th>
<th>Bahrain</th>
<th>Iraq</th>
<th>Jordan</th>
<th>Kuwait</th>
<th>Lebanon</th>
<th>Oman</th>
<th>Pakistan</th>
<th>Qatar</th>
<th>KSA</th>
<th>UAE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population 2000, 2020</strong></td>
<td>1,702</td>
<td>40,222</td>
<td>10,203</td>
<td>4,271</td>
<td>6,825</td>
<td>5,107</td>
<td>220,892</td>
<td>2,881</td>
<td>34,814</td>
<td>9,890</td>
</tr>
</tbody>
</table>

*Source: The World Bank (2020).*

The share of young people (under 15 years old) who will soon go to schools and HEI varies from 37.71% in Iraq, 34.82% in Pakistan and 32.85% in Jordan to 18.28% in Bahrain, 14.81% in the UAE and 13.64% in Qatar [11]. Analysis of the dynamics of demographical statistics and the comparison of the recent decade data with the latest updates of the population growth rate indicate that the population growth rate decelerates in most of the surveyed countries. The steepest decrease is observed in Qatar — from 9.2% in 2011 to 1.7% in 2020. In Jordan and Lebanon, the decrease was also steep — from 5.38% and 4.9% in 2011, after the peak increase in 2014 and 2015, the rate in 2020 was 1.36% and -0.05%, respectively, which is probably due to the return of refugees to Syria, Libya, Iraq and Yemen. The Gulf countries and Iraq demonstrate a decline. For Pakistan, the rate has been stable throughout the decade — slightly above 2% [12].

The large share of youth coupled with increasing number of young expatriates is expected to increase in the future, which will drive enrolments across all education segments, in particular in private educational institutions offering high-quality educational curricula. High per capita income and relatively low-tax environment in the Gulf countries will result in increased spending for quality education by households. The education sector will also be one of the major beneficiaries of public funding as governments recognize the importance of investing in skills and training to improve overall competitiveness [13].

Demographic trends should also be taken into account when analysing the gender balance in education. For example, in Iraq, Jordan, Lebanon and Pakistan the share of female population approaches 50%. In Bahrain, Kuwait and Oman, it has been decreasing during the last decade and reached about 35% in 2020. In Qatar and the UAE, the share has been slightly increasing but still amounted to 24% and 30.9%,
respectively. When this data is correlated with HE and TVET enrolment, as well as with data on unemployment of females (modelled ILO estimate), one can see that the highest unemployment of females in all sectors is observed in Iraq (30.6%), Jordan (23.8%) and Saudi Arabia (23.0%), while the lowest share is in Qatar (0.4%), Pakistan (4.4%) and Kuwait (6.1%) [14]. When this data is weighted against the general unemployment statistical data for both genders, the picture becomes even more paradoxical. The rate of labour force participation for females considerably lower than that for males, despite the fact that females attain higher educational levels [15].

**Employment and Competitiveness**

As to human capital utilization, the high share of the working-age population was employed: Bahrain — 72% (2015), Kuwait — 74% (2016), Oman — 70% (2015), Qatar — 89% (2017), Saudi Arabia — 54% (2018) and the UAE — 80% (2018). These values are higher than both the average for their region and the average for their income group. In Pakistan, 50% (2018) of the working-age population was employed, which is lower than both the average for its region and the average for its income group. In Iraq, Jordan and Lebanon 38% (2017), 29% (2016) and 43% (2011) of the working-age population was employed, respectively, which is lower than both the average for their region and the average of their income group [16].

In 2019, the highest female labour force participation was observed in the UAE (58%), Qatar (57%), Kuwait (50%) and Bahrain (45%), which was higher than the average for their region, while in Oman it was 31%. In Saudi Arabia, the share was 26% in 2020. In Pakistan, the female labour force participation rate was 22% in 2019, which was lower than both the average for its region and the average for its income group. In Iraq, Jordan and Lebanon, the female labour force participation rate was 23% and 14%, respectively, in 2019, which was lower than both the average for the region and the average for the income group. In Iraq, this rate was 12% in 2019, which was lower than both the average for its region and the average for its income group [16].

In the Gulf countries, especially in labour-importing resource-rich Qatar and the UAE, the labour capacity of the citizen population is underutilized and both male and female nationals are underrepresented in the labour force. In Oman, Qatar and the UAE, labour force participation rates for male and female nationals are 15% to 40% lower than the rate for non-nationals. Heavy reliance on expatriate workforce to meet the needs for skilled and unskilled labour results in the domination of foreign workers, e.g., 87% of the total population in Qatar, 87% in the UAE, 70% in Kuwait [17].

In contrast, Jordan and Lebanon have to struggle with the problems related to the huge influx of refugees from neighbouring countries. The share of youth in the immigrant and refugee population is high, which limits access to education and results in tensions at the labour market [18]. For Lebanon, the challenge is the outmigration of university-level graduates because of ongoing political and economic instability in recent decades, which diminished the benefits of producing graduates. The other challenge related to lower per capita income and higher disparities in living standards applies to Jordan, Lebanon and Oman and results in the disparities in access to and quality of educational opportunities [17].

One more challenge is the high rate of unemployment among young, first-time workers and females. These high rates signal a problem with matching workers to jobs at young ages, in part because of a mismatch between the skills of labour market entrants and the
needs of employers, especially in the private sector. Compared with female nationals, male nationals in most of the surveyed countries are particularly vulnerable to unemployment because of their lower rates of post-secondary degree attainment or cultural reasons.

In 2019, the unemployment rate for youth ages 15–24 in Iraq and Jordan was 25% and 35%, respectively, which was higher than both the average for the region and the average for their income group. In Saudi Arabia, this rate was 29%, which was higher than both the average for the region and the average for its income group. In Lebanon, the unemployment rate for youth was 18%, which was lower than both the average for the region and the average for its income group. In Kuwait and Oman, the rate was 16% and 13%, respectively, which was lower than the average for the region but higher than the average for their income group. This share was lower than both the average for the region and the average for the income group, in the UAE (7%), Bahrain (5%) and Qatar (0.4%)[16].

Another challenge is the proportion of nationals working in the public sector. This issue reflects the preferences that nationals receive in the public sector, where the compensation, working conditions, job security, and prestige are better than the private sector offers.

All of the surveyed countries, except for Iraq and Lebanon, are listed in the Global Talent Competitiveness Index 2020 that covers 132 countries. The rankings of the surveyed countries are as follows: Bahrain (41), Jordan (61), Kuwait (63), Oman (43), Pakistan (106), Qatar (29), Saudi Arabia (40) and the UAE (22). Some countries are among the leaders in certain aspects: the UAE is ranked 3rd in the share of population with tertiary education. As to the number of women with tertiary education, Qatar is ranked 1st and Kuwait is 4th. When the ease of finding skilled employees is considered, Lebanon is 5th, the UAE are 6th, Qatar is 7th and Saudi Arabia is 13th. According to the relevance of education system to the economy, Qatar is ranked 6th and the UAE — 9th[19].

Four of the surveyed countries are listed in the World Competitiveness Ranking 2021: out of 64 countries ranked, the UAE (9) and Qatar (14) are among the top 15 countries in general. Saudi Arabia and Jordan are ranked 32nd and 49th, respectively[20].

Below are several key issues and challenges revealed for the Gulf countries, but they are also valid for the other countries surveyed in this report [13]:

- lack of skilled local teaching staff
- nationalization drive leading to recruitment of local teachers
- increasing number of foreign private educational institutions due to abundant expatriate population
- higher dropout rate in secondary and higher education
- increasing costs of setting up/running educational institutions
- overseas higher education used to be preferred destination but during COVID a continued inclination towards pursuing HE among nationals coupled with a rising inbound student mobility

**Adoption of ICT and Digital Transformation Trends**

Being the core of digital transformation, ICT has become a key lever for economic development, an agent of social prosperity and an efficient instrument of rapid service
delivery. One of the major goals of digital transformation in the region is to diversify national economies and increase the share of non-hydrocarbon industries in GDP, which is particularly true for the Gulf countries. The surveyed countries are striving to establish a holistic digital ecosystem in order to ensure sustainable competitiveness. These efforts include development of national ICT policies and frameworks, improving ICT infrastructure to expand the digital connectivity and utilization of ICT across all sectors, including governance, commerce, education, technical training, banking, transport, etc., though geopolitical turmoil and economic conditions may delay the progress in some of them.

In terms of connectivity, all countries are reported to have 4G services available to the general public, with 5G being tested/fully deployed in some countries. Backbone broadband infrastructure can become an opportunity to capitalize on a strategic geographic position with respect to the global connectivity [21], because an alternative and faster Europe-to-Middle-East communication route might lay through Iraq, Jordan and others. In 2020, 4G mobile services were fully available in most of the countries, while 5G technology is either deployed or at least planned in the nearest future, which indicates that the countries of the region are making considerable progress towards digital transformation.

According to ITU Digital Development Dashboard, the level of ICT penetration in the surveyed countries differs among the clusters of countries: the Gulf countries are the leaders in MENA, while the situation in Iraq, Jordan, Lebanon and Pakistan is less favourable [22].

ITU data proves that since 2011 the share of fixed broadband subscriptions has increased for all countries, except for Lebanon. In 2020, it varied from 1.1% to 32.8%. The number of households with computers is increasing and is about or above 90% in Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE; only for Pakistan this indicator is lower (14.3%). In 2020, the share of individuals using the internet is approaching or equal to 100% in the six Gulf countries. In Pakistan, 17.07% individuals used the internet in 2019 [22]. According to the Human Capital Index 2020, the share of population using the internet in Iraq was 75% (2018), Jordan — 67% (2017) and Lebanon — 78% (2017) [16]. As to the share of households with internet access at home, ITU reports that in six Gulf countries in 2020 it was 94% and above, while for Pakistan it was 34.13% (2019) [22].

In 2020, the number of active mobile-broadband subscriptions in six Gulf countries varied from 109.36% to 224.24%. The indicator was slightly above 40% for Iraq and Pakistan; for Lebanon and Jordan it was 63.71% and 68.49%, respectively. As to mobile-cellular subscriptions per 100 inhabitants, this indicator ranged widely from 62.82% (Lebanon) and 68.48% (Jordan), through 79.5% (Pakistan) to 133.84% (Oman), 158.53% (Kuwait) and 185.77% (UAE) [22].

Digital transformation encourages the use of digital technologies to deliver e-government service. National e-government portals, e.g., U.ae in the United Arab Emirates or Gov.sa in the Kingdom of Saudi Arabia, increase the number of provided e-services, improve service delivery and increase engagement of citizens. Such portals as the Qatari Legal Portal (Al-Meezan) contribute significantly to establishing transparent regulatory systems and encourage investments in the country. Other examples include the provision of more than 1,450 services through Qatar’s official e-government portal Hukoomi, online services by the Official Oman Government Portal Omanuna, e-government services of Kuwait and the e-services provided by NADRA and Citizens’ Portal in Pakistan.
Gradual improvement of scores on relevant indicators in the E-Government Development Index, the E-Participation Index, the Global Inclusive Internet Index and the Network Readiness Index reflects the consistency of the authorities of these countries in implementing the developed policies. All of the surveyed countries are presented among 172 countries ranked in the Government AI Readiness Index 2020. The surveyed countries provide a representative snapshot in terms of government readiness for AI. Compared to other regions, the scores of the 10 countries diverge widely: the UAE (16), Qatar (37), Saudi Arabia (38), Bahrain (43), Oman (48), Kuwait (54), Jordan (79), Lebanon (101), Iraq (116), Pakistan (172) [23].

Establishing specialised technological parks and zones, e.g., the Software Technology Parks in Pakistan or the Qatar Science and Technology Park hosting science and tech businesses, is a common approach to attract international ICT companies, nourish local entrepreneurs and revitalise national economies. ICT-related and other small and medium enterprises are often supported through partnerships with international organisations, e.g., World Bank Reimbursable Advisory Services, etc.

KSA’s programme “Shareek” focusing on public-private partnership initiatives for the advancement of the ICT infrastructure is an example of development programmes along with USD 3 billion investment in digitization and AI under Vision 2030 and the Industrial City Communication Infrastructure Initiative [24; 25]. These are the robust ventures to develop ICT infrastructure and support Industry 4.0. The National Program for AI, the Dubai Future Foundation, and Sharjah Research, Technology and Innovation Park are the examples of projects for fostering digital transformation in the UAE. In Kuwait, the National Knowledge Economy Centre has played a significant role towards transformation of digital economy through integrating knowledge and technology.

Policies Related to Digital Transformation

Adopted policies and frameworks demonstrate countries’ commitment to achieve declared targets. ICT is one of the major pillars for the implementation of the fundamental national policies or frameworks for the economic development of the focus countries: Iraq Vision for Sustainable Development 2030, National Vision and Strategy — Jordan 2025, New Kuwait Vision 2035, Oman’s Vision 2040, Qatar National Vision 2030, KSA’s Vision 2030, UAE Centennial Plan 2071, Bahrain’s Government Action Plan (2019–2022), Pakistan Vision 2025, etc. Digital transformation across all sectors through infrastructure development and effective utilization of digital technologies is a shared objective of all these policies and frameworks.

Dedicated ICT-policies were developed to outline the national agenda aimed at accelerating digital transformation and developing a competitive knowledge economy. The most frequent approaches employed by the countries are as follows:

- expanding digital infrastructure to create digital ecosystem
- enhancing the share of ICT-related services and products in national economy
- joining efforts for public and private partnership
- promoting e-governance and utilizing latest and emerging technologies across all sectors
- bridging the digital divide to foster equity and inclusion
• promoting innovation through technology parks and incubators for IT sector
• ensuring digital transformation of the education sector
• focused training of labour force equipped with relevant knowledge, skills and competencies


KSA's Digital Economy Policy aims to boost digital economy through enhancing digital infrastructure, data and platforms; adopting innovative technologies and strengthening social prosperity and inclusion. The major focus of the UAE's National Strategy for Artificial Intelligence is capacity building for the future labour market through better access to data infrastructure and attracting investments into relevant projects. The Digital Pakistan Policy suggests mass adoption of digital technologies and applications to ensure cross-sector socio-economic development and achievement of the Sustainable Development Goals.

Some other countries developed policies for specific facets of digital transformation:

• Jordan: Jordanian Artificial Intelligence Policy 2020, Jordanian Cloud Computing and Services Policy, Open Government Data Policy, Open Application Programming Interfaces (APIs) Policy 2020, etc.
• Pakistan: Rolling Spectrum Strategy (2020–2023), National Broadband Policy — 2021

Oman’s e-Accessibility Policy was developed to support persons with disabilities and elderly people through the use of ICT and to improve IT knowledge and skills of students. Similarly, Qatar Foundation (QF) strategy is also worth mentioning, as it aims to build “Multivercity”, an ecosystem to ensure quality and personalised learning in an inclusive and innovative environment [26]. Kuwait integrated ICT-related strategies into its national policies for higher education, science and technology.

In addition to well-articulated code of ethics, secure use of digital technologies also requires relevant rules and regulations. Most of the focus countries have developed ICT-related regulatory frameworks consisting of proper legislative acts: data privacy and protection policies, cyber security laws, information security policies and disclosure policies.

**Investment in Education**

As most of the surveyed countries are oil producers, low hydrocarbon revenues were one of the main factors — along with the COVID-19 pandemic — influencing the shrinkage of budgets allocated on education in the region during the recent years. Over the past few years, the Gulf countries have been investing more in the education sector than other surveyed countries, with KSA being the leader in absolute figures and the share of government expenditure for the education sector [27].
Budget allocation towards education remained healthy in the Arab States between 2018 and 2020 [27], still these countries attempt to reduce the reliance of education on state funding [28]. A growing trend for private tertiary education is observed. The number of public HEI operating in some of the Arab States is rather small, e.g., one out of 14 in Bahrain, two out of 11 in Kuwait, three out of 91 in the UAE (more information in Annex I). There is no common practice to distinguish the budget for TVET within the total amount of education expenditure, but some data is available, e.g., Kuwait allocated 1.40% of the total government expenditures for the Public Authority for Applied Education and Training in 2020–2021 [29].

In Levant, the shares of educational expenditure vary: Lebanon managed to increase the share of total government expenditure on education from 7.1% in 2017 to 9.9% in 2020; in Jordan total government expenditure on education decreased from 11.2% in 2017 to 9.9% in 2019, while government expenditure on tertiary education increased from 19.9% in 2016 and 18.5% in 2017 to 22.7% in 2018 [12]. Both basic and higher education sectors in Iraq remain underfunded and education expenditure continues to decrease [30]. Allocations for education in Pakistan also decreased in 2016–2019 [12] and is lower than both the regional average and the average for its income group [16].

According to the World Bank data, the share of education spending as a percent of GDP was 2.3% in Bahrain (2017), 3.6% in Jordan (2018), 2.6% in Lebanon (2019), 2.9% in Pakistan (2017), 2.7% in Qatar (2019) and 3.1% in the UAE (2019), which was lower than both the regional averages and the average for their respective income groups. Oman education spending (6.8% of its GDP in 2017) in government education spending was higher than both the regional average (4.4%) and the average for its income group (4.5%) [16].

**ICT in Higher Education and TVET**

Higher education and TVET are considered as major enablers of digital transformation. HE and TVET are key components of the national visions and strategies for economic development of most of the surveyed countries as their governments recognize that improving quality of science and technology education is imperative. Therefore, these countries are trying to increase the number of HE and TVET institutions. In all the focus countries, there are HEI listed in the international rankings. Various programmes are offered at this level, but mostly these are Bachelor’s, Master’s and Doctoral degree programmes. TVET institutions usually provide short-term basic and certificate-level training courses, as well as diploma-level and degree-level training programmes.

Below are some HEI and ICT-related programmes which exemplify ICT education in the countries:

- **Bahrain**: The Arabian Gulf University, which has the regional status, two public universities and nine out of total 11 private universities offer ICT-related degrees. The most common majors are computer science, engineering, information technology, information systems, software engineering, big data operations and financial technology.

- **Iraq**: Numerous public and private universities, institutes and colleges offer ICT-related majors. The most common ICT-related majors offered in public universities are electronics engineering, information technology, computer science, networks and cyber security, information and communication engineering, computer engineering, automation and control engineering.
• Jordan: Most of 29 universities, 45 university/community colleges and 3,330 recognized non-Jordanian HEI provide ICT-related majors. The most popular ICT majors include computer science, computer engineering, computer information systems, business information technology, data science, AI (and robotics) and software engineering. Abdul Aziz Al Ghurair School of Advanced Computing provides training in advanced computing: software development, cyber security, AI and cloud computing.

• Kuwait: There is one public university and ten private universities, and 22,744 approved international HEIs, which offer ICT-related engineering programmes in computer engineering, industrial management and systems engineering, information systems and technology, telecommunications and networking technology, architectural engineering and computer science.

• Lebanon: There are one public and 48 private universities, university colleges and university institutes. The most frequent ICT-related majors are computer science, information systems, computer engineering, electrical and communication engineering, graphic design, business informatics and information technology.

• Oman: 23 universities and colleges admit students to ICT-related majors, the most frequent of which are mechanical engineering, information technology, mechatronics, computer science, software development, computer networks, telecommunications engineering and information security. Vocational colleges offer only basic courses on ICT skills.

• Pakistan: 105 out of 134 public universities and 70 out of 83 private HEI offer degree studies in ICT. The most frequent ICT majors are computer science, information technology, software engineering, software development, electronic engineering, computer engineering and library & information science.

• Qatar: There are 19 private universities, one public HEI and several public post-secondary educational institutions. ICT-related university and college majors include electrical engineering, mechanical engineering, computer engineering, industrial and system engineering, computer science.

• Saudi Arabia: There are 30 public and 14 private universities, as well as 42 specialized private colleges. The most frequent ICT-related majors include computer science, engineering, information technology, mathematics, computer science and computer engineering.

• The United Arab Emirates: There are three public and 71 private higher education institutions, as well as 17 branch campuses of international universities. Degree studies in ICT are offered by 35 higher education institutions and 12 branch campuses of international universities. The most frequent ICT majors include information technology, mechanical, electrical and electronics engineering, computer science, aeronautical engineering, computer engineering and information systems.

Various TVET institutes, including training centres, technical schools, technical and vocational institutes, colleges and technical universities (in some countries) deliver technical and vocational education. Each country has developed or drafted its own TVET qualification framework. However, these frameworks commonly include certificate- and diploma-level courses, with some tertiary-level studies. The duration of programmes may vary from a few months to two years. Degree courses can last for two to four years, which
is similar to academic degrees. Integration of TVET courses into school-level programmes provides students with an option to choose TVET pathways for higher qualification.

A rise in the number of TVET institutions can be noticed across almost all of the surveyed countries, which reflects governments’ efforts to nurture skilled labour force. Many countries have established specialized higher education institutes for graduate and postgraduate level TVET as an alternative to traditional HEI programmes. Bahrain Polytechnic, the National Skills University and the Information Technology University in Pakistan, the University of Technology and Applied Sciences in Oman and King Abdullah University of Science and Technology in KSA are a few examples in this context. HEI contribute to technical training not only through offering graduate and postgraduate-level TVET programmes but also through delivering vocational courses using available ICT infrastructure. The launch of the online DigiSkills Training Programme by the Virtual University of Pakistan together with the National Technology Fund “Ignite” illustrates this trend. The DigiSkills Programme is freely accessible across Pakistan to train as many people as possible for future jobs involving technology.

As the demand for ICT talents is ever increasing, HE and TVET institutions continue expanding the range of relevant courses. Moreover, these institutions are also revising ICT-related curricula and courses/programmes to align them with competencies requested by the labour market. On the other hand, the employers still think that fresh graduates lack proper skills.

Higher education and TVET institutions of the focus countries are expanding the use of ICT solutions for instruction and for delivering various services to students. Educational institutions are using both in-house and imported software/platforms. The services provided by the platforms include announcements, admissions, academic schedule, examination results, student support, e-library, etc.

In KSA, the Saudi Electronic University and the Arab Open University offer a range of blended-learning programmes, while King Faisal University, Al Imam Muhammad Ibn Saud Islamic University and others offer e-learning programmes. Think Tech serves as a platform for awareness raising and capability building in the areas of emerging technologies such as blockchain, AI and IoT.

**Equity and Inclusion in Higher Education and TVET**

Ensuring inclusive and equitable access to high-quality HE and TVET is at the heart of SDG 4. To meet these international commitments, the governments of the surveyed countries take measures which include the establishment of legislative frameworks and development and implementation of policies and programmes to build more inclusive education systems. The surveyed countries demonstrate progress in addressing the issue of inclusive and equitable quality HE and TVET, although this progress is uneven, particularly at the policy implementation stage. The following financial mechanisms are employed: tuition fee reduction or exemption, in-kind financial support through highly subsidized food, housing and transport for enrolled students, as well as competitive grants for educational institutions to encourage them to admit students from groups at risk of exclusion. To reach underserved populations, some countries have set up virtual universities with an explicit equity focus, such as the Arab Open University (Bahrain, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia), the Allama Iqbal Open University (Pakistan), the Virtual University of Pakistan (Pakistan).
More attention is paid to the participation of women in HE and TVET as compared to the participation of minority groups and migrants and refugees, adults with disabilities, residents of remote or rural areas, etc. The MENA educational gender gap is quite narrow but the region comes last in the Global Gender Gap Index 2020 with low female participation in the labour market. Out of nine surveyed countries representing the region, the lowest regional score in the Educational Attainment subindex is assigned to Iraq (0.812 out of 1.0), whose score is close to that of Pakistan (the only surveyed country outside MENA), while other surveyed countries’ scores tend to the maximum. In Saudi Arabia, female enrolments grew at a Compound Growth Annual Rate of 5.1% during 2012-2018, while Qatari females outnumber male students by a factor of three at the tertiary level (though it might be due to the fact that males skip HE for public sector jobs) [31]. In 2018, 43% of researchers in the Arab region were female, and the current challenge is to remove the cultural obstacles that Arab women encounter on the path to leadership positions [32].

Collaboration Initiatives

To contribute to the achievement of SDG 4, the international community helps the countries that face financial and other constraints by supporting projects and scholarship programmes for HE and TVET sectors in Iraq, Jordan, Lebanon, Bahrain and Pakistan. UN agencies, European Commission, The World Bank and Asian Development Bank, USAID; the governments of Australia, China, Germany, Japan, Norway, UK and other countries are among the most active donors to the region.

For example, the EU Erasmus+ projects for Jordan include: Capacity Building in Higher Education; International Credit Mobility Projects; FORC-Pathway in Forensic Computing, Developing Curricula for AI and Robotics, Improving Higher Education Quality in Jordan Using Mobile Technology for Integration of Disadvantaged Groups (mEQUITY), Developing Curricula for AI and Robotics Application (DeCAIR), Heal+ — Master in Health Informatics, Building Innovation Infrastructure via Technology Transfer Offices (BITTCOIN-JO), etc.

The Arab Open University (AOU) is an excellent example of regional and international cooperation. The network of its regional campuses covers several surveyed countries: Bahrain, KSA, Kuwait, Jordan, Lebanon, Oman. AOU offers undergraduate and graduate programmes in collaboration with the Open University UK.

Businesses which operate in the surveyed countries contribute to setting up an ICT talent ecosystem and boosting the ICT industry’s development in the Middle East. Such international corporations as Cisco, IBM, SAP and Microsoft have launched multiple ICT academies across the region. Facebook, Microsoft and Oracle are among global partners of the One Million Arab Coders Initiative. As for local businesses, Qatar Petroleum, BenefitPay in Bahrain, Oman Liquefied Natural Gas, etc. support ICT-related education through arranging internships, awarding scholarships, sponsoring laboratories and ICT centres, etc. Huawei organises ICT competitions and establishes Huawei ICT Academies. One of the examples is the ICT Academy at AOU which provides quality courses and support services via the Huawei Authorized Information and Network Academy programme. Saudi Talent Enabling Programme (STEP) is another good example, which includes long-term Seeds for the Future Initiative, Huawei ICT Skills Competition, Huawei Future Leaders Initiative, etc.
There is collaboration between HEI in the region and beyond. The Information Technology University in Pakistan is an ICT university aspiring to emulate the success of Massachusetts Institute of Technology. ITU and edX, a non-profit institute founded by MIT and Harvard University, collaborate to provide free online courses. An example of pan-Arab MOOC platform is Edraak initiated by the Queen Rania Foundation for Education and Development to promote knowledge in the Arab world based on the open-source edX platform. A partnership was established between the Lebanese American University, the Lebanese University and University College London developing MOOCs in the Arabic language and hosting them on Edraak and FutureLearn platforms. Disseminating educational resources in languages other than English is an important focus of existing partnerships. Education and research in French is supported: some of the surveyed countries (Iraq, Jordan, Lebanon, Pakistan, Qatar, Saudi Arabia and the UAE) are the members of the global Agence Universitaire de la Francophonie which unites higher education and research institutions teaching and publishing in French.

Collaboration in sharing resources and infrastructure is supported through partnerships within the surveyed countries. The Oman Research and Education Network, an e-learning network providing the infrastructure for fast internet connection, interlinks above 50 local academic institutions and connects them with global research and education communities. With the aim to develop a competitive private tertiary education sector, several of the surveyed countries set up special education zones to host branch campuses of foreign universities, e.g., Education City in Kuwait or Dubai Free Zones, and to attract private investment.

**Innovative Practices in ICT in Education**

The instructional strategies employing innovative ICT have the potential to provide cost-effective quality education and bridge the inequalities in provision of education with respect to geographical areas, cultural differences, social background and gender. HEI are making efforts to launch innovative initiatives, often in collaboration with other institutions. The following examples illustrate the adoption of the innovative technologies in HE and TVET:

- The Virtual University of Pakistan (VU) delivers instruction through its LMS. The University developed several MOOCs, the content of its programmes is freely available at VU website, broadcast television, on DVDs and at VU YouTube channel. The Allama Iqbal Open University (AIOU) offers education using distance, face-to-face, blended and online modes. AIOU aims to bridge the gender, geographical and economic disparities providing quality education to disadvantaged groups of population.

- The Lebanese HE and TVET institutions employ mostly third-party ICT solutions, including LMS and video conferencing tools (e.g., Blackboard, Moodle), MOOC platforms, distance learning infrastructure, cloud platforms, etc.

- The University of Bahrain (UOB) has adopted blockchain technology and awards certificates to its graduates through Amazon Web Services (AWS). Bahrain Polytechnic and UOB launched the Cloud Innovation Centre to provide NGOs, education institutions and government agencies with access to the technology expertise of AWS.
UAE’s Telecommunications and Digital Government Regulatory Authority (TDRA) supports the ICT-sector in education through a number of initiatives: Virtual Academy, an open learning platform with courses in information technology, data and business analytics. TDRA’s ICT Fund provides scholarships and grants to talented students, invests into research and development and establishes incubators.

Saudi Digital Academy aims to develop relevant capabilities of the youth in the field of modern and advanced technologies: data science, AI, natural language processing, cloud computing, web development, blockchain, gamification, AR and VR. As the initiative is public-private partnership, a special place in the curriculum is reserved for apprenticeship and employment.

**Preventing Education Disruption during COVID-19**

The pandemic accelerated the digital transformation of education. Governments paid special attention to define legal framework for teaching and learning under emergency conditions. For example, the UAE Ministry of Education developed a set of guidelines and instructions defining the roles and responsibilities of educational stakeholders online and the Higher Commission of Pakistan developed standards and guidelines for online classes.

The COVID-19 pandemic forced educational institutions to intensify the employment of digital technologies. To ensure the continuity of education, HEI invested much greater amounts to upgrade or expand the digital infrastructure. The majority of HEI used outsourced digital platforms, e.g., Microsoft Teams, Zoom, Google Meet, YouTube, while others employed LMS. During the shift to distance learning, it has become evident that teachers and instructors need additional ICT training to ensure quality and continuity of education. In the UAE, Hamdan Bin Mohammed Smart University launched a free online course “Be an online tutor in 24 hours” available in English, Arabic, Spanish, Russian and French.
Conclusions and Recommendations

The governments of the surveyed countries have elaborated relevant policies and strategic plans that prioritise science, technology, engineering and ICT. Modernising education systems and upgrading ICT infrastructure has become one of the national priorities across all surveyed countries, as the availability of proper infrastructure and qualified human capital are pivotal for achieving Sustainable Development Goals, in particular the following outcome targets:

- **SDG 4.3**: By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university.
- **SDG 4.4**: By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.
- **SDG 4.5**: By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations.

Country-specific recommendations on future actions are presented in case studies. This part of the Insight Report attempts to generalise them for the clusters of surveyed countries, the region and beyond.

Although such ICT-related majors as information technology, computer science and engineering ensure that graduates receive advanced training in the ICT field, currently more specific occupations become in demand at the labour market. Data scientists and machine/deep learning engineers are one of the most marketable occupations, while their training requires new industry-driven educational resources or even more specific majors. For now, higher education and TVET institutions attempt to unbundle core programmes into more specific majors, e.g., data analysis, computational linguistics and computer vision, to equip graduates with relevant skills and prepare them for the modern labour market.

ICT skills are being integrated into curriculum across all levels of education. However, the skills essential for the human capital development are not limited to technical and digital skills. Critical thinking and soft skills, i.e., leadership, innovation, creativity and complex decision making, should be a part of the curriculum as well. HE and TVET institutions should review their programmes thoroughly and with the help of various stakeholders, including employers and recruiters.

Expanding partnerships with the private sector is recognised as an adequate measure to improve the quality of education. Misalignment between education outcomes and employers’ expectations is observed across several of the surveyed countries, and an iterative examination of content and curricula in cooperation with industry representatives is recommended. Constant and rapid emergence of new technologies has an impact on ICT-related majors. It is advised to establish a common platform where public and private sectors can collaborate thus ensuring a steady supply of well-trained ICT specialists. Institutions should become more impactful and responsive to the market needs.

In addition to updating curricula and course content, HE and TVET institutions should integrate the latest educational technologies and adopt innovative pedagogical
approaches. Institutions can foster exchange of experience and collaborative research, share knowledge and resources.

Teaching ICT requires fast, affordable and accessible internet connection both at institutions and at home. In the majority of countries, an increase of investments in e-learning infrastructure is observed, but this trend might not be sustained since it is mainly driven by the current pandemic. Solid legal frameworks, strong political will and commitment are essential for the implementation of policies enabling innovation, and their enhancement is advisable to integrate new technologies, especially AI, in education.

Aligning programmes implemented both by national and international development agencies would increase the impact and optimize the use of available resources, thus accelerating the progress towards Sustainable Development Goal 4. In this context, it is recommended to conduct a thorough inventory of relevant agencies operating in a country and harmonise their initiatives and interventions.

The disruption of education due to the COVID-19 pandemic proved that both institutions and educators should adapt to thrive in the changing environment. Questions of quality of education and academic integrity have been on the agenda for long. Now the issues of data privacy and protection in e-learning, which often depend on the level of ICT and other related skills of students and educators, are in the spotlight. In order to harness digital pedagogy, relevant pre-service and in-service training — for faculty members and staff in general — should be organised. Institutions are advised to establish e-learning units that would supervise the development, management and use of digital content, including open educational resources.

Overall, much improvement can be observed in bringing digital transformation in higher education and TVET of the surveyed countries. A considerable rise in the number of ICT-related courses/programmes is evidenced in HE and TVET institutions. One can also observe an increase in the number of specialised ICT departments in the educational institutes of the focus countries. However, the governments still need to continue their efforts in strengthening the ICT capacities of HE and TVET institutions. ICT tools are being mostly used for campus management and less for learning management. Technologies should reinforce the traditional face-to-face instruction through wider use of blended learning after the pandemic as well.

As the TVET system experiences challenges with public perception in most of the surveyed countries, local educational institutions suffer from lower enrolment and retention rates. TVET is often seen as a second-choice option. To change this attitude, promotion campaigns for TVET as a valid and clear career path is needed. Awareness programmes disseminating stories of success are advised to foster interest and encourage prospective students to apply for TVET education. The capacities of technical and vocational training to equip all students with relevant skills for employment and decent jobs should be highlighted.

To promote inclusive technical education for vulnerable and marginalised groups of population as well as adults, opportunities should be offered to obtain applied general and tech level qualifications. To this end, the TVET system should be updated with the elements of lifelong learning to make such training more accessible. In the provision of technical training, especially at the upper secondary level, it is important to ensure that students, especially those, who opt for a vocational track, could get their learning achievements recognized and are allowed to pursue higher education in the future.
Frameworks that enable students of technical tracks to reuse previously acquired credits at higher levels of education are powerful tools for creating a flexible and adaptable education system. Such a system would allow TVET training to reach out all students and not only those who have not met the admission requirements to enter higher education.

Beyond the recognition of previously acquired competencies, benchmarking national qualifications with regional and international frameworks is also critical and will contribute to the modernisation of national education systems and increase countries competitiveness to train, attract and retain talent. Networking with regional and international organisations is already in progress in several countries and further development of existing initiatives is encouraged.

Ensuring inclusive and equitable access to high-quality HE and TVET is one of the core principles of Sustainable Development Goal 4; thus, gender parity deserves a particular attention. MENA has low female labour force participation and their underrepresentation in the labour market, despite their better learning outcomes from the early years all the way to adulthood, is an illustration to underutilization of human capital. Access of female students to ICT education should be expanded, in parallel this could contribute to the enhancement of their employment opportunities.

In certain countries, females outnumber males in technical education, but upon graduation they experience difficulties finding relevant jobs in both private and public sectors. Enabling participation of females in the ICT sector, especially in decision-making positions, should be prioritised to align the demand and supply of professionals with relevant skills.

The Insight Report released at a time when the COVID-19 pandemic is still far from being behind was intended to encourage all stakeholders involved in decision-making regarding the development, acquisition and empowerment of talent to think beyond COVID. Within the framework of new post-COVID strategies, future talent strategies should be developed for the changed labour market and global landscape of talent competitiveness. In many sectors, digital transformation has become the top priority; thus, digital talent will continue to be in high demand. Digital skills are already a must to thrive in the modern labour market but soon they might have to be supplemented with new skills in such fields as AI, IoT, cloud computing, big data and others that have yet to emerge. To reach maximum capacity, ICT talent development ecosystems should become the result of close collaboration among governments, academia and business.
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# Kingdom of Bahrain

**Population (000, 2020)**  1,702  
**Population density (per km², 2020)**  2,238.9  
**Surface area (km², 2019)**  778  
**Sex ratio (m per 100 f)**  184.5  
**Gross domestic product (billion, current US$, 2020)**  34.73*  
**GDP growth (annual %, 2020)**  -5.1*  
**GDP per capita (current US$, 2020)**  20,409.95*  
**Unemployment (% of labour force, estimate)**  0.8  
**Labour force participation rate (female / male population %, estimate)**  45.0 / 87.2  
**Population growth rate (average annual %, 2015-2020)**  4.3  
**Government expenditure for education (% of GDP, 2017)**  2.3  

*Sources: United Nations Statistics Division (2021); *The World Bank (2020).*
Digital transformation is a strategic priority for the Kingdom of Bahrain and a crucial enabler of its Economic Vision 2030. The decline in hydrocarbon revenues motivates the country to make transition to more knowledge-based economy through consistent efforts for economic diversification, increasing the share of non-hydrocarbon industries and fostering the role of the private sector.

To support the development of the telecommunication and ICT sector, the Government of Bahrain works towards developing infrastructure, establishing transparent policy and regulatory frameworks, creating opportunities for international investment, nourishing highly qualified local talent, expanding e-government services and strengthening e-commerce. The infrastructure development for the ICT industry contributed significantly to the growth of Bahrain’s digital economy.

As of 2019, the mobile penetration in Bahrain was 126% and the broadband penetration reached 144% [1, p.7]. 4G networks are available to almost all consumers in the country and 5G networks have been started to roll out by operators [2, 2019]. The Kingdom expanded its digital infrastructure in 2019 with the launch of the Amazon Web Services data centre, a cloud service platform that offers computer power and database storage, among other things. The National Telecommunications Plans laid the foundations for the growth of the competition in the mobile sector and retail competition in the fixed telecommunication sector as well the development of the national broadband network to provide all businesses and 95% of residences with ultra-fast broadband. There are other ICT industry-related initiatives in place aimed to develop e-governance, cyber security and AI.

The telecommunications sector is considered to be one of the most advanced in the region [3]. Its revenues amounted to 446 million Bahraini Dinars in 2019, or 3% of GDP [2, p. 8]. As of 2019, there were 23 telecommunication companies operating in Bahrain, of which two — Batelco and Zain Bahrain — were licensed to provide mobile services [2, p. 6]. The other major players include STC Bahrain, Viacloud, Ascentech Telecoms, etc. Telecommunication companies provided employment to 2,743 people, of whom 73% were Bahrainis and 32% were females [2, p. 9].

**Policies Related to ICT Use in Education**

The Government Action Plan (2019–2022) outlines a set of objectives to be achieved to ensure the balance between expenditures and revenues, as well as to pursue economic growth, monetary stability and inclusive development. Among other things, the document highlights the importance of developing high quality and safe infrastructure; strengthening the effectiveness and efficiency of the government performance; supporting the advancement of education, healthcare, housing, social welfare and labour market regulation; enhancing the democratic system institutions and adopting legislation and initiatives aimed to ensure gender equity; promoting creativity and excellence;
highlighting the role of women and youth in all government programmes and initiatives, etc.

The Government of Bahrain works consistently on the deployment of digital technologies to enable a more open, responsive and efficient government. This is evidenced by a number of strategic documents developed over the last decades, including the eGovernment Strategies (2010, 2016, 2018) and the Digital Government Strategy 2022, the latter commits to proactively transforming the government services through both emerging and mature technologies, which will enable the country to enhance the digital environment, advance digital readiness and encourage the use of digital technologies. The Strategy covers the following focus areas:

- strengthening digital infrastructure, data and AI to foster digital economy
- accelerating the transformation and collaboration efforts of various public sector entities
- ensuring the enforcement of policies, regulations and standards safeguarding users’ basic rights and protecting them against cyber risks
- strengthening accountability, transparency and civic engagement through open data and e-participation
- encouraging innovation and nurturing entrepreneurship

In line with the Economic Vision 2030 and the Government Action Plan 2019–2022, the Digital Government Strategy 2022 recommends government entities to explore the potential of emerging technologies: cloud computing, blockchain, data analytics, AI, robotics, IoT, smart cities, etc., which provide a wider positive impact on citizen engagement and public administration. To this end, the following initiatives are planned to be undertaken by government entities in collaboration with public and private sector organizations, and academic institutions:

- encouraging the use of new and emerging technologies in the public sector
- building relevant skills within the private and public sectors focusing on talent pipeline and retention
- leveraging the potential of the cloud technologies and big data to encourage economic growth in the country
- promoting innovation through global partnerships and attract global talent
- granting assistance to academic institutions and businesses to develop and adopt innovative solutions using new and emerging technologies
- supporting the private sector and encouraging public-private partnership

The National Telecommunications Plan (2019–2022), adopted in its fifth iteration by the Government in 2020, sets out the strategic plan and general policy for the telecommunication and ICT sector. The key policy-making areas include national optical fibre infrastructure; supply of international connectivity to and from Bahrain, mobile competition, spectrum management, 5G deployment (Machine to Machine, IoT and specialized low latency services using 5G networks), national security of electronic communications networks and services, development of the digital economy and the telecommunication and ICT ecosystem, etc. The major areas of the Plan are as follows:
• developing a national digital transformation strategy and a national strategy on AI to foster investment and innovation in AI technologies
• identifying capacity-building needs and taking measures to provide skills relevant to sustained growth of the telecommunication and ICT ecosystem and digital economy
• promoting and supporting facilities for research and precommercial testing of technology, including 5G or Narrow Band IoT technologies
• identifying relevant initiatives to encourage innovation

In 2002, the Kingdom put into force its Telecommunications Law (Legislative Decree No. 48 of 2002) that regulates various areas of responsibilities within the telecommunication sector. The Telecommunications Directorate of the Ministry of Transportation and Telecommunications is the key authority mandated to design and implement the national telecommunication policy and plan. To oversee the telecommunication sector on a day-to-day basis, the Government established an official independent body, Telecommunications Regulatory Authority (TRA), responsible for regulation, policy making, market research, consumer protection and technical operations related to licensing, spectrum management, telecom utility infrastructure, etc.

In 2017, the Government introduced the Cloud First Policy, which gives a clear road map and sets general guidelines for the adoption of cloud computing solutions at the public sector level and commits all government entities hosting data, applications or services in a centralized cloud environment to apply a cloud-first approach as an integral part of information technology planning and procurement. This approach aims to reduce the government costs related to ICT, increase security by using accredited platforms and improve the quality of services provided to citizens through the enhancement of capacity.

The Personal Data Protection Law (Law No. 30 of 2018) is the national law aimed to address the right to personal data protection and impose obligations on businesses that collect personal data with respect to the way how they use and secure it. The Law requires businesses to manage their personal data processing activities, including ensuring that personal data is processed fairly, that individuals are notified when their personal data is collected and processed, etc. The Personal Data Protection Authority was established to investigate allegations of violations of the Law either as a result of the request of the responsible Minister or a complainant.

The National Higher Education Strategy (2014–2024) highlights the critical role of higher education in economic growth, investment and innovation in Bahrain. Particular emphasis is placed on developing STEM, 21st century skills and knowledge needed to succeed in the labour market by both male and female graduates; strengthening the linkages between higher education, vocational and continuing education; and promoting the effective use of technology in higher education.

The National Research Strategy (2014–2024) provides guidelines for the development of efficient national research system in Bahrain and sets major objectives: strengthening university research capacity, improving integration with international research institutions and addressing such priority research areas as financial services, banking and insurance, health services and public health, ICT, etc.
Bahrain ranks 45th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 38th (out of 193) in the E-Government Development Index and 51st (out of 193) in the E-Participation Index (UN, 2021) and 51st (out of 130) in the Network Readiness Index.

**Higher Education and TVET**

While the Ministry of Education (MoE) is responsible for public education in the country, the Higher Education Council (HEC), working under MoE's chairmanship, is authorised to supervise both public and private universities. As for the TVET sector, it is also supported by the Ministry of Labour and Social Development (MoLSD) [4].

The Education and Training Quality Authority (BQA) is an independent public agency supervising quality assurance activities that target all education and training institutions operating in Bahrain. The Agency is also responsible for the National Qualifications Framework (NQF) breaking down national education into 10 levels and ensuring vertical and horizontal progression across higher education, vocational education and training and general education.

Higher Education qualifications include Diplomas, Associate Degree, Bachelor’s Degree, Postgraduate Diploma, Master’s and Doctoral Degrees. TVET qualifications issued in Bahrain are vocational qualifications, awards and professional awards, certificates, national and higher national diplomas [5].

| Inequality in education17 (%) | 22.7 |
| Unemployment, youth (% ages 15–24) | 4.6 |
| Youth not in school or employment (% ages 15–24) | 18.0 |
| Gross enrolment ratio, tertiary (% of tertiary school-age population) | 50 |

*Source: UNDP (2020).*

According to HEC, Bahraini public tertiary education is offered by two institutions: Bahrain Polytechnic and the University of Bahrain (UOB), the latter is the largest university in the country [6]. As of July 2021, there were one public regional Arabian Gulf University and 11 private universities accredited to offer higher education degrees in the Kingdom [7]. The public UOB and the private Applied Science University are two Bahraini universities listed in the international ratings.

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17 Inequality in distribution of years of schooling based on data from household surveys estimated using the Atkinson inequality index.
Since Bahrain Polytechnic is an ICT-focused university and there are numerous ICT-related majors in UOB (though UOB’s Colleges of Arts and Business Administration were reported to be the two largest colleges in 2018–2019, the number of students taking engineering majors is ranked the third [8]), degrees referring to ICT prevail in the public higher education domain. Private higher education institutions mostly offer degrees in business administration, banking, finance and accounting, management and computer science [7]. In general, business administration is the most popular major in the country even if it might not match the labour market needs [9].

Based on the data of the Information and e-Government Authority’s Census 2020, there were 48,278 students obtaining their higher education degrees, with 27,832 of them being female (136 per 100 males) [10]. The majority of students was presumably enrolled in public universities and colleges as UOB only reported about 25,030 enrolled students in 2018–2019, 16,275 of them being female (186 per 100 males) [8].

As for TVET, BQA stated that in 2020 there were 90 vocational education and training providers registered in the country, “excluding those that have been licensed recently and those that have not undertaken any significant training activity as per the awarded grades in the previous cycle review” [11]. There are four public vocational centres: the Bahrain Training Institute, the Bahrain Institute of Banking and Finance, the Bahrain Institute of Public Administration and the Bahrain Institute of Political Development.

The Information and e-Government Authority reported about 15,862 post-secondary non-tertiary students in 2019, with 5,733 of them being female (57 per 100 males) [10]. Apparently, students getting National Diplomas and Higher National Diplomas are not included into this statistical data. Furthermore, no data is available on TVET enrolment segregated by funding type of TVET institutions.

### ICT in Education

| Individuals with basic ICT skills (%), 2019 | 63 |
| Individuals with standard ICT skills (%), 2020 | 41 |
| Individuals with advanced ICT skills (%), 2020 | 17 |

*Source: ITU (2020).*

The Fourth Industrial Revolution reshapes the request for learning outcomes and skills thus influencing the process of curriculum development. To ensure fair and comprehensive education and to enhance lifelong learning opportunities for all, the Kingdom of Bahrain is working hard to achieve a sustainable, knowledge-based and diversified economy in line with the goals of Bahrain’s Economic Vision 2030. To keep pace with global developments and market needs, the Kingdom introduced a range of pioneering programmes at universities and educational institutions, such as the Big Data Operations Programme, the Master of Environment and Sustainable Development Programme and the Financial Technology Master Programme [12].

Both Bahraini public universities accept students to ICT-related degrees. The Faculty of Engineering, Design and Information & Communications Technology (EDICT) at Bahrain Polytechnic offers Bachelor degrees in Engineering Technology, ICT and Web Media. Two ICT-related colleges are open to students at the University of Bahrain: College of Engineering, which offers programmes in Electrical, Electronics and Mechanical
Engineering, and College of IT with programmes in Computer Science, Computer Engineering, and Information Systems, Network Engineering and Software Engineering, as well as Cyber Security.

An increase in the number of enrolled students is observed in both Bahrain Polytechnic [13] and UOB [8]. As for the actual number of students, the most recent available data refers to 2018–2019. There were 966 students enrolled in Bahrain Polytechnic’s EDICT programmes (excluding Visual Design), 1,879 students enrolled in UOB’s College of IT, with 810 of them being female (76 per 100 males), and 4,112 students enrolled in UOB’s College of Engineering, with 1,890 of them being female (85 per 100 males).

Nine out of 11 private universities and one regional Arabian Gulf University offer ICT-related degrees. The most common majors are Computer Science, Engineering, Information Technology, Information Systems, Software Engineering [7]. Although, no data on the enrolment to the ICT-related majors is available, increase in the overall number of enrolled students in the private universities and colleges was observed [9].

The Bahrain Training Institute (BTI) is one of the major TVET providers in the country. It offers two-year programmes in Higher National Diploma in Electrical and Electronics Engineering, Mechanical Engineering, and Computing and Systems Development (Networking). Shorter Diploma/Extended/Advanced/National programmes in Mechatronics, Software Development, Network and Systems Support are available to students as well. As for private TVET providers, IT courses are among most popular specialisations in centres accredited by BQA [14].

Graduates of ICT-related degrees are employed across all sectors: telecommunications (e.g., Zain, Batelco); healthcare; oil and gas (e.g., Bapco); banking, insurance, finance and fintech (e.g., BenefitPay). According to Bahrain’s Social Insurance Organisation, ICT is the 7th largest job category for Bahraini males, 6th for Bahraini females, 10th for non-Bahraini males and 9th for non-Bahraini females. Engineers (aircraft, oil and gas, operations) are among most highly paid jobs [15].

UOB has adopted blockchain technology to become one of the first educational institutions in the region to award certificates to its graduates through this technology. Through blockchain technology, it is possible to achieve greater security and to verify the academic certificates granted by UOB from anywhere in the world. This ensures the issuance of certified digital certificates that cannot be falsified and can be easily shared with employers and other universities [16].

Cooperation and Partnership Programmes in Higher Education and TVET

The absolute amount of government expenditure on education sector has been decreasing in the previous few years. Funding is distributed among the Education and Training Quality Authority, the Bahrain Teachers College, Bahrain Polytechnic, the University of Bahrain and the Ministry of Education. The latter three receive additional project funding, the amount of which has been fluctuating over three years [17]. As many Arab States, Bahrain attempted to reduce reliance of education on state funding and fostered the opportunities for the growth of private universities in the country [18].

The country invests into modernisation of the infrastructure, in particular Bahrain partnered with Amazon Web Services (AWS) for cloud deployment of the IT
infrastructure [19]. UOB plans to deploy its systems, including student information system (SIS), correspondence management system (CMS) and all backend systems to the AWS capacities [20]. Bahrain Polytechnic and UOB launched the Cloud Innovation Centre to provide NGOs, education institutions, and government agencies with an access to the technology expertise of AWS [21].

Bahrain Polytechnic hosts the Huawei ICT Centre. The University is an active participant of the events and competitions organised by Huawei [22]. UOB aims to strengthen relations with private industry to cultivate the future ICT talent pool through partnership with international companies, for instance, through collaboration with Huawei, which helps UOB students to develop their creativity and skills [23].

These two universities are the most active in establishing partnerships with the private sector. However, various companies, e.g., Zain, Bapco, BenefitPay and BFG, provide students of other universities with an opportunity to undertake their graduation projects with them. Huawei Technologies organises ICT training sessions in private universities, e.g., Ahlia University [24].

Bahrain joined WorldSkills in 2013 [25] and since then, its citizens participated in regional and national competitions. Other partnership programmes available to local students are Erasmus+ (which includes Bahrain as a Partner Country) [26], the Crown Prince’s International Scholarship Programme, Rayaat Programme by AlMabarrah AlKhalifia Foundation and several Community Partnership Scholarships [27].

To support national workforce, the government has launched Tamkeen, the country’s primary labour fund, which supported 1,500 budding entrepreneurs and 4,000 institutions between 2018–2020 [28]. The Fund stimulates employers to hire recent graduates and contributes to their salaries over the first three years using the Wage Support Programme [29].

In 2008, the Regional Centre for Information and Communication Technology was established in the country. This UNESCO Category 2 centre’s activities include policy making, capacity building, research, technological support and fostering collaboration among educational stakeholders. Another Bahrain-based non-profit organisation is the Regional Centre for Development of Educational Software. The Centre’s main focus is ICT in Education in the Arab region.

The country is actively collaborating with intergovernmental organisations to develop national capacities. Within the framework of one cooperation initiative, UNDP Bahrain helped identify critical themes for the development of digital capabilities in Bahrain, such as strategy and responsibility, digital government, digital skills, data and AI, the private sector, and culture of cross government collaboration [30].

Along with initiatives, aimed to support ICT capacity building, Bahrain supports the UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of ICT in Education. The Prize acknowledges the innovative application of new technologies for educational purposes, in line with the 2030 Agenda for Sustainable Development and its Goal 4 on education [31].

**Conclusions and Recommendations**

Bahrain invests a lot of resources and efforts to foster its ICT capabilities. Activities aimed at policy making, infrastructure development and networking with regional and international organisations are in progress.
A common feature in the region is a growing competition for talent across the Gulf countries, especially KSA, Qatar and the UAE, and the Bahraini higher education sector opts for ICT to enable collaboration and innovation [32]. In the Gulf, higher positions in science and engineering remain dominated by men but Bahrain is steadily improving the gender balance in these fields [28].

Further efforts to develop regulatory and legal frameworks are needed to establish a sustainable ecosystem for digital transformation, which — along with additional investments in the educational infrastructure — will enhance national capacities.

Currently, students tend to choose business administration rather than career paths that are in higher demand by the job market [9]. Enrolment in STEM-related fields is around 10% only, while enrolment of students taking a business-related programme is nearly 60% [32]. More efforts are required to promote TVET. The position of Technician (Engineering) is listed among most frequently registered jobs for non-Bahraini males and it seems to be filled by expatriates as neither male nor female Bahraini jobs lists include this position [15].

To ensure the match of the graduates’ skills with the requirements of the job market, it is advisable to focus on partnership programmes between universities, colleges and TVET institutions. To this end, it is recommended to strengthen employers’ engagement in the education sector at all levels. As students need to obtain skills that are relevant to the demands of the most innovative industries, especially AI and 5G, even more intensive partnership programmes should be established between education providers and the most advanced local and international businesses. This will also help educational institutions develop and update their training materials to meet the requirements of the modern ICT sector.

To improve the overall quality of higher education and TVET, it is recommended to benchmark national academic standards against international ones and develop a Bahrain-specific e-learning competency framework, considering the need to integrate 21st century and entrepreneurship skills into the curriculum.

References


### Republic of Iraq

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td>Population (000, 2020)</td>
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<td>Surface area (km², 2017)</td>
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<td>Sex ratio (m per 100 f)</td>
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<td>Gross domestic product (billion, current US$, 2020)</td>
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<td>GDP growth (annual %, 2020)</td>
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<td>GDP per capita (current US$, 2020)</td>
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<td>Unemployment (% of labour force, estimate)</td>
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<tr>
<td>Labour force participation rate (female / male population %, estimate)</td>
<td>11.8 / 74.3</td>
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<tr>
<td>Population growth rate (average annual %, 2015-2020)</td>
<td>2.5</td>
</tr>
<tr>
<td>Government expenditure for education (% of total state expenditure, 2017)</td>
<td>9.3**</td>
</tr>
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</table>

Iraq is a federal parliamentary republic with one constitutionally recognized semi-autonomous region – the Kurdistan Region of Iraq (KRI), which has the right to exercise legislative, executive and judicial powers, except for the exclusive powers that belong to the federal authorities, the Government of Iraq (GOI) [1]. Having faced serious challenges that undermined the country's prosperity, Iraq now attempts to transform itself into a safe and well-governed country with a diversified economy and sustainable environment [2]. Though the implementation of this vision has been complicated by oil price volatility, the COVID-19 pandemic, the increase in both oil and non-oil sectors GDP was projected, and the Government of Iraq plans to achieve sustainable medium-term growth [3]. For this, the country needs to ensure critical infrastructure that would enable digital transformation.

Though Iraq's mobile broadband sector is among the most competitive in the MENA region [4], major telecom operators have only been providing Global System for Mobile Communications (GSM) and Third Generation (3G) connectivity until very recently. However, companies such as Zain Iraq, Asiacell and Korek Telecom started deploying 4G and 4G-LTE services and opening them to the general public. Providers often focus on certain regions, e.g., on Iraq or KRI only [5].

Despite this delay, there is a potential for fast transformations due to the country's location. The networks through the Iraqi territory can provide an alternative and faster solution for Europe-to-Middle-East communication routes thus prone to investing [6]. Attracting investments for these purposes will contribute to the Fibre-to-the-Home (FTTH) Initiative that was prioritised in 2014 by the Government of Iraq but has been deployed with a limited pace [4].

**Policies Related to ICT Use in Education**

The Iraq Vision for Sustainable Development 2030 developed in 2019 by the Iraqi Ministry of Planning sets short-, medium- and long-term goals for the national education sector. The short-term goals include a better education environment (e.g., providing furniture and education material to schools, identifying the schools which require reconstruction), provision of services to the children affected by the conflict (e.g., flexible education options, enrolment and examination procedures for refugees and displaced), and school nutrition programmes in cooperation with the healthcare sector.

The medium-term interventions should target pre-school and primary education, TVET and higher education, including teacher training. These interventions should focus on enhancing skills, so that educational outcomes could meet the needs of the economy. Construction, agriculture, tourism and entrepreneurship should be included in the development programmes.

The long-term goals comprise:

- improving accessibility of education
- enhancing the quality of education, including the quality of higher education institutions

"Education is a right guaranteed by the state... The State shall encourage scientific research for peaceful purposes that serve humanity and shall support excellence, creativity..."

*Constitution of Iraq, Article 34*
• ensuring social cohesion and building peace and active civil awareness
• strengthening the institutional framework and governance in the sector
• upgrading curricula to ensure acquisition of relevant skills, including creative critical thinking, entrepreneurship, problem solving, communication, perseverance and flexibility
• adopting national requirements for quality education
• extending compulsory education until the lower secondary level
• providing the opportunities for education and lifelong learning
• establishing more vocational schools and institutes to meet the labour market needs

To reflect local features of the Kurdistan Region, the Kurdistan Regional Government (KRG) developed its own vision. Introduced in 2013 by the KRI Ministry of Planning, a Vision for the Future 2020 defined priorities such as ensuring access to and high quality of all levels of K-12 education, improving relevance and quality of TVET and higher education and increasing transparency and accountability in education. The higher education goals of the Vision included establishment of polytechnic universities and update of the curriculum for the ICT-related majors, among others. The TVET goals accentuated the need for a uniform TVET student qualification that would be based on employers’ inputs and meet their expectations.

Vision 2030 for KRI will be developed in the near future by the KRI Ministry of Planning with the help of the United Nations Development Programme. The Ministry plans to align the Vision with the new Government Programme 2019–2023 by building a new human resource management system and restructuring the education ministry, focusing on capacity building and development of education facilities, and inviting experts who have experience on a comprehensive review of the education system in order to identify existing gaps and fill them [7].

The National Development Plan for Iraq 2018–2022 has been introduced in 2018 and includes objectives grouped by the level of education that they address. The tertiary education objectives are to improve the international ranking of Iraqi universities, develop their academic quality, enhance partnerships with the private sector and reconstruct universities in the liberated areas.

The following means are to be used to achieve these goals:
• developing cooperation with universities and study centres to attract qualified international teaching staff
• improving curricula and teaching methodologies to promote research, exploration and innovation
• prioritising technical and applied education and capacity-building programmes at all levels
• sponsoring business incubators in higher education institutions and support start-ups
• enhancing opportunities that university entry may serve society at the local and national levels
As for the TVET sector, implementation of vocational training and education programmes to encourage work in the private sector is defined as one of the means to reduce unemployment. Ensuring balance between learning outcomes and labour market requirements by focusing on vocational education and training, as well as developing lifelong learning opportunities, are the measures defined by the Ministry of Planning.

Further planning for TVET and higher education is included in the National Strategy for Education and Higher Education in Iraq for 2012–2022 and the TVET Strategy (2014–2023) for Iraq and KRI, a ten-year strategic plan developed by an inter-ministerial group with the support of EU and the British Council [8].

As for the ICT sector, Iraq’s vision on its development is to be specified. There is no modern data privacy and protection policies in Iraq that would regulate telecommunication services and protect the right to privacy in the digital environment [9]. The ICT-related regulatory framework is fragmented, in general [10].

| Mobile-cellular subscriptions per 100 inhabitants | 92 |
| Fixed (wired)-broadband subscriptions per 100 inhabitants | 10 |
| Mobile-broadband subscriptions per 100 inhabitants | 44 |
| Households with a computer (%), 2017 | 37 |
| Households with internet access at home (%), 2017 | 59 |
| Individuals using the internet (%), 2017 | 49 |

Source: ITU (2020).

Iraq ranks 143rd (out of 193) in the E-Government Development Index and 158th (out of 193) in the E-Participation Index (UN, 2020). The country is present neither in the Global Inclusive Internet Index, nor in the Network Readiness Index.

Higher Education and TVET in Iraq

Higher education in the Republic of Iraq is governed by two ministries: the Ministry of Higher Education and Scientific Research (MoHESR) based in Baghdad and responsible for Iraq, and the Ministry of Higher Education and Scientific Research (MOHE) with the mandate for the Kurdistan Region of Iraq. The TVET sector is regulated by the Ministry of Labour and Social Affairs (MoLSA), the Ministry of Education (MoE), and MoHESR on the federal level and by the KRG’s line ministries in this semi-autonomous region [11].

In 2021, the Council of Ministers approved the Technical and Vocational Qualifications Framework for Iraq (TVQF) intended to bring all TVET qualifications across Iraq into a single Qualifications Framework for TVET [12]. TVQF was developed collectively by the representatives of the Ministries of Education, of Higher Education and Scientific Research, and of Labour and Social affairs in the Republic of Iraq and KRG under the leadership of the Prime Minister’s Advisory Council within the framework of the EU project implemented by UNESCO “Reforming TVET in Iraq”.

TVQF breaks down technical and vocational education and training into 10 levels: Certificate 1–4, Diploma, Technical Advanced Diploma, Technical Bachelor, Technical Higher Diploma, Technical Master, Technical Doctorate. The level from Diploma to Technical Doctorate corresponds to the following higher education levels: Associate
TVET institutions can currently be grouped under the following categories:

- public institutions under the umbrella of polytechnic universities: two years of post-secondary non-tertiary education
- private institutions (may or may not be recognised by Higher Education Ministries in Baghdad and Erbil): two years of post-secondary non-tertiary education and a diploma certificate upon graduation
- institutions under the umbrella of the Ministry of Education (both public and private): three or five years of post-secondary education and a diploma upon graduation
- training centres: two-to-six-month courses and a certificate upon completion

<table>
<thead>
<tr>
<th>Inequality in education (%)</th>
<th>29.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment, youth (% ages 15–24)</td>
<td>25.1</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24)</td>
<td>44.6</td>
</tr>
<tr>
<td>Enrolment ratio, tertiary, technical (2015)</td>
<td>4*</td>
</tr>
<tr>
<td>Enrolment ratio, tertiary, males (2015)</td>
<td>20.2*</td>
</tr>
<tr>
<td>Enrolment ratio, tertiary, females (2015)</td>
<td>18.5*</td>
</tr>
</tbody>
</table>

Sources: UNDP (2020); *Iraq Ministry of Planning (2018).

As TVET and higher education systems of Iraq and KRI are administered separately by national and regional ministries, consolidated statistical data on the total number of educational institutions in the country is not available. In 2018, the Ministry of Planning reported that 35 public universities, 382 private universities and 51 private colleges operated in all provinces during the 2016–2017 academic year [14]. There were four universities and 15 colleges which offered higher education and TVET in technical disciplines. According to MoHESR of the Republic of Iraq, there were 35 public universities (including colleges and institutes) [15] and 66 private universities (including colleges) [16]. In 2021, 16 public universities, 19 private universities and 14 private institutes were listed at the website of the KRI Ministry of Higher Education and Scientific Research [17]. Five Iraqi universities are included in international rankings: the University of Basrah, the University of Technology — Iraq, the University of Baghdad and the University of Kufa. All of them are public and endorsed by MoHESR of the Republic of Iraq.

The most frequent majors offered by public higher education institutions are in the field of education, agriculture, foreign languages and literature, engineering, Islamic studies, mathematics, business administration, computer science and engineering and medicine. Private higher education institutions most frequently offer degrees in law, accounting, foreign languages and literature, business administration, computer science and engineering, dentistry, pharmacy, banking and finance.

According to the Central Statistical Organisation (CSO) under the Ministry of Planning of the Republic of Iraq, 91,093 students graduated from public higher education institutions in the academic year 2018–2019: 71,528 of them were female (93 per 100 males).
were 24,056 graduates from private higher education institutions, 8,715 of them were female (57 per 100 males) [18].

Two of the research centres in Iraq offer either postgraduate or TVET courses. The Kurdistan Institution for Strategic Studies and Scientific Research accepts applications for post-graduate courses only, while the Foundation of Technical Education (FTE) comprises 25 technical institutes and 16 technical colleges offering TVET courses. FTE is an Iraqi member of the UNEVOC Network, UNESCO’s global network for institutions specialized in TVET [11]. During the academic year 2018–2019, 314 vocational schools for students between 15 and 21 years old operated in Iraq (outside KRI) according to CSO. These educational institutions are categorised into industrial, agricultural, commercial, computer and information technology, and arts vocational schools, with the largest categories being industrial (184 institutions) and commercial (103 institutions) [19]. During the same academic year, 30,126 students graduated these schools, above 12,900 graduates were female (74 per 100 males) [18].

**ICT in Education**

<table>
<thead>
<tr>
<th>Individuals with basic ICT skills (%)</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals with standard ICT skills (%)</td>
<td>1</td>
</tr>
<tr>
<td>Individuals with advanced ICT skills (%)</td>
<td>5</td>
</tr>
</tbody>
</table>

*Source: ITU (2020).*

Out of 150 public and private higher educational institutions, 103 universities, institutes and colleges offer some ICT-related majors, with 40 of them being public. Among public universities, the most common majors are electronics engineering, computer science, information and communication engineering, computer engineering, automation and control engineering. The most frequent ICT-related majors offered in private higher education institutions are computer science and engineering, information technology, electronics and telecommunications engineering, networks and cyber security.

According to CSO, there were 12 vocational schools in Iraq (excluding KRI) offering computer and information technologies courses during the academic year 2018–2019. There were 7,451 students taking these TVET courses at that time, 2,077 of them were female (39 per 100 males) [19]. Based on information published on FTE’s website, it is possible to infer that public TVET organisations, which are FTE members, accept students to obtain the following ICT-related majors: electronics engineering, mechanical and chemical engineering, and engineering in medicine (e.g., advanced professional technicians in medicine). Private technical institutes in KRI most frequently offer computer science and computer skills courses to their students.

In general, ICT skills are highly valued by Iraqi employers but the level of these skills among recent graduates is often inadequate. Therefore, extra training to improve students’ skills, knowledge and abilities to fit into specific work environments is needed. Some specific gaps in computer skills may include management software, machine operating software (e.g., CNC, CAD or CAM), banking and SWIFT transfer system software, computer maintenance, etc. [20]. Despite its importance, the prevalence of ICT skills in the country is still low, as only 6.3% of women aged 15 to 19 y.o. have such skills. Nonetheless, more educated Iraqis tend to have more
advanced ICT skills, given that 17.3% of women who attended upper secondary education or higher can carry out computer-related activities [21].

Concerning the job opportunities, telecommunications and mobile payments were seen as the only two competitive tech sectors in Iraq in 2019 while e-commerce, e-banking and digital payments were considered as major underdeveloped sectors in Iraq [22]. In 2020, it was reported that sales workers, business and administration staff and ICT professionals were the top 3 occupations. Employers were recruiting programmers, software engineers, graphic designers, SMM specialists, etc. [20].

**Funding of Higher Education and TVET and Collaboration Programmes**

Basic and higher education sectors in Iraq remain underfunded. As compared to approximately 6% of the total budget was allocated to the Ministry of Education and 3% to MoHESR in 2013, these amounts decreased to approximately 2% annually to each of the Ministries for the period 2019–2021 [23]. Some funding comes from international development organisations. For example, the TVET Reform Project launched in 2014 and funded by the European Union is focused on the following objectives:

- revising and improving the TVET governance quality and assurance systems
- transforming TVET into a demand-driven education based on comprehensive understanding of labour market needs
- facilitating transition to work for TVET graduates and providing work opportunities for vulnerable groups
- improving capacities of TVET stakeholders

Phase 2 of this Project launched in 2020 is to embed the policy and systems developed earlier in federal and local policies and procedures, and to apply them at the institutional level. The goal is to create “Centres of Vocational Excellence (CoVEs) in five MoE vocational schools in Duhok, Mosul, Baghdad, Karbala and Basra and four Technical Universities [24].

The following projects and programmes have been implemented to support Iraqi higher education through capacity building activities:

1. EU Erasmus+:  
   - Training for Medical Education via innovative eTechnology (2017–2021)  
   - Online Platform for Academic Teaching and Learning in Iraq and Iran (2016–2020)  

2. International Research & Exchanges Board (IREX)  
   - U.S. — Iraq Higher Education Partnerships Programme [25]  
   - Iraq University Linkages Programme  
   - Visiting American Professionals for Iraq  
   - MEPI Alumni Connection  
   - Community Engagement Exchange
• Community Solutions Programme
• Building a Remote Experimentation Network for Serving Higher Education Teachers and Students in Iraq (REXNet) (2017–2020)

3. Fulbright: The Fulbright Teaching Excellence and Achievement Programme (Fulbright TEA)

4. Partnerships for Enhanced Engagement in Research (PEER): Soil Water Retention Technology to Improve Vegetable Production among Highly Permeable Soils under Water Scarcity and Dry Climate Conditions In Iraq

5. USAID: LASER

In order to assist Iraqi citizens, including recent graduates, in finding a decent employment, GOI launched the Employment Initiative for Job Opportunities in Iraq. Within the framework of the Initiative, the digital portal was deployed to provide Iraqi nationals with a tool for registering as job seekers. The portal was designed to facilitate the employment process not only in the government sector, but in the private sector as well, including foreign companies and local, regional and international organizations operating in Iraq.

**Conclusions and Recommendations**

Higher education and TVET systems have been and are being affected by numerous challenges tormenting the country, and there is a long way ahead to overcome their consequences. The recent announcement on adoption of TVQF, a qualification framework for TVET in the country, is one important step towards harmonisation of post-secondary education.

Current activities on aligning national qualifications with qualification frameworks in the region and internationally would contribute to modernisation of the Iraqi education system. The need to revitalise the education system is acknowledged at both governmental [14] and intergovernmental levels [4]. It is especially important to link educational outputs with the needs of the labour market. It is advised to encourage establishing the networks of educational institutions and industry representatives, so that the latter could provide their input for the national curriculum. Building upon existing courses and certifications, e.g., Cisco Certified Network Associate or International Computer Driving Licence, is also recommended.

A number of necessary procedures, some of which are to be taken urgently, refer to infrastructural changes. They influence education indirectly but will have a significant effect on its quality. For example, before the COVID-19 pandemic, such applications as LMS, CMS, video conferencing tools were not widely applied in education, mostly due to unaffordable access to the high-speed internet. Now, it is imperative for universities and colleges to use these tools on a daily basis, and accessibility is necessary more than ever.

The country needs to take a general direction towards digital economy, and it should cover all five pillars defined by the World Bank Group’s Digital Economy Framework: Digital Infrastructure, Digital Financial Services, Digital Platforms, Digital Skills, and Digital Entrepreneurship [4]. As the ICT sector is at the core of digital economy, it is also advisable for the government to define clear policies and regulations guiding the sector [22].
To improve the quality of education at the institutional level, universities, colleges, institutes and vocational colleges are encouraged to create and re-use e-learning resources, including open educational tools, reaching out to industry representatives, integrating their knowledge into educational process and investing into on-campus internet access. In order to support e-learning initiatives and to harness digital pedagogy, faculty and staff need to receive relevant training. Finally, to improve international rankings of Iraqi universities, it is recommended to foster scientific research and collaborative research projects.

References


HASHEMITE KINGDOM OF JORDAN
المملكة الأردنية الهاشمية

Population (000, 2020) 10,203
Population density (per km², 2020) 114.9
Surface area (km², 2017) 89,318
Sex ratio (m per 100 f) 102.6
Gross domestic product (billion, current US$, 2020) 43.70*
GDP growth (annual %, 2020) -1.6*
GDP per capita (current US$, 2020) 4,282.77*
Unemployment (% of labour force, estimate) 14.6
Labour force participation rate (female / male population %, estimate) 14.4 / 63.5
Population growth rate (average annual %, 2015-2020) 1.9
Government expenditure for education (% of GDP, 2019) 3.0*

Since emir Abdullah I had established the Emirate of Transjordan as a British protectorate in 1921, the Hashemite Kingdom of Jordan, a fully sovereign state since 1946, had weathered several shocks of regional turmoil but showcased its ability to remain resilient [1]. The global financial crisis of 2009, Arab spring turbulence, disruption of trade routes and increasing food and oil prices resulted in the decline in Jordan's GDP average growth from 6.5% (2000–2009) to 2.5% (2010–2016) with further drop to 2.0% (2016–2019). The World Bank classified Jordan in 2016 as an upper-middle-income country, but in 2017 reclassified the Kingdom as a lower-middle-income economy [2]. In 2020, Jordan's economy contracted by 1.6%, which was the first contraction in three decades. Yet, Jordan's economy is expected to recover gradually from the COVID-19 crisis: real GDP in 2021 is projected to grow by 1.4% [3].

The economic growth was hampered by the above factors and unprecedented influx of migrants. International migrant stock to Jordan rose from 1,146,349 in 1990 to 3,457,691 in 2020 [4]. According to UNHCR, Jordan hosted 754,818 asylum seekers and refugees as of 15 May 2021, including 666,234 Syrians, 66,739 Iraqis, 13,666 Yemenis, 6,024 Sudanese, 709 Somalis, and 1,466 people from other countries [5].

Indicators of human development and living standards have stagnated since 2009, after strong improvements from 1990 to 2008. The Human Development Index (HDI), measuring long and healthy life, access to knowledge, and decent standard of living, has been 0.729 in 2020 ranking Jordan the 102nd of 188 countries [6].

The COVID-19 pandemic has had a devastating effect on economy, in particular the tourism sector, which accounted for 18% of GDP and total employment in 2019 [7]. The COVID-19 crisis has created an urgency to adapt to the post-pandemic world driven by digital infrastructure and services.

**Policies and Strategies Related to ICT and Education**

Jordan has made a strong policy commitment to digital transformation and has been one of the earliest to boost digital transformation in the MENA region [9]. There are several regulations in place to provide guidance and assign roles and responsibilities, mainly for digital government development and transformation. The Ministry of Digital Economy and Entrepreneurship (MoDEE) is designated as the lead agency in facilitating the implementation across government ministries, departments and agencies.

A National Vision and Strategy — Jordan 2025 entered into force in 2015 is a long-term strategy, which includes more than 400 policies/procedures to be implemented through participatory approach between the government, business sector and civil society to ensure improvement in construction and engineering, transport/logistics, tourism and culture, healthcare and life sciences, education, digital and financial/business services.

Jordan Economic Growth Plan 2018–2022 (JESP) issued in 2018 to supplement the Jordan Vision 2025 outlined economic and fiscal strategies, policy interventions, public projects and private investments to achieve sustainable growth, enhance competitiveness, improve business environment, ease bureaucracy, digitalize government services,

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**The Government shall ensure work and education within the limits of its possibilities, and it shall ensure a state of tranquillity and equal opportunities to all Jordanians.**

*Constitution of the Kingdom of Jordan, Article 6.II [8]*

Annex I. Case studies: Hashemite Kingdom of Jordan
improve infrastructure and promote investments. In focus are tourism and hospitality, manufacturing, agriculture, transport, ICT, construction, energy and education.

The National Strategy for Human Resource Development — Education for Prosperity: Delivering Results (2016-2025) — sets out the recommendations for reforming the education system to achieve sustainable economic, social and environmental development. The focus is on governance, quality assurance, the status of educators, private sector providers, engaging employers, innovation and culture change. As to education, the Strategy focuses on access, quality, accountability, innovation and mindset change.

In 2016, REACH2025: Jordan’s Digital Economy Action Plan. From Vision to Action. Roadmap to excellence [10] supplemented JESP to introduce “Smart Government” and upgrade the broadband infrastructure. Furthermore, the optimal utilization of advanced technologies such as 5G, AI and cloud computing is expected to enable Jordan to achieve sustainable economic development and drive productivity across all sectors.

The General Policy for the Telecommunications, Information Technology and Postal Sectors stated the role of MoDEE and the contribution from all ministries and public sector involved in the programme. An emphasis is placed on the integration of digital technologies and encouraging the optimal use of 5G, AI and cloud computing. Jordan’s roadmap for digital transformation was reiterated in 2019 at the Mashreq Digital Economy and Entrepreneurship Development Forum. The Government committed to developing broadband internet access for all, opening the existing broadband network for public-private partnership, increasing nationwide digital payments and launching a national skills development initiative. MoDEE launched the Jordan Digital Transformation Strategy 2020 to adopt a common data architecture for governmental agencies and to allow for the interoperability and support of Business Intelligence, Data Analysis and Big Data [9].

Jordanian Artificial Intelligence Policy 2020 defined the government’s AI approach in vital economic sectors, created an enabling environment for AI application in the legislative, regulatory and technological aspect aimed to build Jordanian capabilities and skills in this field.

Jordanian Cloud Computing and Services Policy (2020) sought to develop an ecosystem contributing to the growth of digital economy through encouraging government entities in the use of cloud services; developing government private cloud; ensuring protection of users’ rights and promoting fair competition among cloud service providers and supporting the growth of local SMEs and Jordan cloud markets.

Open Government Data Policy was approved to provide online access to data possessed by government agencies. Jordan Open Government Data License (v1.0) allows the use, reuse and sharing of data, in line with the Creative Commons (CC-BY) license and enables government entities to publish data without copyright restriction. MoDEE is currently working on a Data Quality Framework for Open Data.
Open Application Programming Interfaces (APIs) Policy 2020 aims to ensure the availability of classified data and information, facilitate access and enable the utilization of key functions of systems and functions available by APIs in a way that supports innovation in the public/private sectors for individuals and entrepreneurs.


The Education Strategic Plan (2018–2022) developed by MOE defines the priority domains: early childhood education and development; access and equity; system strengthening; quality; human resources and vocational education.

**ICT Infrastructure in Jordan**

In parallel to leading political and regulatory environment, Jordan’s ICT infrastructure offers various opportunities and faces some challenges. International connectivity has been secured since 1999 through Aqaba port with the 27,300-km submarine cable. Terrestrial alternatives are available through Amman’s interconnection with two major terrestrial optical fibre networks. But the fixed broadband scores are relatively low and there is a gap between the adoption of basic mobile services and mobile broadband services [9].

According to the Speedtest Global Index, Jordan ranks 80th in download speed over mobile networks [11]. 3G or 4G networks are still under development and are being scaled up, thus the transition to 5G might happen by 2023. The core of the broadband infrastructure is the National Broadband Network (NBN) — a 2,400-km optical fibre open-access data network connecting more than 1,300 sites across Jordan, including 633 public schools, 8 universities, 23 knowledge stations, 127 government entities and 88 healthcare centres.

Jordan is aiming to enhance its cloud infrastructure and increase data storage capacity. A National Government Cloud managed by MoDEE has been established, while the expansion of commercial cloud open to licensed service providers is encouraged. There is a potential for scaling up the cloud infrastructure. Main telecom operators (Zain, Umniah and Orange) and several private providers are currently offering commercial cloud services, including IoT and data storage. Additional cloud hosting capacities are available at Jordanian enterprises, e.g., the Jordanian Electric Power Company. Several small-capacity data centres have been established as part of NBN at 85 schools and substations (shelters).

Jordan has been a pioneer in initiating e-government in the region. E-government services have expanded significantly, from 15 in 2003 to 125 in 2018. However, Jordan is still catching up by expanding its digital government platform and services to support the mid-term development strategy: the number of monthly transactions exceeded one million in January 2020, almost a threefold increase from 2018.

| Mobile-cellular subscriptions per 100 inhabitants | 68 |
| Fixed (wired)-broadband subscriptions per 100 inhabitants | 6 |
| Mobile-broadband subscriptions per 100 inhabitants | 68 |
| Households with a computer (%), 2017 | 43 |
| Households with internet access at home (%), 2017 | 37 |
| Individuals using the internet (%), 2017 | 67 |

*Source: ITU (2020).*
Jordan ranks 70th in the Global Inclusive Internet Index 2020 (The Economist, 2021), 117th (out of 193) in the E-Government Development Index and 148th (out of 193) in the E-Participation Index (UN, 2021) and 72nd (out of 130) in the Network Readiness Index.

**Education in Jordan**

Jordan has long established a legacy of developing high-quality human capital, which has been the key contributor to its economic growth. The Government of Jordan has developed the National Strategy for Human Resource Development (NSHRD), which identifies key interventions needed in early childhood education, basic and secondary schooling, vocational training and higher education to ensure retaining human capital competitive edge.

The National Qualifications Framework (NQF) System adopted via a bylaw in 2019 is a national framework for qualifications, which includes a hierarchical classification of all levels of qualifications and certificates associated with HE, general education and TVET programmes within descriptors for each level to determine the knowledge, skills and competencies.

**Post-secondary Education and TVET System**

Post-secondary education lies within the national priorities. The Council of Higher Education (COHE) is responsible for shaping the HE policy, approving the establishment of HEIs, supervising private HEIs, distributing public subsidies and additional fees for public universities and formulating the criteria of admission. The main authorities governing HE are as follows:

- The Ministry of Higher Education and Scientific Research (MOHE(SR)) is responsible for implementing the higher education policy, coordination of HEIs, conducting agreements with other countries, recognition of universities and degrees from foreign HEIs, as well as assisting the COHE.
- The Accreditation and Quality Assurance Commission for Higher Education Institutions (AQACHEI) advances quality and equity through assessment, ranking or provision of unbiased testing services.

Jordan education spending for 2019 was 3.1% of GDP, the share for 2018 was 3.0% of GDP.\(^{18}\) Funding for the higher education sector comes from the public budget of MOHE and AQACHEI and student fees collected by universities. In 2019, initial government funding per tertiary student was 969 PPP$. The student’s share of spending for higher education (% of GDP per capita) was 22.62% in 2017 and 25.33% in 2018.\(^{12; 13}\)

There are three levels of higher education degrees:

- diploma level: two- to three-year programmes
- undergraduate level (Bachelor degree): four- to six-year programmes
- graduate level (Master or Ph.D.) degree: an advanced level programme

\(^{18}\) In 2018, expenditure on tertiary education (% of government expenditure on education) was 22.7%: https://databank.worldbank.org/source/world-development-indicators
According to MOHE(SR), in the academic year 2020–2021 there were 10 public universities, 16 private universities, 2 universities established under special law, 1 regional university, and 45 university/community colleges. The number of students amounted to 337,280, (863,384 at private universities and 2,508,986 at public universities), while the number of students at community colleges amounted to 34,374 students. The university faculty staff was about 11,394 members (8,011 in public universities and 3,383 in private universities). Among 1,607 specializations, 882, 637 and 88 were open at public universities, private universities and community colleges, respectively: 89 new specializations were open in 2020 (40, 36 and 14 at public and private universities and community colleges, respectively) [14]. Moreover, there are 3,330 non-Jordanian HEIs recognized by the Ministry, of which 283 are Arab institutions and 3,047 are foreign institutions.

Universities offer studies in a wide range of disciplines in Arabic and English: veterinary, trade, business administration and administration, social services, personal services, human studies, mathematics and statistics, agriculture, health and medicine, journalism, media, social and behavioural sciences, educational sciences and teacher training, life sciences, physical sciences, architecture and construction, arts, law, engineering, information technology and computing, personal development, environmental protection, manufacturing and production processes, security services and transport.

The following Jordan universities are mentioned in the international rankings [15]:

• Jordan University of Science & Technology (JUST, Irbid) offers 143 undergraduate and graduate (MSc and PhD) degrees through 15 faculties and institutes. More than 23,000 students are currently enrolled, with nearly 60% of these being females.

• The University of Jordan is one of the leading research universities. Its masters and doctorate degree community of over 4,000 students which offers 161 postgraduate programmes in a wide range of fields taught by internationally recognized scholars.

• Al-Balqa’ Applied University (BAU) established in 1996 supervises private, governmental and military university colleges. BAU is the umbrella that supervises around 30 private and public community colleges offering two-year diploma programmes in various technical and vocational fields.

• The Hashemite University was established in 1991 and started teaching in 1995.

In addition, there are other acknowledged universities, for example, Yarmouk University, the German Jordanian University, Mutah University and Princess Sumaya University for Technology. The latter one is famous for winning the annual IEEE Xtreme Programming Competition against 4,555 teams representing prestigious universities as MIT, the University of Illinois, the University of California, Berkeley, etc.

The majority of the universities provide ICT-related majors. The most popular ICT specialities are as follows: Computer Science; Computer Engineering; Computer Information Systems; Business Information Technology; Data Science; AI (and Robotics) and Software Engineering. Inaugurated in 2019, Abdul Aziz Al Ghurair School of Advanced Computing based at Luminus Technical University College (LTUC) is considered to be a leading school that provides teaching and training with industry-relevant content in diverse areas of Advanced Computing such as Software Development, Cyber Security, AI and Cloud Computing.

Several ministries and agencies supervise TVET: the Ministry of Education, MOHE(SR) and the Ministry of Labour, the Vocational Training Corporation (VTC), BAU, the National
Employment and Training Company, the National Centre for Human Resources Development, the Civil Service Bureau, and the Higher Education Accreditation Commission (HEAC). In 2014, the Employment — Technical and Vocational Education and Training (E-TVET) Council was formed to set policies and plans to develop programmes for all TVET providers in Jordan. The Council supervises the Centre for Accreditation and Quality Assurance (CAQA), established as the national authority for TVET providers and trainees’ accreditation and qualification. In 2019, the Vocational and Technical Skills Development Commission (VTSDC) was set up as a new entity affiliated with the Ministry of Labour. The government also established a National Skills Council for ICT (NSC-ICT) as an advisory body for the VTSDC.

VTC includes 42 training institutes and offers vocational training in almost 20 specializations within more than 100 training programmes. IT family consists of three main training programmes (data entry, computer technical support and design, and computer and network maintenance). In collaboration with BAU, VTC established nine training programmes. The number of students who have been trained since the establishment of VTC in 1977 until the end of 2019 amounted to more than 400,000 trainees, 30% of them are females.

The Jordanian Government has placed tremendous emphasis on reforming the TVET sector in an effort to bridge the gap between education and employment, equip the youth with skills needed in the labour market and increasing the enrolment rate in TVET to 15% of secondary students by 2025 [16]. A law on Vocational and Technical Skills Development has been adopted by the Senate.

The primary source of TVET financing is public funding through the Ministry of Finance (MoF). Furthermore, an E-TVET Fund was created to support the funding for TVET based on demand-driven skills training. The Jordanian Technical and Vocational Qualifications Framework (TVQF) includes four-level vocational qualifications:

- two-year comprehensive (both academic and vocational) and an apprenticeship track offered at the secondary education level (ISCED 3) at secondary school grades 11 and 12 under MOE
- two-year Technical Diploma programmes are offered at the post-secondary non-tertiary level (ISCED 3) by vocational training institutions
- two-year technical education and training offered at the tertiary level (ISCED 4) by community colleges under BAU, as well as public technical and community colleges
- two- to five-year TVET programmes offered at the tertiary education level (ISCED 5–6) by universities, private and public community colleges

Community colleges offer intermediate-level courses to prepare pupils for middle-level professional work in the following fields: engineering, academic, meteorological, administrative, social work, hotel management, computer, paramedical, agriculture, education and applied arts. There are five types of community colleges:

- governmental community colleges that are under the umbrella of BAU
- private community colleges that are administered by the private sector under the supervision of BAU
- applied health colleges and departments of BAU
Annex I. Case studies: Hashemite Kingdom of Jordan

- Jordanian military colleges supervised by BAU
- Community colleges under the umbrella of the United Nations Relief and Work Agency for Palestinians Refugees (UNRWA) supervised by a technical university

According to UNEVOC, 14,217 males and 10,817 females were enrolled in secondary vocational training under MOE in 2016 [16].

<table>
<thead>
<tr>
<th>Inequality in education (%, 2019)</th>
<th>15.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment, youth (% ages 15–24, 2019)</td>
<td>35.0</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24)</td>
<td>32.5</td>
</tr>
<tr>
<td>Gross enrolment ratio, tertiary (% of tertiary school-age population)</td>
<td>34</td>
</tr>
</tbody>
</table>

*Source: UNDP (2020).*

**ICT in Education**

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<thead>
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<th>63</th>
</tr>
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<tbody>
<tr>
<td>Individuals with standard ICT skills (%, 2020)</td>
<td>48</td>
</tr>
<tr>
<td>Individuals with advanced ICT skills (%, 2020)</td>
<td>17</td>
</tr>
</tbody>
</table>

*Source: ITU (2020).*

During the recent years HE and TVET institutions have increasingly used the following ICT tools, in particular during the lockdown: platforms for online classes (mobile conversation for audio materials, e.g., WhatsApp, Microsoft Teams, Zoom, Google meet, YouTube, etc.), platforms for material sharing (WhatsApp groups, Microsoft Teams, Zoom, LMS, university website/email, YouTube video uploads, etc.). A study [17] proved that the majority of the Jordanian universities have relied on web conferencing tools to continue the education process, whereas they should also invest efforts in exploring LMS potential.

Queen Rania has launched and given patronage to several initiatives in education and learning. The Queen Rania Al Abdullah Centre for Educational Technology was established in 2001 to promote the use of modern technologies in education. In 2005, in partnership with MOE, the King and Queen launched an annual teachers’ award, the Queen Rania Award for Excellence in Education. The Queen Rania Teacher Academy launched in 2009 provides in-service professional development programmes for teachers and supports a comprehensive preparation programme for new teachers in partnership with MOE. The Queen Rania Scholarship Programme partners with several universities from around the world to support the provision of a number of scholarships and training for Jordanian students.

In 2014, the Queen Rania Foundation for Education and Development (QRF) initiated a massive open online course (MOOC) platform Edraak to promote knowledge in the Arab world based on the open-source edX platform. Courses are offered primarily in Arabic and translations of courses from prestigious universities like Harvard and MIT.

are available. Edraak collaborated with several regional and international scholars from prestigious universities to design and deliver courses. Currently Edraak contains 192 courses for life-long learning, which typically ran from 3 to 8 weeks. The disciplines vary from Science, Nature & Environment and Design & Architecture to Language & Literature, Business & Entrepreneurship, Health & Nutrition, Employment Skills, Arts & Media, Economics, Education & Teaching, Personal Development, Humanities, etc. The greatest number of courses is in the field of technologies, among them: Excel; International Computer Driving Licence; Digital Marketing: SEO, Analytics, and Online Presence; Cyber Security; Digital Advertising; IoT; Product Management; Intro to Python Programming; Alternative Power Resources; Java Programming; Intro in AI; Data Science & Machine Learning; Computer Essentials; Internet & Email Essentials; Word Processing; Excel Spreadsheets & Advanced Excel; Android Application Programming; Arduino Programming Fundamentals; Game Design; Intro to Networking; iPhone Application Programming; Intro in Nanotechnology; Microsoft Office 365; Agile Methodology; Digital Literacy; WordPress, etc. Edraak also hosts courses for K-12 system students, parents and teachers.

The Jordan Education Initiative (JEI), now integrated within the Queen Rania Foundation, developed the Fursati Liltamayyoz programme, a strategy whereby ICT students across the country worked as interns within schools and communities for part of their coursework during a one-year programme. This experience provided technical and practical training, mentor support and on-the-job training with partner enterprises.

**Internal and External Cooperation**

The HE and TVET reform agenda in Jordan is heavily dependent on external funding. The main donors involved in the support of HE and TVET reforms are the World Bank, EU, USAID, GAC (Canada), BMZ (Germany), DFID (UK), JICA (Japan), KOICA (South Korea), the Ministry of Foreign Trade and Development Cooperation (the Netherlands), UNHCR, the World Food Programme, the governments of Finland, Iceland, Australia, etc.

- **IBRD**: US$200 million Youth, Technology and Jobs Project aims to increase the access of Jordanian youth to jobs and expand government digital services. The project will capitalize on Jordan’s potential to grow digital economy and promote economic growth and job creation.

- **Jordanian Government and EU**: Skills for Employment and Social Inclusion Programme (SESIP).

- **Erasmus+**: Capacity Building in Higher Education; International Credit Mobility Projects; FORC-Pathway in Forensic Computing, Developing Curricula for Artificial Intelligence and Robotics, Improving Higher Education Quality in Jordan using Mobile Technology for Integration of Disadvantaged Groups (mEQUITY), Developing Curricula for Artificial Intelligence and Robotics Application (DeCAIR), Heal+ — Master in Health Informatics, Building Innovation Infrastructure via Technology Transfer Offices Conducted in Jordanian Higher Education Institutions (BITTCOIN-JO), etc.

- **Samsung Electronics Levant** inaugurated the Samsung Academy and Ultrasound Medical Laboratory at the University of Jordan. Samsung Electronics Levant initiated the endeavour by empowering the academic staff with skills and apparatuses in subjects such as electronics, maintenance of mobiles, audio visual devices and LFDs, in addition to specialized courses in software and networks [18].
• Microsoft IT Academy programmes are established in universities to teach the latest technology by the company as additional certified courses within the student's study plan, which would contribute to raising the efficiency of graduate students according to the requirements of the local and global labour market.

• Through the Microsoft 4Afrika initiative aimed at promoting affordable access to the internet, world-class skills and innovation to unlock Africa's potential to create technology, Microsoft has extended its reach beyond Africa and partnered with three Jordanian universities to launch SkillsLab programmes aimed at addressing the shortage of digital talent, empowering youth with digital and AI upskilling. The SkillsLab programme is part of a partnership between Microsoft, the Crown Prince Foundation of Jordan and MoDEE (under MoU signed in 2020).

• Huawei has launched the Jordan's first Huawei ICT Academy at BAU to train more than 500 students per year in such technologies as cloud computing and AI. There are plans to transform the Academy into the regional training centre. For five years Huawei have been running the ICT Competition “Seeds Programme for the Future in Jordan” to stimulate innovative thought, accelerate integration with advanced technology and upgrade the skills of university students.

• Cisco established four Academies at public universities to provide training and technical support in networking. JUST signed MoU to establish Cisco Networking Academy at Yarmouk University and BAU [19].

• Orange Jordan and Ericsson boost online learning and develop the skills of students through Ericsson Educate to increase readiness for jobs in the telecom and ICT sectors. Ericsson Educate programme includes free-of-charge interactive courses on 5G networks, IoT, data science, automation, AI and machine learning [20].

• The University of Jordan and ProgressSoft Corporation officially opened a lab facility in the King Abdullah II School of Information Technology (KASIT) in 2019.

• Int@j Information and Communication Technology Association — Jordan.

• KfW and Al-Hussein Technical University — H2U+ project aims to train and qualify young people in technical and vocational education. It is planned to establish two training centres in the north of Jordan and an academy in Amman. The budget of the project is 25 million EUR.

• Through Employment, Vocational Training and Education project GIZ works on creating economic and vocational prospects for Jordanians, Palestinians and Syrians living in Jordan. GIZ is promoting measures to support education, vocational training and job creation in collaboration with key public institutions.

• UNHCR is working to enhance educational opportunities for refugees in Jordan through the Open Society University Network initiative, which allows refugees to apply for two university-level blended programmes at EdX. Education for Employment (EFE) announced 150 slots for Syrian refugees for an internationally-accredited certificate in software development that qualifies the student to work in Jordan and abroad [21].

• Nuffic runs the project Jordan: Country Plan of Implementation. Orange Knowledge Programme.
• The Crown Prince Foundation, MoDEE and the UAE’s Ministry of Cabinet Affairs and the Future launched the “1 Million Jordanian Coders Initiative” aimed to train young Jordanians in computer programming through free online courses, granting them accredited international certificates and equipping them with skills to enter the labour market [22].

**Conclusions and Recommendations**

The proportion of well-educated and skilled workers in Jordan used to be among the highest in the region in sectors such as ICT and industry, due to a comparatively modern educational system, even though it has experienced some decline during the recent years.

The unemployment rate has increased from 18.7% in 2018 to 19.0% in 2019 [23], and some further increase was observed during 2020–2021. The high unemployment rate is partially due to the mismatch between the skills provided to students in educational institutions and the skills in demand in the labour market. Skills shortages are most prevalent in streams that are not academically oriented (technical and vocational). According to a survey by the Jordan Chamber of Industry, a considerable number of employers believes that students graduating from technical streams “do not meet the basic requirements for the jobs for which they are applying” [24]. Yet, the main reason for unemployment remains the low level of job creation.

Currently the following ICT-related jobs are in demand at the labour market: information systems, network and communication, software engineering, big data, machine learning, computer science, game development, data science and analysis, cloud computing and cloud infrastructure, AI, RPA, information security, IT project management, virtualization, IoT, etc. According to the Ministry of Labour, top 10 professions in demand in 2017–2019 were: ICT sales/advertising and marketing specialists, programmers, telecom engineers, electrical engineers, electronic/computer engineers, electronic/computer technicians, database developers, chief technology officers, website and multimedia designers, electronics ICT maintenance specialists [25].

Most companies need ICT specialists with relevant degrees: IT departments in private companies in IT and telecommunication sectors, banking and hospitals (IT departments), teachers for computer-related courses. But the companies hesitate to hire new graduates because they may lack the experience, skills, and knowledge of how to operate in the corporate environment in addition to not being tested in real life situations.

To bridge the gap between the academy and the industry, so that graduates could find decent jobs and realize themselves professionally, additional efforts are needed. Therefore, educational institutions are advised to:

• Modify/enhance institutional policies or develop new polices to account for labour market requirements.

• Work with national, regional, municipal governments to develop a robust infrastructure to support, attract and retain students.

• Adapt curricula to the requirements of new and emerging ICT and develop ICT-related curricula.

• Improve teachers’ ability to make use of ICT in educational practice.
• Develop educational programmes and plans to introduce the technical side and to include life skills in these programmes and plans.

• Establish e-learning units to supervise the development, management and use of digital content.

• Provide instructors and students with open educational resources/materials hosted on open platforms to be shared nationwide.

• Establish a real partnership with industry representatives so that students could be integrated into working life from the start of the study.

• Create partnerships among educational institutions to exchange experience, share knowledge and jointly build and use virtual laboratory facilities in unified cloud-based systems.

• Support programmes aimed at nourishing ICT talents.

Private companies and institutions should invest and partner with the educational institutions in growing ICT talents, involve students in practical programmes, develop in-home training programmes to nourish talents and provide them with practical skills requested at the labour market. To integrate the latest ICT-related industry knowledge, especially 5G/Al/Cloud technologies, into HE and TVET more effectively, the current local policies should be enhanced to enable innovation in ICT. Local and foreign investments in ICT should be encouraged through simplified procedures, such as exemption from taxes. Linkages between the academy and private sector/industry should be promoted by engaging private and public sectors.

References


### STATE OF KUWAIT

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
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<td>239.7</td>
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<tr>
<td>Surface area (km², 2017)</td>
<td>17,818</td>
</tr>
<tr>
<td>Sex ratio (m per 100 f)</td>
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</tr>
<tr>
<td>Gross domestic product (billion, current US$, 2020)</td>
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</tr>
<tr>
<td>GDP growth (annual %, 2020)</td>
<td>-8.7*</td>
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<tr>
<td>GDP per capita (current US$, 2020)</td>
<td>24,811.77*</td>
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<tr>
<td>Unemployment (% of labour force, estimate)</td>
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<tr>
<td>Labour force participation rate (female / male population %, estimate)</td>
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</tr>
<tr>
<td>Population growth rate (average annual %, 2015-2020)</td>
<td>2.1</td>
</tr>
<tr>
<td>Government expenditure for education (% of GDP, 2020)</td>
<td>6.6*</td>
</tr>
</tbody>
</table>

*Sources: United Nations Statistics Division (2020); *The World Bank (2020).*
The State of Kuwait has robust communication networks that are adequately distributed across the country — 60% of local premises were covered by FTTH networks in 2019, and 100% coverage is foreseen for 2027 [1]. In terms of its mobile infrastructure, Kuwait is fully covered by 4G mobile network services, while local telecommunication companies are cooperating with global 5G networks service providers to deploy 5G.

Even though Kuwait is one of the pioneers in the implementation of e-government services in the region [1], digital transformation of education is now driven mainly by the COVID-19 pandemic. During the first months of the crisis, education in public schools and universities was put on hold for at least six months. Despite having the necessary infrastructure in place, students in public schools were not offered any options to study remotely, while private schools continued working [2].

Currently, both private and public universities and colleges have advanced in terms of digital technologies and programmes that benefit staff and students. On the other hand, educational stakeholders are facing new challenges appearing with online methods of instruction. Maintaining quality of teaching and learning, ensuring students and educators’ data privacy and protection, and developing reliable assessment methods are the main concerns about online instruction and these issues need to be addressed urgently.

**Policies Related to ICT Use in Education**

Back in 2016, the country adopted the New Kuwait Vision 2035, a national development plan aimed, among other priorities, at capacity building. Within the framework of one of its pillars, Creative Human Capital, national authorities are attempting to reform the educational system.

Since 2015 the main drivers of science, technology and innovation (STI) have been the Ministry of Education (MOE), the Ministry of Higher Education (MOHE), the Kuwait Foundation for the Advancement of Sciences (KFAS), Kuwait Institute of Scientific Research (KISR) and Kuwait University [3]. The Communication and Information Technology Regulatory Authority (CITRA) is a public agency overseeing the ICT sector. Policies, regulations and strategies by these organisations were developed with reference to the New Kuwait Vision 2035 and compliment it.

KFAS Strategy 2017–2021 is based on three main directions or “thrusts”: advocating science, education and scientific culture; enhancing research and development capacities for scientific institutions in Kuwait; strengthening capacity for innovation among business and the youth. Recently, KFAS has signed the Memorandum of Understanding with Huawei Technologies Kuwait to empower ICT professionals with skills related to latest technological developments such as big data, cloud computing, AI and pervasive technologies.

KISR’s main activities are focused on such broad areas as oil, water, energy and construction; environment and life sciences; techno-economics [2]. The Institute provides training and development programmes for the general public.
Kuwait University Strategy 2018–2022 was developed and adopted before the COVID-19 pandemic but one of its objectives was to enhance technological infrastructure of the university, including its management information systems.

CITRA’s National Cyber Security Strategy for the State of Kuwait (2017–2020) and Data Privacy Protection Regulation were developed to ensure proper usage of cyberspace, manage information exchange and secure national data. Other national ICT-related policies and regulations include Law No. 20 of 2014 on Electronic Transactions and Law No. 63 of 2015 on Combating Cyber Crimes [4]. CITRA was working on a cloud data classification policy [1], but it is still to be released.

Regulations related to the COVID-19 pandemic were adopted on the organisational level with reference to governmental agencies. For example, the Central Agency for Information Technology (CAIT) launched the “Empowerment” initiative to encourage and enable working from home, including in the education sector. Following this, Kuwait University decided to shift education to remote and distance learning. Now, the University continuously updates its regulations to reflect the changing situation. The Public Authority for Applied Technology and Training (PAAET) and private colleges and universities designed their own procedures as well.

| Mobile-cellular subscriptions per 100 inhabitants | 159 |
| Fixed (wired)-broadband subscriptions per 100 inhabitants | 2 |
| Mobile-broadband subscriptions per 100 inhabitants | 127 |
| Households with a computer (%) | 88 |
| Households with internet access at home (%) | 99 |
| Individuals using the internet (%) | 99 |

Source: ITU (2020).

Kuwait ranks 28th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 46th (out of 193) in the E-Government Development Index and 18th (out of 193) in the E-Participation Index (UN, 2021) and 55th (out of 130) in the Network Readiness Index.

Higher Education and TVET

Education in Kuwait is supervised by MOE and MOHE, however there are a number of agencies with a focus on certain sectors only. The Private Universities Council (PUC) is a public organization in charge of regulations, procedures and licenses related to private universities and colleges.

The National Bureau for Academic Accreditation and Education Quality Assurance (NBAQ) is a government agency that ensures the quality of higher education institutions in the State of Kuwait. Additionally, it maintains the list of foreign higher education institutions accrediting degrees and certificates that are recognised in Kuwait.

The demand for technical and vocational education and training in Kuwait is mainly driven by the needs of the country's corporate sector and national authorities are committed to develop the TVET system [5]. Several training institutes were established in the recent past, including Public Authority for Applied Education and Training (PAAET), a government agency offering a wide range of programmes across all its institutions. Additionally,
the Kuwaiti government often engages private sector partners to arrange training programmes.

Between 2019 and 2021, slightly more than 12% of total government expenditures were planned to be spend on education annually. 9.24% of the total government expenditures were allocated to the Ministry of Education and 2.81% to the Ministry of Higher Education in the Budget 2020–2021 [6]. In the budget of the previous fiscal year, it was 9.50% and 2.42%, respectively [7]. In 2020–2021, 2.19% of the expenditures were allocated to Kuwait University, 1.40% for PAAET, 0.25% for KISR.

Tertiary level of education includes Bachelor’s, Master’s and Doctorate degrees (ISCED levels 5–8). Students taking the TVET path may begin it at the lower secondary level (4 years of Vocational Training Institute, ISCED level 2), the next step can be Training Certificates A-D (Upper Secondary education, ISCED level 3). At post-secondary levels, students are to achieve Applied Diploma and/or complete Applied Bachelor’s Programme [8].

<table>
<thead>
<tr>
<th>Inequality in education (%)</th>
<th>22.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment, youth (% ages 15–24, 2019)</td>
<td>15.8</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24, 2019)</td>
<td>27.0</td>
</tr>
<tr>
<td>Gross enrolment ratio, tertiary (% of tertiary school-age population)</td>
<td>54</td>
</tr>
</tbody>
</table>

*Source: UNDP (2020).*

Public higher education is consolidated within Kuwait University, the largest university in the country. Other 10 universities are private. Additionally, NBAQ maintains the list of Recommended Higher Education Institutes around the world which, as of June 2021, included 22,744 institutions. Three Kuwaiti universities are included in the international rankings: public Kuwait University and private Gulf University for Science and Technology (GUST) and the American University of the Middle East (AUM).

The Central Statistical Bureau (CSB) collects educational statistics from responsible agencies and summarises them into the annual statistical bulletins [9]. Overall, women have much higher enrolment rates than men in tertiary education in the country. Based on CSB’s data, 6,050 students graduated from Kuwait University in the academic year 2019–2020 (first, second and summer semesters), of which 4,664 were female (337 females per 100 males). The year before, 6,441 students graduated from Kuwait University, with 4,996 of them being female (346 females per 100 males).

In the private education sector, women have higher enrolment rates as well. In 2018–2019 (first, second and summer semesters), 5,023 students graduated from private higher education institutions, with 3,197 of them being female (175 females per 100 males). The year before, there were 4,713 graduates and 2,933 of them were female (165 females per 100 males). It is important to highlight that CSB’s data for private higher education is incomplete as it does not include all the colleges and universities.

TVET education in Kuwait is mainly public and supervised by PAAET, which is a UNEVOC Network Member for Kuwait [8]. There are 13 colleges and institutes under PAAET’s umbrella. The only private technical institution, which offers diplomas in either Information Systems and Technology or Business Management, is Kuwait Technical College (ktech).
Annex I. Case studies. State of Kuwait

According to CSB, 4,796 students graduated from training institutes operating under PAAET's supervision in the academic year 2018–2019 (both first and second semesters). 2,042 of them were female (74 females per 100 males). The year before, there were 4,439 graduates and 1,508 of them were female (51 females per 100 males). The largest number of graduates were certified in telecommunication and air navigation, industrial training and secretary and office works majors.

Applied Educational Colleges is another category of TVET institutions supervised by PAAET. They offer majors in basic education, commercial studies, health science, technology studies and nursing. In 2018–2019 (first, second and summer semesters), 8,107 students graduated from these colleges, and 5,286 of them were female (187 females per 100 males). The year before, there were 7,372 graduates, with 4,805 being female (187 females per 100 males, too). The College of Basic Education was the largest in terms of the number of graduates.

**ICT in Education**

| Individuals with standard ICT skills (%), 2020 | 44 |
| Individuals with advanced ICT skills (%), 2020 | 15 |

*Source: ITU (2020).*

Many countries with the majority of Muslim populations display gender parity among graduates in ICT and other STEM fields, but Kuwait has one of the highest ratios of female engineers in the world [2]. College of Engineering and Petroleum at Kuwait University, the largest university in the country, admits students to the following ICT-related engineering programmes: computer engineering, electrical engineering, industrial management and systems engineering and mechanical engineering. In addition to this list, other universities offer programmes such as information systems and technology, telecommunications and networking technology, architectural engineering and computer science.

According to CSB, 786 students graduated from Kuwait University's College of Engineering and Petroleum with 619 of them being female (371 females per 100 males) in 2019–2020 (first, second and summer semesters). Among all the colleges of Kuwait University, the College ranked 4th in terms of the total number of graduates that year and 3rd in terms of the absolute number of female graduates [9].

Three TVET institutions supervised by PAEET offer engineering and related majors: Higher Energy Institute, Industrial Institute in Sabah Al-Salem and College of Technological Studies. CBS reports about 1,416 graduates of the College of Technological Studies, with 287 of them being female (25 females per 100 males), 315 graduates of Higher Institute for Energy (males only), and 822 graduates of Industrial Institute in Sabah Al-Salem (males only) in the academic year 2018–2019. The data for Kuwait Technical College, a private TVET institution offering information systems and technology [10], is not openly available.

Since Kuwait's economy relies heavily on oil and petrochemical products, the Kuwait Petroleum Company and its subsidiary companies are major recruiters of graduates with ICT-related degrees. Similarly to other countries of the region, the majority of the private sector employees working in ICT-related positions are expatriates. Approximately 10% of the labour force registered under the Information and Communication economic activity in 2020 were citizens of Kuwait [11].
Internal and External Cooperation

In 2020–2021, 0.04% of the total government expenditures was allocated to the Kuwait National Fund for Small and Medium Enterprise Development to facilitate and finance the ICT sector. The Fund fosters ICT ventures via ICT-focused incubation programmes implemented in collaboration with local private-sector incubators and internationally renowned specialised institutions to diversify Kuwait’s national economy and promote the development of small and medium enterprises (SME) [1].

Fostering SME is included in Kuwait and World Bank’s partnership programmes. The World Bank contributes to the development of the sector through its Reimbursable Advisory Services (RAS), programmes offered by the World Bank to middle- and high-income countries. The Kuwait RAS portfolio is one of the largest and includes among others support to SME and education [12].

Huawei Kuwait Talent Enabling Programme is a major initiative aimed to contribute towards building a talent ecosystem and boosting the development of the ICT industry. It includes (a) the Seeds for the Future programme that encourages young talents to study latest digital technologies and culture; (b) Huawei ICT Academy & Huawei Certificate programme that focuses on cooperation with top universities to transfer ICT ability to teachers and students; (c) Huawei ICT Skill Competition and (d) Huawei Internship programme that provides a platform for the youth to practice their ICT knowledge and work experience [13].

Kuwaiti youth pursue studies at higher education institutions abroad with the support of MOHE scholarships. The Public Authority for Persons with Disabilities in coordination with the Ministry of Education and the Ministry of Higher Education awards scholarships to students with disabilities and cover education both in the Kuwait and abroad [14].

Conclusions and Recommendations

For more than a decade various attempts have been taken to diversify national economy but more time is needed to reach the goal and to promote the role of the private sector. The country depends heavily on oil, providing security, infrastructure, education and health care through the prevalent social contract. The revenues generated from oil enable to offer well-paid jobs, which in consequence give very few incentives to Kuwaiti nationals to work in the private sector and engage in risky endeavors such as innovation and entrepreneurship [15].

The New Kuwait Vision 2035 places a strong emphasis on education as a catalyst to economic diversification, sustainable growth and social progress. Human capital is viewed as one of the pillars of the Kuwait National Development Plan, which aims to reform the education system to better prepare youth to become competitive and productive members of the workforce. Government spending on education is relatively high, with tertiary education being the largest item of education expenditures, while there is still room for improvement for the Kuwaiti educational system.

One of the challenges faced by the national tertiary education system is the mismatch of the curricula content and resulting skills with the labour market needs. This leads to oversaturation of graduates in disciplines perceived as prestigious and lack of graduates in disciplines vital to sustainable development of the economy, such as science, engineering
and ICT. In addition, the tertiary education system experiences difficulties in preparing the youth to private sector career opportunities.

TVET education has been acknowledged in the national development plan as a means to empower youth, develop education and labour sectors and strengthen the economy [16]. Though several national authorities invest considerable efforts and resources to optimize TVET system, the graduation rate in TVET institutions decreases and there is also a mismatch between the skills taught and the needs of the labour market. There is lack of data that would influence TVET decision-making, policy and curriculum development, as well as coordination of collaboration on the national and regional levels [8].

To meet the challenges faced by tertiary education and TVET and get exposure to latest technologies, such as 5G, AI, IoT, cloud computing, big data, etc., it is recommended to explore the gap between tertiary education and TVET outcomes and the expectations of the labour market, especially in private sector, and update the systems accordingly, in particular:

- revise the curriculum, enrich the classroom experience and apply new creative methods of learning
- improve the quality of teachers and trainers by strengthening the pre- and in-service teacher training mechanisms
- increase the use of technology in teaching and training processes
- identify priority specialisations and encourage enrolment in such programmes to ensure engagement of recent graduates in understaffed industries, which are critical for the national economy
- promote TVET as a valid path capable of equipping all students with relevant skills for employment and decent jobs
- increase public awareness in favour of scientific education and culture and bring the quality of teaching closer to international standards, notably in STEM and ICT education
- advocate science and enhance research and development capacities for educational institutions
- promote an entrepreneurial mindset among the youth
- increase the number of internship opportunities and encourage private sector to get involved in curriculum design and educational activities
- regulate and collect data and performance indexes in order to integrate and align the national HE and TVET system with other regional systems
- encourage the private sector to contribute to the development of tertiary education and TVET through join programmes and financial support
- continue cooperation and partnership programmes with international organizations aimed to support further development of HE and TVET education systems, paying special attention to consistent coordination of programmes implemented

It is advisable to align all the above interventions in order to nourish talents required to ensure sustainable development of the national economy based on the use of advanced technologies.
References


### LEBANESE REPUBLIC

**Al-Jumhūriya al-Lubnāniyya**

<table>
<thead>
<tr>
<th><strong>Population (000, 2020)</strong></th>
<th>6,825</th>
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<tbody>
<tr>
<td><strong>Population density (per km², 2020)</strong></td>
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<td><strong>Surface area (km², 2017)</strong></td>
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<tr>
<td><strong>Sex ratio (m per 100 f)</strong></td>
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<td><strong>Gross domestic product (billion, current US$, 2020)</strong></td>
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<tr>
<td><strong>Unemployment (% of labour force, estimate)</strong></td>
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</tr>
<tr>
<td><strong>Labour force participation rate (female / male population %, estimate)</strong></td>
<td>22.9 / 71.3</td>
</tr>
<tr>
<td><strong>Population growth rate (average annual %, 2015-2020)</strong></td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Government expenditure for education (% of GDP, 2019)</strong></td>
<td>2.6*</td>
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</tbody>
</table>

*Sources: United Nations Statistics Division (2020); *The World Bank (2020).*
The Lebanese Republic makes considerable efforts to unlock the opportunities of digital transformation. The Government of Lebanon understands the importance of using digital technologies to boost sustainable growth and development and plans to take appropriate measures.

Meanwhile, due to internal and regional instability in the last decades the progress is relatively slow. Lebanon continues to suffer from the prolonged effects of a 15-year civil war (1975–1990), the consequences of the Israeli-Hezbollah War (2006) and the conflict in Syria (since 2011) which caused a huge influx of refugees. The devastating explosion at the Port of Beirut (2020) and the COVID-19 pandemic further exacerbated the development constraints. The ongoing political turmoil produced unprecedented challenges to the economy and social system of the country and caused deepening poverty and humanitarian deprivation. The quality and availability of the infrastructure in Lebanon is inadequate: there are significant deficiencies in key basic services, including electricity, water supply, sanitation, transport, waste management, telecommunications, etc.

Lebanon is a small upper middle-income country with a liberal economy based on entrepreneurship and largely reliant on services [1]. The ICT sector is defined as a promising one, mainly due to export orientation, low capital requirements and robust regional and international demand [2]. The sector growth over the years is supported by various government initiatives aimed to strengthen the ICT policy, legal and regulatory framework, to encourage the ICT infrastructure investments and to develop new funding mechanisms for the digital economy (e.g., Circular 331 of the Central Bank of Lebanon). In 2018, the Capital Investment Programme designed to address the issues of the Syrian crisis, develop the infrastructure and public services, stimulate economic growth and create jobs was adopted. The Lebanon SME Strategy: a Roadmap to 2020 was introduced by the Ministry of Economy and Trade, and the Integrated Vision for the Lebanese Industrial Sector to be implemented by 2025 was formulated by the Ministry of Industry with support from UNIDO.

The development of innovation and entrepreneurship is encouraged through the establishment of a technology ecosystem built from incubators and accelerators (e.g., Berytech, Speed@BDD, Smart ESA, Flat6Labs), mentorship and training institutions (e.g., Darwazah Student Innovation Contest, Endeavor Lebanon, MIT Enterprise Forum Pan Arab, Tripoli Entrepreneurs Club), business parks and innovation clusters (e.g., Beirut Digital District, Lebanon Softshore). The government, private sector and international organizations offer financial support for ICT start-ups and growing companies, including equity and grant financing, tax incentives, loan guarantees [3, p. 16]. The vast majority of ICT companies operating in the country are small and medium-sized enterprises; however, multinational corporations are also represented, including big players such as Huawei, Microsoft, Ericsson, Nokia, Cisco, SITA, etc.

In 2019, internet penetration in Lebanon reached 94% [3, p. 16]. Available internet services, managed by the Ministry of Telecommunication, include dial-up, wireless internet and ADSL. The optical fibre network is under deployment and is expected to be completed across the entire country by 2022 [3, p. 16].

**Policies Related to ICT Use in Education**

In 2017, General Michel Aoun, President of Lebanon, launched the Digital Transformation Initiative and empowered the Office of the Minister of State for Administrative Reform (OMSAR) to set the course for the development of the national strategy for digital
transformation. 2018 and 2019 became the years of fruitful work performed by the Government of Lebanon in this area.

In 2018, OMSAR developed the Lebanon Digital Transformation Strategy 2018, a national roadmap for 2020–2030, which advocates an open government approach and seeks to improve radically digital services in Lebanon. The Strategy aims “to guide the digital transformation of public service in Lebanon into an inclusive digital society where all citizens, businesses, government departments and organizations can benefit from internet era opportunities offered by digital technologies” [4, p. 7]. The Strategy was designed to transform the relationship between citizens and government by making services digital-by-default, more convenient and user-friendly; integrate digital technologies into the government routine; support digital industry; and build strong infrastructure. Particularly, the Strategy outlines plans to develop digital skills through the establishment of the Digital Academy to develop digital skills among the government personnel, a new internship programme for graduate students, a digital assistance programme to support citizens from specific groups, the collaboration with academia and research institutions, digital industry partners, etc. In addition, the Strategy includes a programme of actions that implies the implementation of 80 projects supported financially by the World Bank [5].

In 2019, the Ministry of State for Investments and Technology (MSIT) was established and mandated to work out a roadmap for digital transformation in the private sector in order to boost employment and increase the contribution of the knowledge economy to GDP. MSIT Action Plan for 2019–2021 “The Road Towards Digital Transformation: Realizing the Potential of the Lebanese Knowledge Economy” is based on seven pillars: reforming the business environment, attracting capital and investments, improving digital skills on the national level, transforming Lebanon into a pioneering regional hub in the knowledge economy, supporting the export of technology products, local development and innovation. Some of the priority projects within MSIT Action Plan include the National Digital Up-Skilling Project, the Online Digital Skills Learning and Training Platform, the Nationwide Digital Awareness Campaign to promote digital adoption, the Lebanese Global Tech Network and the Global Lebanese Tech Online Platform, the Special Digital Zones Project, the Digital Park/District Design and Service Legislation, the Electronic Transactions (Law 81), the Data Privacy Law, the Cybersecurity Law, Research and Innovation Programme, the National AI Strategy, etc.

While OMSAR is responsible for digital transformation in the public sector and MSIT is in charge of digital transformation in the private sector, the Ministry of Telecommunications plays a major role in the deployment of digital infrastructure in an intensive collaboration with public and private operators.

In 2019, the Lebanon National Cyber Security Strategy was developed to protect the Lebanese economy and the privacy of Lebanese citizens against cyber threats and attacks. The document represents a strategic defence plan which outlines “a set of decisions leading to operational actions that make Lebanon confident, capable and resilient in a fast-moving digital world” [6, p. 35]. The Strategy is based on eight pillars:

- taking defence and deterrence measures and promoting efforts to combat domestic and foreign cyber threats through the establishment of a national system aimed to coordinate responses via a unified law and integrated technical framework
- developing international cooperation in the field of cyber security
- continually growing state capacities to support the development of ICT
• strengthening domestic educational capacities
• strengthening domestic industrial and technological capacities
• supporting the export and internationalization of domestic cyber security companies and industries
• strengthening cooperation between the public and private sectors
• strengthening the role of the security and intelligence agencies and strengthening cooperation and coordination with support and supervision from the Supreme Defence Council

Developed by the Ministry of Economy and Trade to support the ICT sector, the E-Commerce Law includes a set of standards, guidelines and frameworks destined to enable e-commerce in the country, covering areas such as e-transactions, e-payment, e-signature, consumer protection, privacy, copyright and cyber-crimes. A few examples of such standards and guidelines are the E-Transactions and Personal Data Law and the Data Privacy Law and Data Security Law.

The Telecommunications Law (No. 431), issued in 2002, aims to adopt the principle of liberalization of the telecommunications sector and establish the Telecommunications Regulatory Authority (TRA) legally mandated to liberalize, regulate and develop the telecommunications sector.

However, the legislative framework necessary for digital transformation of the country is yet to meet the needs of Lebanon. Some researchers state that existing national laws are “outdated, fragmented and ridden with loopholes”, weak and not consistent with modern international standards; they do not address many relevant issues such as smart cities, social media platforms, AI, metadata, cyber security, etc. [7].

<table>
<thead>
<tr>
<th>Mobile-cellular subscriptions per 100 inhabitants</th>
<th>63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed (wired)-broadband subscriptions per 100 inhabitants</td>
<td>6</td>
</tr>
<tr>
<td>Mobile-broadband subscriptions per 100 inhabitants</td>
<td>64</td>
</tr>
<tr>
<td>Individuals using the internet (%) (2017)</td>
<td>78</td>
</tr>
</tbody>
</table>

Source: ITU (2020).

Lebanon ranks 85th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 127rd (out of 193) in the E-Government Development Index and 148rd (out of 193) in the E-Participation Index (UN, 2021) and 93rd (out of 130) in the Network Readiness Index.

**Higher Education and TVET**

The education system in Lebanon is centralised. The main authority responsible for all levels of education is the Ministry of Education and Higher Education (MOEHE) that unites under its aegis the Directorate General of Education, the Directorate General of Higher Education (DGHE) and the Directorate General of Technical and Vocational Education (DGTVE). MOEHE is responsible for overseeing the overall education sector, from the approval of national policies to the provision of service delivery in public schools, as well as regulation of private schools and other education service providers. Operating as an autonomous body under MOEHE, the National Centre for Educational Research
and Development is mandated to support improvements in education quality through conducting education research, documenting education publications, advising on educational plans, studying curricula and producing textbooks and educational resources, providing in-service training to education staff, developing norms and specifications for school buildings and equipment.

<table>
<thead>
<tr>
<th>Inequality in education (%)</th>
<th>6.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment, youth (% ages 15–24)</td>
<td>17.6</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24)</td>
<td>25.5</td>
</tr>
<tr>
<td>Enrolment in TVET (% as of the total enrolment in secondary education)</td>
<td>27.97*</td>
</tr>
</tbody>
</table>

*Sources: UNDP (2020); *UIS (2020).

DGHE regulates, supervises and coordinates the private higher education sector comprised of private universities, university colleges and university institutes. In addition, DGHE facilitates the transition of TVET students into tertiary education. DGTVE is in charge of the administration of TVET provision, including the public provision of TVET and the performance monitoring of private educational institutions and training providers such as NGOs.

According to Decree No 8590 approved in 2013, the formal TVET system is organized into vocational training and technical education. Vocational training is related to jobs which do not implicate extensive general knowledge. Vocational training is divided into three strands, which can lead to a vocational intermediate level professional diploma (Brevet Professional, BP), a vocational secondary certificate (Lycée Professionnel, LP)/a dual system secondary education diploma (DS, a combination of apprenticeships and vocational education) and Meister Degree. Technical education is related to professions, which require high scientific and technological skills, and therefore more extensive general education. Technical education has three levels: executive, middle and higher, which can lead to a technical baccalaureate certificate (Baccalauréat Technique, BT), a superior technician certificate (Technicien Supérieur, TS) and a technical educational bachelor certificate (Licence d'Enseignement Technique, LET), respectively [8]. Non-formal TVET education is mainly provided by authorised public and private institutions as an addition or alternative to formal studies in the format of short-, mid- and long-term courses that range from three to nine months. Upon completion of such courses, educational institutions and DGVTE issue certificates. Informati TVET is mostly provided as on-the-job training which can lead to a certificate of attendance upon the completion, although less formalized. The most frequently offered TVET courses include accounting, education, arts and design, electrical engineering, nursing, electronics, hospitality and tourism, mechanics, beauty services and information technology.

In 2018, to reform TVET system and provide the roadmap aimed at widening access and improving the quality of TVET provision in the country, the Government of Lebanon with the support of UNICEF and ILO developed the National Strategic Framework for TVET in Lebanon 2018–2022. The document is based on three main strategic axes: (i) expanded access to TVET, (ii) enhanced quality and relevance of TVET provision and (iii) improved TVET governance.
The provision of technical education (except for agriculture and animal husbandry) is under centralized supervision of DGVTE. At the same time, the provision of vocational education is fragmented: short-term vocational training is offered by several providers with little coordination among them, including the Ministry of Social Affairs, the National Centre for Vocational Training, the National Employment Office, national and international non-profit and for-profit organizations. As of 2019, there were 398 private training providers and 168 public training institutes supervised and administered by DGTVE [8]. In 2017, the number of students enrolled in public TVET institutions totalled 26,578 while the number of students enrolled in private TVET institutions was 22,038 [9].

Compared to international standards, public expenditure on education in Lebanon is relatively low. According to the UNESCO Institute of Statistics data, government education expenditure in 2019 averaged around 2.6% of GDP or 8.1% of total government budget [10]. The public expenditure is complemented by considerable investments from private households as private education service delivery dominates in the country.

The higher education system in Lebanon is notable for its diversity and multiplicity which is explained by the fact that different education provision models are adopted [11]. Almost all higher education institutions apply a three-cycle credit-based system and offer programmes at undergraduate, graduate and doctoral levels (Bachelor’s, Master’s and Doctorate degree studies). According to the UNESCO Global Education Monitoring Report, 0.2 million Lebanese students were enrolled in tertiary education out of one million people of appropriate age group in 2017 [12, p. 282]. The number of students enrolled in private universities in Lebanon totalled about 125,000 while the number of students enrolled in the Lebanese University reached almost 76,000 in 2017 (and over 79,000, including 70% female and 30% male students, in 2019) [13; 14].

Higher education in Lebanon is provided by one public Lebanese University as well as 48 private universities, university colleges and university institutes. HEIs mainly offer degree studies in management and business administration, finance and accounting, law, computer science and information technology, economics, hospitality and tourism, marketing, health sciences and education.

The Lebanese University is the only public higher education institution which is financially and administratively independent but falls under the authority of MEHE. There are several private universities included in international university rankings — the American University of Beirut, Saint Joseph University, the University of Balamand, the Lebanese American University, the Holy Spirit University of Kaslik — and the only public one — the Lebanese University.

**ICT in Education**

ICT may create new jobs, which might help solve problems related to unemployment of Lebanese youth and immigrants, as well as emigration of Lebanese skilled workers and strong occupational segregation [15, p. 1].

Following global trends, the opportunities related to the development of the ICT sector fuel local demand and drive IT outsourcing in such areas as cloud computing, AI and robotics, as well as those in which Lebanon has traditionally been strong (FinTech, EdTech and HealthTech) [3, pp. 17–23]. In 2018, the ICT sector contributed to around 2.1% of the country’s GDP (USD 1.1 billion) [3, p. 4]. Today, the sector encompasses ICT services and manufacturing, hardware retail and telecommunications. The ICT services and
manufacturing subsector is the most prominent one; in 2019 it comprised about 10,150 high-skilled individuals employed by 550 companies specialized in digital economy (50%), software (44%), business process services (3%), telecom solutions (1%), data centres (1%) and ICT manufacturing (1%) [3, p. 5]. The trendy areas include development of software, and mobile applications, in particular for people speaking French, English and Arabic, and development of ICT solutions for financial, e-commerce and media streaming sectors.

The majority of Lebanese graduates with ICT-related degrees are employed in the following economic sectors: education, IT and telecommunication, financial services and banking, food and agriculture, healthcare and medicine, broadcast media, e-commerce, public e-governance and security.

As indicated by ILO, there is a continuing demand for a wide range of professional skills, including those related to the ICT field [15, p. 6]. The ICT-related majors that are in demand at the labour-market include computer engineering, computer science, information technology, information system, information security, management information system, data management and analysis, data security, telecommunications engineering, electrical engineering, electronics, mechatronics engineering, food engineering, food technology, medical technology, educational technology, educational engineering, instructional design, web design and development, management and execution of digital content, graphic design, 2D and 3D animation, multimedia creation, Microsoft certificate, management and informatics, accounting and informatics, systems and networks, network security, etc. In many cases, employers in Lebanon expect ICT skills to be complemented with other professional skills, such as communication, foreign languages, entrepreneurship, teamwork and leadership, problem solving, management, innovation and creativity.

To support the ICT-related employment and skills development, the Government of Lebanon plans to promote coordinated activities from the civil society, universities, vocational training centres, non-governmental organisations and private companies [16, p. 23].

Higher education and TVET institutions have a key role to play in providing the ICT-related skills. Degree studies in ICT are offered by 34 universities, including the Lebanese University and private HEIs. The most frequent ICT-related majors in higher education institutions are computer science, information systems, computer engineering, electrical and communication engineering, graphic design, mathematics, business informatics and information technology. The most popular courses related to ICT in TVET institutions include electronics, information technology, information technology management, systems and networks, business informatics, industrial informatics and software engineering.

Higher education and TVET institutions apply different ICT solutions — LMS and video conferencing tools (e.g., Blackboard, Moodle), MOOC platforms, distance learning infrastructure, cloud platforms, etc. — produced mainly by external developers. Some institutions develop their own MOOCs and the others borrow those from other producers. Distance learning infrastructure is usually built in-house or purchased and accessible to registered students of a particular institution only. To support ICT infrastructure, institutions mostly use their own IT specialists, but sometimes have to seek technical support from external companies depending on ICT tools applied.

The Ministry of Education and Higher Education does not recognize academic degrees obtained fully through online learning, which means that students — even during the ongoing coronavirus pandemic — cannot pursue online studies if they wish to enter the job market in Lebanon after graduation [17]. Academic programmes are typically taught...
by higher education and TVET institutions in a face-to-face or blended mode with up to 25% online components [17].

**Technical Assistance to HE and TVET and Partnership Programmes**

UNESCO Global Education Monitoring Report states that the total aid to Lebanon education in 2018 was 280 million USD (of which direct aid was 280 million USD), including 66 million USD for post-secondary education (of which direct aid was 48 million USD) [18, p. 411].

Many UN agencies and donor organisations, including ILO, UNDP, UNHCR, UNIDO, UNICEF, the World Bank, the European Union, the German Federal Ministry for Economic Cooperation and Development (BMZ), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Kreditanstalt für Wiederaufbau (KfW), the UK Department for International Development (DFID), etc. intensified their activities in Lebanon following the Syrian refugee crisis. They provide strategic and technical advice as well as funding.

The major TVET initiatives include:

- UNICEF together with ILO supported in 2018 the development of the National Strategic Framework for TVET in Lebanon 2018–2022.

- ILO conducts a variety of national and regional programmes to support employability, vocational training and decent work. A joint ILO/UNICEF project “Towards Improved Formal and Non-Formal Technical Vocational & Education Training in Lebanon” addresses the challenges and needs identified within the formal and non-formal TVET sector mapping at both policy level and capacity development level of service providers.

- Initiated by ILO and funded by the Norwegian Agency for Development Cooperation, the SKILL-UP Lebanon project is a component of the ILO Global Programme on Skills and Lifelong Learning which aims to provide coordinated and enhanced support for the development and implementation of new generation skills and lifelong learning ecosystems. The Lebanon project builds on ILO Lebanon’s strategy for skills interventions, which seeks to improve the match between skills supply and market demand with a complete package of support, from labour market analysis, a competency-based approach to training, upgrading of skills through training, career orientation and post-training employment support.

- Initiated by UNICEF and financed by KfW, the Generation of Innovation Leaders programme is aimed to address high unemployment rates among marginalised youth in Lebanon and the lack of access to the knowledge economy. This is a three-phase programme that guides youth in the journey to acquiring 21st century digital and business skills through various events, trainings and initiatives.

- Commissioned by GIZ and EU, BMZ implements several projects in Lebanon that contain capacity-building and skills-training components: Local Development Programme for Deprived Urban Areas in North Lebanon aimed to improve the formal vocational training system and Technical Assistance for More Practice Oriented VTE in Lebanon aimed to support entrepreneurs, micro-, small- and medium-sized enterprises and vulnerable youth and women with regard to income creation, infrastructure development and improvements in social stability.

Some examples of the ongoing initiatives focused on higher education are:
• The Foreign, Commonwealth and Development Office (FCDO) of the Government of the United Kingdom through the British Council in Lebanon implements projects aimed to support skills and employability of young people, strengthen English language teaching and learning and increase collaboration in higher education and research.

• RELIEF: Refugees, Education, Learning, Information Technology and Entrepreneurship for the Future project by FCDO aims to have both conceptual and policy impact by reframing the debates surrounding the future development of sustainable cities, the education and capacity-building of refugees, the use of new educational technologies for education to people on the move and the indicators for assessing wellbeing and prosperity.

• Chevening Scholarships in Lebanon offered by FCDO enable students to pursue postgraduate study at UK HEIs and return to contribute to the development of their home country.

• The Arab-German Young Academy of Sciences and Humanities (AGYA) brings together Arab and German scholars to address common challenges and develop solutions through sustainable research cooperation. It promotes early-career scholars (3–10 years after PhD) from 22 countries in the Arab world and Germany. The Academy members implement joint research projects and initiatives with a focus on education, innovation and science policy.

• EU Erasmus+ Programme is an integrated programme that supports transnational partnerships and offers opportunities for cooperation in education, training, etc. Lebanese HEIs and stakeholders may benefit from many opportunities structured over three key actions: learning mobility for individuals, cooperation for innovation and good practices and support to policy reforms. Jean Monnet activities are part of many university projects, including the American University of Beirut, Université Saint-Joseph, Notre-Dame University, the Lebanese University, the Lebanese American University, Beirut Arab University, etc.

• Agence Universitaire de la Francophonie, as a multilateral organization, supports cooperation and solidarity among French-speaking higher education and research institutions. The Agency operates in many countries of Africa, the Arab world, Southeast Asia, North and South America and the Caribbean, Central, Eastern and Western Europe.

• USAID provides scholarships to financially needy and academically eligible public school graduates from Lebanon, including the most disadvantaged areas. These scholarships enable students, often from marginalized families, to study at high-quality Lebanese universities, offering an American-style education that promotes critical thinking, leadership skills and community service.

Lebanese educational institutions make partnerships with ICT companies, governmental and non-governmental organizations:

• The Lebanese American University, the Lebanese University and University College London collaborate with Edraak and FutureLearn platforms on the development of MOOCs “Teachers for Change” and “Transforming Education in Challenging Environments” in the Arabic language.

• Within the MoU between Huawei and the Arab Open University, the Huawei ICT Academy was established for the college students at the Faculty of Computer
Studies. The MoU aims at promoting joint cooperation and paves the way for knowledge exchange by providing quality courses and support services for the university experts and students via the Huawei Authorised Information and Network Academy programme.

- To accelerate ICT training and networking and support young technology professionals, Cisco actively collaborates with leading Lebanese educational institutions. Its Networking Academy Programme helps students prepare for entry-level ICT jobs, additional training or education, and globally recognized certifications.

- DOT Lebanon works towards mobilizing the potential of young people and the power of technology in Lebanon. In particular, the organization offers ICT training programmes which support young leaders to transform the education system through education technology; develop the digital entrepreneurship skills of young people, Palestinian and Syrian refugees; and encourage young college and university graduates to become social innovators that apply digital solutions to solve community challenges. DOT Lebanon collaborates with more than 50 governmental (e.g., Ministry of Education and Higher Education, Ministry of Social Affairs, etc.), non-governmental and private sector organisations (e.g., Cisco, Microsoft, Intel, etc.).

- Partnership between HEIs and Lebanese Industrial Research Achievements (LIRA) aims to bridge the gap between the industry, academia and research centres to build a knowledge-based economy. In particular, the partnership is focused on matching university activities and research with the industry needs; seeking sponsorship for proposed university projects; helping engineering and science students in developing their research and projects output into industrial-quality prototypes at minimum cost; providing industrial trainings, especially on new technologies, to fresh graduates and engineers, etc.

Conclusions and Recommendations

Despite the considerable efforts invested in digital transformation, Lebanon still has a long way to go on this journey. The country demonstrates capacity, innovation and skills required to improve its ICT sector; however, the lack of financial resources, adequate infrastructure and regulations hinders the sector development. In this context, it would be advisable to give priority to the following measures:

- Establishment of policy and legal frameworks intended to govern the development, implementation, adoption, monitoring, evaluation and application of ICT. Strong political will and commitment to implementation of such policies is crucial.

- Investment in development of appropriate and affordable infrastructure and technology equipment across the whole country. Slow internet connectivity and unreliable electricity supply present challenges for both educational institutions and students. Technology equipment and computers should be available and regularly updated to ensure a smooth educational process and student access.

- Promotion of ICT skills and profession among young people, both males and females, in order to harness the economic and social potential of emerging technologies.
HEIs and TVET institutions should be responsive to new demands of the labour market and update curricula to meet ICT industry requirements. Strong partnerships among educational institutions, government agencies and private sector companies should be built to achieve better outcomes and make talent development more effective and mature. As emerging technologies continuously demand new skills, students and young professionals should be able to go through practical and advanced trainings.

The usage and development of open educational resources, tools and services should be encouraged in the educational process; free access to e-libraries on emerging technologies should be provided.

In order to grow the ICT talent pool further, it is important to foster research and publishing activities as well as knowledge sharing within national and international subject-related events and projects.

References


Annex I. Case studies. Sultanate of Oman

SULTANATE OF OMAN سلطنة عمان

Population (000, 2020) 5,107
Population density (per km², 2020) 16.5
Surface area (km², 2017) 309,500
Sex ratio (m per 100 f) 194.1
Gross domestic product (billion, current US$, 2020) 64.65*
GDP growth (annual %, 2019) -0.8*
GDP per capita (current US$, 2020) 12,659.72*
Unemployment (% of labour force, estimate) 2.6
Labour force participation rate (female / male population %, estimate) 31.0 / 90.4
Population growth rate (average annual %, 2015-2020) 3.6
Government expenditure for education (% of GDP, 2019) 5.4*

The Sultanate of Oman began its transition towards digital society in 2003 with an adoption of the first Oman’s national e-Governance Initiative [1]. By now, the national ICT strategies have been revised several times, thus the authorities remain fully committed to transform Oman into a knowledge-based economy. Resources are channelled to modernisation of the national infrastructure, ICT talent development and design of a relevant legal framework.

Through consultations with representatives of various sectors and the analysis of the current status of the digital readiness of institutions operating in Oman, the Ministry of Transport, Communications and Information Technology (MTCIT) attempts to develop a roadmap for the government digital transformation programme and align it with Oman’s Vision 2040. As the Ministry intends to make the ICT sector one of the main pillars for the Vision, it is establishing a unified government network and a number of centres specialized in ICT, cyber security and digital certification [2]. To ensure proper functioning of e-Government, MTCIT launched Omanuna — the Official Oman e-Government Services Portal which provides access to online services, national policies and open data.

As for the education sector, its digitalisation is supported by the Oman Research and Education Network (OMREN) — an e-learning network that united more than 50 local academic institutions. OMREN provides these institutions with the infrastructure for fast internet connection. Additionally, it links Omani academia with such global research and education communities as GÉANT and Internet2.

**Policies Related to ICT Use in Education**

To define national priorities for the future, the Government of Oman developed Vision 2040, a document outlining the strategic directions, goals and key policies. One of its priorities is “Education, Learning, Scientific Research and National Capabilities”. The following objectives are set within the framework of the Vision:

• a high-quality educational system with societal partnership

• a system that empowers human capabilities in the educational sector

• diversified and sustainable funding sources for education, scientific research and innovation

• national talents with dynamic capabilities and skills that are competitive locally and internationally

• an effective national system that nurtures scientific research, innovation, and creativity to build a knowledge-based economy and society

• an integrated and independent system to govern and evaluate the educational ecosystem against national and international standards

• value-enforcing curricula that incorporate Islamic principles and Omani identity, are inspired by Oman’s history and heritage, consistent with the contemporary requirements of sustainable development and future skills, and support the diversification of learning pathways

“The State ensures the independence of universities and admission to higher education for all on an equal footing on the basis of efficiency and merit. The State guarantees freedom of scientific research and supports scientific institutions. It encourages intellectual innovation and the development of arts and literature.”

*Basic Statute of the State*
The vision for the future of education in Oman is described in the National Strategy for Education 2040. It is formulated around six components: maintaining Arabic and Islamic culture; reinforcing national identity; diversifying educational paths; supporting research, innovative and creative capabilities; promoting work ethics; being effective in the world’s knowledge economy. With the framework of the Strategy, it is planned to:

- develop an effective framework for education
- build capacities and expertise for the management of education
- transfer responsibilities from the ministerial level to schools and higher education institutions
- evaluate the performance of educational institutions with the focus on outcomes, especially student competencies

The Information Technology Unit within MTCIT is responsible for the development and implementation of a number of strategies and policies that influence education directly and indirectly. Firstly, the e.Oman strategy is aimed, among other goals, to provide students with basic IT knowledge in schools and offer intermediary and specialised IT training and certification to IT professionals.

The e-Accessibility Policy is developed to provide fair and equal life opportunities to persons with disabilities and the elderly people through the use of ICT. It defines the Standards Compliance Requirements:

2. New ICT-based public equipment shall be made accessible for persons with disabilities and the elderly people.
3. Employees with disabilities and elderly employees shall attend the required training programme on the relevant use of assistive-ICT products and tools.

| Mobile-cellular subscriptions per 100 inhabitants | 134 |
| Fixed (wired)-broadband subscriptions per 100 inhabitants | 11 |
| Mobile-broadband subscriptions per 100 inhabitants | 115 |
| Households with a computer (%) | 96 |
| Households with internet access at home (%) | 94 |
| Individuals using the internet (%) | 95 |

Source: ITU (2020).

Oman ranks 55th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 50th (out of 193) in the E-Government Development Index and 38th (out of 193) in the E-Participation Index (UN, 2021) and 48th (out of 130) in the Network Readiness Index.

### Higher Education and TVET

The Ministry of Higher Education, Research and Innovation (MOHERI) is responsible for higher education and TVET, while the Oman Authority for Academic Accreditation and
Quality Assurance of Education (OAAA) ensures its quality through accreditation of public and private higher education institutions and programmes.

Postsecondary education in Oman is structured in line with the National Qualifications Framework, adopted in 2005. To improve the recognition, consistency and quality assurance of all qualifications offered in Oman, a new and more comprehensive system, Oman Qualifications Framework (OQF), is now being developed by QAA. It is planned that OQF will summarise all academic, technological, professional, vocational and school qualifications. Postsecondary education will consist of the following tracks [3]:

1. Professional pathway — professional qualifications: introductory and levels 1–5.

2. Academic pathway — Certificate, Diploma, Advanced Diploma, Bachelor or Graduate Diploma, Master or Postgraduate Diploma, Doctorate.

3. Technological pathway — Certificate of Technology, Diploma of Technology, Advanced Diploma of Technology, Bachelor of Technology, Master of Technology, Doctorate of Technology.

4. Vocational pathway — two secondary levels (General Vocational Certificate or Certificate of Vocational Competency 1 and General Vocational Diploma or Certificate of Vocational Competency 2) and two postsecondary levels (Certificate of Vocational Competency 3 and Vocational Diploma).

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<tbody>
<tr>
<td>Inequality in education (%)</td>
<td>11.9</td>
</tr>
<tr>
<td>Unemployment, youth (% ages 15–24)</td>
<td>13.2</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24)</td>
<td>19.8</td>
</tr>
<tr>
<td>Gross enrolment ratio, tertiary (% of tertiary school-age population)</td>
<td>38</td>
</tr>
</tbody>
</table>

Source: UNDP (2020).

Three public universities [4], 17 public colleges, 9 private universities and 19 private colleges [5] are accredited to offer higher education degrees. Sultan Qaboos University (SQU), one of the public universities, is the only Omani university listed in international rankings. It is also the largest university in the country.

In the academic year 2020–2021, the following majors were the most popular among university students: management and commerce, engineering and related technologies, information technology, society and culture, natural and physical sciences [6]. Five years ago, practically the same programmes were the most popular: engineering and related technologies, management and commerce, information technology, society and culture, creative arts [7].

In 2020, 12 technical colleges, which operated under the Ministry of Labour and MOHERI, were merged into one public university, the University of Technology and Applied Sciences (UTAS). All colleges continue offering a total of 29 specializations, i.e. 16 in engineering, 7 in information technology and business studies, and 6 in applied science, pharmacy, photography and fashion design. TVET institutions are mainly public but MOHERI is attempting to privatise TVET sector by giving licenses to private institutions that offer short courses.
UTAS is supervised by MOHERI, so technical education and training is closely intertwined with the national higher education system. Even though vocational colleges are now supervised by MOHERI [8], the Ministry of Labour remains the UNEVOC Network Member for Oman [9]. Vocational colleges commonly offer the following certifications:

- Vocational Diploma Certificate (received upon completion of the Vocational Diploma programme)
- Certificate of Professional Competence (received when a trainee fulfils the requirements of the apprenticeship pathway)
- Training Course Certificate (awarded to individuals who seek to upskill, change their careers, — training programmes for people with special needs and local community development programmes award these certificates as well)

Majors with the largest number of enrolled students and offered by vocational colleges are sales and marketing, electronics maintenance, industrial electricity and legal drafting [10].

To study in most of the education institutions, students have to apply through MOHERI as the Ministry plays a major role in both HE and TVET. In addition to accreditation, it supports public and private educational institutions through scholarship programmes to Omani citizens. Only nine public colleges admit students directly.

Based on annual statistical reports by the Higher Education Admission Centre (HEAC), a gradual decrease in the number of students enrolled in postsecondary education (including TVET) was observed between 2016 and 2019 [11]. In 2019, 55,474 students were enrolled in private higher education institutions, 36,110 of them were female (186 per 100 males). As for public education institutions, the total number of students in public higher education institutions is included into the Oman Statistical Yearbook 2020 by the Oman National Center for Statistics and Information (NCSI) [10]. There were 63,710 students registered in the academic year 2018–2019 for the private higher education institutions.

As for the female-to-male ratio, of 13,821 students enrolled in SQU 7,489 were female (118 per 100 males). UTAS did not exist in 2018–2019, but the total number of students in public technical colleges was 33,219. There are fewer female students in these colleges (though not as few as in military academies) — 84 females per 100 males (15,151 female students).

More recent educational statistics is not currently available, though there is data on the number of awarded scholarships for the academic year 2020–2021: MOHERI awarded 22,815 scholarships, 12,035 of them were granted to students of public educational institutions and 9,588 to students of private universities and colleges. Moreover, 797 students received external scholarships to complete their bachelor’s degrees abroad [12]. Private colleges in the Sultanate of Oman are heavily reliant on fees from subsidised students.

There was a slight increase in the number of enrolments in vocational colleges: 1,606 (737 of them were females, i.e., 85 per 100 males) students in 2017–2018 and 1,778 (803 females, 82 per 100 males) in 2018–2019 [10]. Since the decline in the number of expatriates in both public and private sectors is observed in Oman [13], a larger number of Omani nationals might continue choosing vocational colleges as a shorter track to a qualification.
ICT in Education

| Individuals with standard ICT skills (%, 2020) | 37 |
| Individuals with advanced ICT skills (%, 2020) | 8 |


Out of 30 higher education institutions, 23 universities and colleges admit students to ICT-related majors. The most frequent ICT-related majors offered by public higher education institutions are mechanical engineering, information technology, mechatronics, computer science, software development, computer networks, telecommunications engineering and information security. Vocational colleges offer only basic courses on ICT skills.

Between 2016 and 2019, the number of students enrolled in Information Technology decreased at an average annual rate of 28.9%. Similar situation is observed for engineering-related majors, the number decreased at an average annual rate of 26.8% [11]. Both these groupings of majors are in top 3 most funded by MOHERI after the management and commerce majors. 24.1% of the total number of scholarships were granted for engineering-related majors, while students choosing Information Technology received 15.6% of them.

Universities and colleges actively cooperate with the tech industry representatives. Such cooperation often results in opening specialised academies in local higher education institutions. For example, there are Cisco and Oracle academies in many Omani universities and colleges. Huawei opened its academies in SQU and UTAS. In addition to these companies, Omani higher education institutions partner with Microsoft, EC-Council, SAP, Linux Professional Institute, etc.

To minimize the gap between employers’ expectations and skills obtained by students during their studies, several initiatives are implemented at different levels. HE and TVET students enrol for training programmes in computer laboratories or engineering workshops as one of the graduation requirements. For example, in SQU students of the Engineering College should complete a two-week in-house training in their third year during the break between the fall and spring semesters. During their fourth year, students have to complete an eight-week internship in a private company or government agency relevant to their specialisation.

Local universities and colleges actively engage in academic affiliation and cooperation programmes. Some of them are listed below:

- Sohar University — the University of Queensland, Australia
- The Arab Open University — the Open University, UK
- The Modern College of Business and Science — the University of Missouri St. Louis, USA

Students may be awarded a grant for summer training abroad within the framework of such collaboration agreements. They can also apply for Oman Skills, GCCSkills and WorldSkills programmes that establish local, regional and global partnership networks.

On the governmental level, MOHERI establishes partnerships with leading employers such as Eiddad. The programme is aimed to harmonise courses with market needs, create
technical training and collaborative learning opportunities for students. The initiative engages HEI students in one-year applied learning programmes.

**Partnership Programmes in Higher Education and TVET**

Between 2016 and 2020, the amount of expenditure on education remained stable as the Ministry of Finance followed the Ninth Five-Year Development Plan (2016–2020) [14]. Education received 16–17% of total government’s spending. In 2020, 4.67% were allocated to higher education and 1.26% to TVET. In January 2021, the Tenth Five-Year Development Plan (2021–2015) (10th FDP) was published and the Budget for 2021 is based on this Plan. Since the 10th FDP assumes that the amount of spending on social services will be maintained at the same level, it is reasonable to expect that the education sector will receive comparable amounts in the next five years [15].

Higher education and TVET also receive support through various public and private agencies, for example Research and Innovation Unit at MOHERI. The Unit opens ICT-related research chairs at Omani universities, funds PhD studies and opens ICT Centers of Excellence. One of such centres is the Modern Telecommunication and IoT Center of Excellence founded to support the regulatory authorities in the development of a comprehensive 5G and IoT vision for Oman and identify policy objectives, key use cases, industry priorities and deployment scenarios. Another Center’s objective is to encourage local academia, industry and business representatives to participate in the development and testing of new 5G services and applications. The Center is contributing to digital skills development programmes for the youth of Oman. The programmes will foster relevant skills, knowledge and attitudes.

Another public agency supporting ICT education, the Information Technology Unit at MTCIT, opens specialised centres that empower talented Omanis in the main technology areas (Sas Programmes [16]). It contributes to spreading awareness and creating the demand for relevant technologies, encourages research and development, and introduces new technologies to the market. Some of the specialised centres are:

- Sas Center for Virtual Reality, which ensures a robust environment for Virtual Reality, Augmented Reality and other related technologies.
- Sas Center for Mobile Applications Development working to improve mobile applications development capabilities in Oman and establish an ecosystem for local talent development.

The Unit is also engaged in the Free and Open-Source Software (FOSS) initiative and organises introductory lectures, workshops, training courses, competitions and awareness-raising campaigns on FOSS.

Private-sector donors include Oman Liquefied Natural Gas and Petroleum Development Oman, major oil and gas companies. Two companies sponsor laboratories and centres established in local universities, technical and vocational colleges.

OmanTel is one of the major supporters for higher education and research in Oman. In addition to ensuring the connectivity of local universities and colleges, the company provides financial and other kinds of support through the following projects:

- Masader — the virtual science library at OMREN
- Shuaaa — the national research and publication repository at OMREN
• Upgrade — the programme focusing on best graduation projects and transforming them into successful ICT start-ups

• Mobile academy — the mobile learning portal

Conclusions and Recommendations

Oman is one of the two countries in the Gulf region where the number of nationals exceeds that of expatriates. The number of foreign workers is decreasing [13], even though this trend is not observed in the ICT Sector (over 60% of ICT employees are expatriates [10]). The country is still a small market competing for the workforce with strong neighbouring economies.

There are initiatives focusing on talent acquisition from other countries of the region, for example the Oman Technology Fund (OTF). OTF encourages promising technological entrepreneurs, who work in the Middle East, to move to Oman, thus enhancing knowledge-based economy and contributing to the local ICT sector. However, a great amount of national attention has to be channelled to Omani citizens to prepare them for the digital age.

In terms of gender balance in the ICT sector, the alarming 21 female employees per 100 males happens due to a number of expatriates working there. Among 4,416 Omani citizens, engaged in this sector, 1,738 are females (65 per 100 males) [10]. There is a room for improvement, and some activities to promote ICT education among girls is advised. These activities will contribute to the sustainability of the sector, as according to the estimates by the European Commission, the fact that women were significantly underrepresented at all levels in the ICT sector, especially in decision-making positions, was one of the causes of the lack of 700,000 skilled ICT workers needed in Europe [17].

Providing opportunities for in-house trainings and internships would affect the employability of recent graduates, since relevant work experience can be considered one of the major criteria in recruiting of Omani graduates [18].

At the moment, a number of public and private organizations contribute to ICT education in Oman but there is a lack of coherence in their actions. If harmonised, interventions would increase the impact and save available resources. For example, all initiatives can be organised in several levels and then coordinated by one responsible agency. Below is an example of groupings that might be used for the alignment:

1. Initiatives that target students directly would focus on access to learning resources, fostering basic and advanced skills, knowledge and attitudes, sharing knowledge through various courses and trainings.

2. Initiatives supporting institutions are grouped by their aims to provide financial and technological support to HE and TVET. It might include assistance in digitalisation of education, training faculty and staff for e-learning, adoption of emerging technologies to increase the quality of education at the institutional level.

3. Initiatives aimed to link industry representatives, government agencies and local educational institutions would focus on bridging the gap between employers’ expectations and skills that graduates are to obtain during their studies. It might include the development of competency frameworks, organisation of competitions and hackathons.
References

**ISLAMIC REPUBLIC OF PAKISTAN**

<table>
<thead>
<tr>
<th>Population (000, 2020)</th>
<th>220,892</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density (per km², 2020)</td>
<td>286.5</td>
</tr>
<tr>
<td>Surface area (km², 2017)</td>
<td>796,095</td>
</tr>
<tr>
<td>Sex ratio (m per 100 f)</td>
<td>106</td>
</tr>
<tr>
<td>Gross domestic product (billion, current US$, 2020)</td>
<td>262.61*</td>
</tr>
<tr>
<td>GDP growth (annual %, 2020)</td>
<td>-0.9*</td>
</tr>
<tr>
<td>GDP per capita (current US$, 2020)</td>
<td>1,188.86*</td>
</tr>
<tr>
<td>Unemployment (% of labour force, estimate)</td>
<td>4.4</td>
</tr>
<tr>
<td>Labour force participation rate (female / male population %, estimate)</td>
<td>22.2 / 81.7</td>
</tr>
<tr>
<td>Population growth rate (average annual %, 2015-2020)</td>
<td>2</td>
</tr>
<tr>
<td>Government expenditure for education (% of GDP, 2019)</td>
<td>2.5*</td>
</tr>
</tbody>
</table>

*Sources: United Nations Statistics Division (2020); *The World Bank (2020).*
Pakistan is on a development journey in employing digital technologies as vital tools to drive social development and economic growth. The Government of Pakistan recognizes the critical importance of ICT in terms of fuelling the economy and catalysing change across all other sectors. Digital transformation suggests encouragement of a more consistent approach to the use of digital technologies to deliver good governance. Government and public institutions as well as private and development organizations use digital platforms to improve service delivery and increase engagement of citizens. More than 31 ministries and divisions and 50 affiliated departments gained access to e-office suite software, and above 10,500 staff members were trained to use the e-governance system.

The number of IT companies has increased from 1,762 to 2,354 between 2018 and 2020. The Software Technology Parks (STPs) have been established to support the companies. City Islamabad App, Baytee App, COVID-19 Gov PK App, Durust Daam App, Pak Neghayban App, Pakistan Citizen's Portal, Kamyab Jawan Portal, Yaran-e-Watan Platform, We Care Portal, Clean and Green Pakistan and SIS App are some examples of national digital applications.

Advanced technologies, in particular 5G Wireless Networks, have been successfully developed and tested. Mobile technologies play a key role in digital transformation. Mobile broadband networks now cover 80% of the population, and 97% of internet connections are based on mobile connectivity [1]. Mobile technologies also enable the application of IoT across various areas, including agriculture, clean energy and safe water solutions. Today, mobile technologies are the primary channel for digital financial services, birth registration, health solutions and learning platforms.

In education, Pakistan strives to make effective utilization of ICT to provide massive access to quality education at all levels and also to enhance teacher training. Moreover, for better preparation of the youth for a workplace, information and communication technologies have been integrated with the national curriculum from Grade 6 and onwards [2].

Policies Related to ICT and Education

Pakistan Vision 2025 is the national strategy and roadmap of actions to be taken to make Pakistan one of the 25 world largest economies and one of the 75 most competitive countries by 2025. Pillar I of the Vision “Putting People First”, which suggests developing social and human capital and empowering women, is connected to SDGs 1 (poverty), 3 (health), 4 (education) and 5 (gender). Pillar 6 of the Vision “Knowledge Economy: Developing a competitive knowledge economy through value addition” is related to SDGs 9 (innovation) and 4 (education).

Specifically, the Vision aims to double Pakistan's higher education coverage by establishing new universities in each district and supporting the growth of online learning. Emphasis is also placed on improving the quality of science and technology education, particularly the sciences, mathematics and ICT, and modernising existing content to better meet labour market needs and equip the workforce with the required skills [4].

The goal of the Digital Pakistan Policy is mass adoption of emerging digital technologies and innovative applications to enable cross-sector socio-economic development and
transformation of economic activities, governance models, social interaction and achievement of sustainable development goals. The policy includes the strategies for:

- creation of a digital ecosystem with infrastructure and institutional frameworks for the rapid delivery of innovative digital services, applications and content
- promotion of the use of technology in education, health, agriculture and other key socioeconomic sectors
- enhancement of the current market size of electronic and mobile commerce
- empowering women and girls through ensuring equal access to ICT
- promotion of innovation and entrepreneurship, setting up incubators and start-ups in IT sector
- increasing software exports, IT remittances and domestic market
- improving Pakistan’s ICT ranking based on international indices and benchmarks
- bridging the digital divide between urban and rural, unserved and underserved areas, and genders
- promotion of e-Governance
- increasing foreign and domestic investment in the IT/ITeS industries
- reducing barriers to online access for persons with disabilities
- coordination and support to standardization efforts

The main goal of the Rolling Spectrum Strategy (2020–2023) is to provide a framework for coordinating spectrum management activities in a structured and transparent manner. There is a future roadmap for spectrum allocation. The Strategy outlines (a) the challenges faced by spectrum managers, (b) approaches that are now being adopted/investigated by various countries to overcome some of the challenges, and (c) different radio services, their current utilization and the future of various spectrum bands.

The country also developed several policies to promote digital transformation and security. The National Broadband Policy–2021 (Consultation draft) aims to revitalize the state of telecommunication by accelerating the efforts for universal digital inclusion, enhancing the use of digital space and timely and sustainable adoption of cutting-edge technologies and digital infrastructure. The National Cyber Security Policy–2021 is focused on developing secure and resilient cyber systems and networks for national cyber security and response. The National Personal Data Protection Bill–2020 (Consultation draft) formulates the rules for collection, processing and disclosure of personal data.

| Mobile-cellular subscriptions per 100 inhabitants | 80 |
| Fixed (wired)-broadband subscriptions per 100 inhabitants | 1 |
| Mobile-broadband subscriptions per 100 inhabitants | 41 |
| Households with a computer (%), 2019 | 14 |
| Households with internet access at home (%), 2019 | 34 |
| Individuals using the internet (%), 2019 | 17 |

Source: ITU (2020).
Pakistan ranks 90th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 153rd (out of 193) in the E-Government Development Index and 103rd (out of 193) in the E-Participation Index (UN, 2020) and 97th (out of 130) in the Network Readiness Index.

Higher Education and TVET in Pakistan

Since Pakistan is a federal parliamentary constitutional republic, both federal and provincial governments are responsible for higher education and TVET systems. The 18th Amendment to the Constitution of Pakistan (2010) expanded powers and devolved delivery of key education services to the provinces. The federal government still retains core or shared responsibility for higher education and TVET, but multiple bodies are involved in the governance and regulation, implementation and management of post-secondary and professional education both at national and provincial levels.

The main authority responsible for higher education in Pakistan is the Higher Education Commission (HEC), an independent body constitutionally established by the Higher Education Commission Ordinance in 2002. The Ordinance provides controlling authority of HEC to the Prime Minister, who appoints the HEC Chairperson [5]. HEC deals with all matters related to policy, plans, programmes, standards and quality assurance, funding, oversight and transformation of higher education.

The main body responsible for TVET policy, planning and coordination is the Ministry of Federal Education and Professional Training. At the federal level, the National Vocational and Technical Training Commission (NAVTTC) established by the Ministry develops TVET standards, quality-assured national qualifications, assessment and certification system and monitors compliance with the standards. Technical Education and Vocational Training Authorities (TEVTAs) and special organizations (Directorates) plan, coordinate and implement TVET at the provincial and regional levels, while provincial Boards of Technical Education (BTEs) and Trade Testing Boards (TTBs) are responsible for assessment and certification. To improve TVET system, the Government of Pakistan embarked upon a comprehensive reform with the support of the European Union and the governments of Germany, the Netherlands and Norway in 2011. During the first phase of the reform (2011–2016), the National Skills Strategy (2009–2013) was developed in order to propose a paradigm shift from curricula-based to competency-based education, and to envision the provision of relevant skills for employability, industrial and economic development, improvement of access, equity and assurance of quality through an integrated approach. In addition, the National TVET Policy, the National Vocational Qualifications Framework (NVQF) and Competency-based Training & Assessment (CBT&A) were designed. During the second phase of the reform (2017–2021), the TVET Sector Support Programme was initiated to support the implementation of the revised National Skills for All Strategy (2019) at the federal and provincial levels. In accordance with this strategy, in 2019 the Government of Pakistan initiated the Skills for All (Hunarmand Pakistan) Programme, which “provides a comprehensive roadmap for TVET sector to enhancing infrastructure capacity, enlarging skill development opportunities for youth, and bringing their technical capacities at par with international standards both in conventional as well as high-tech and high-end technologies” [6]. Special emphasis in the Programme is given to “effective public-private partnership towards a substantially enhanced role of the private sector in governance of TVET sector and creation of strong linkage with informal sector through recognition of prior learning” [6].
<table>
<thead>
<tr>
<th>Inequality in education (%)</th>
<th>43.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment, youth (% ages 15–24)</td>
<td>8.9</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24)</td>
<td>31.3</td>
</tr>
<tr>
<td>Gross enrolment ratio, tertiary (% of tertiary school-age population)</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: UNDP (2020).

After 12 years of schooling graduates may continue academic education (four- and five-year Bachelor’s, two-year Master’s and doctoral degree programmes) and advanced vocational and professional education. Degree Awarding Institutions (DAIs) or chartered universities and colleges or institutes affiliated with DAIs are two major categories of HEIs. Gross enrolment in tertiary education was the highest in 2015 — 9.73%, while in 2018 this ratio decreased to 8.96% (male 9.55% and female 8.32%) [7]. According to the UNESCO Global Education Monitoring Report, 1.8 million students were enrolled in tertiary education out of almost 21 million people of appropriate age group (2018) [8, pp. 348–349].

According to HEC, there were 217 (134 public and 83 private) HEIs in 2020. The majority of leading universities included in international university rankings are public: the National University of Sciences & Technology (NUST), the Pakistan Institute of Engineering & Applied Sciences, Quaid-i-Azam University, the University of the Punjab, the University of Engineering & Technology, the COMSATS Institute of Information Technology, the Abdul Wali Khan University, Bahauddin Zakariya University, the Government College University Lahore, the Government College University Faisalabad, the Islamia University, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, the University of Agriculture Faisalabad, the University of Sargodha, the University of Peshawar. The Lahore University of Management Sciences (LUMS) is the only private Pakistani university included in international rankings.

Public universities most often offer degree studies in computer science, mathematics, English, business administration and management, biological and life sciences, electrical engineering, education, economics, physics, chemistry, journalism and mass communication, information technology and political sciences. In private universities, the most frequent disciplines are software development and engineering, management and business administration, biology and life sciences, electrical engineering, economics and finance, education, information technology, mathematics, accounting and finance, civil engineering, English, finance and mechanical engineering.

TVET system in Pakistan is “highly complex” and “fragmented” [9, pp. 19–32]. It includes various types of public and private institutions, which provide training at different skills levels and in many trade or technology areas. According to a course/programme type and duration as well as a qualification obtained, TVET may be grouped into four categories:

- short courses of basic training (labour-helper, three to six months) offered by Vocational Training Centre (VTC) or Technical Training Centre (TTC)
- certificate-level training (skilled and semi-skilled worker, 12 to 18 months) offered by VTC and TTC
- three-year diploma-level training offered by a polytechnic institute or commerce college
- degree-level training offered by a college or university
As stated in the Comparative Analysis of TVET Sector in Pakistan, there are 3,581 technical and vocational education institutions, of which 1,062 and 2,519 are public and private, respectively [10, p. 33]. About 285,426 male and 147,811 female students (which amounts to 34% of the total number of TVET students) are enrolled in technical and vocational institutions [11, p. 46]. Among the most frequently offered TVET courses are electrical engineering, dress making and design, computer applications, auto mechanics, heating/ventilation/air conditioning/refrigeration, beauty services, computer and information technologies, welding, electronics applications and AutoCAD [12].

According to the UNESCO Institute of Statistics data, government education expenditure was 2.9% of GDP or 14.5% of total government budget (2017) [13]. The Government of Pakistan has allocated 102 billion Rupees (about 0.64 billion USD) budget for higher education for the year 2020–2021 [14], which is 1.16% of the total government expenditure (calculations of the national expert).

Since 2010 education financing has become the responsibility of provincial governments. Federal government continues to fund public DAIs/Universities, while provincial governments establish and finance new public universities. Private DAIs/Universities manage their expenditures chiefly through the tuition fees. Provincial governments finance numerous public graduate and postgraduate colleges affiliated with DAIs/Universities.

The amount of public TVET funding is yet to meet the needs of the country, where almost one third of the population is aged between 10 and 24 years, and the share of unemployed youth increases. In 2017–2018, the federal government allocated 2,376 billion Rupees for TVET [14]. As calculated by the national expert, federal expenditure for TVET in 2020–2021 amounts to 0.545 billion Rupees. Some TVET programmes are sponsored by Telenor Pakistan and Pakistan Mobile Communications [15].

### ICT in Education

<table>
<thead>
<tr>
<th>Individuals with basic ICT skills (%), 2019</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals with standard ICT skills (%), 2019</td>
<td>2</td>
</tr>
<tr>
<td>Individuals with advanced ICT skills (%), 2019</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: ITU (2020).*

Information Technology sector, which is among the fastest growing sectors, plays a vital role in the development of other sectors, as ICT graduates are in demand in almost all the sectors of economy:

- education: recent COVID-19 pandemic has forced educational institutions to provide online learning, some examples of the projects are Smart Classrooms, Smart schools, TeleTaleem, e-Learn Punjab and Youth Employment Programme
- e-commerce
- IT industry
- Software Technology Park and IT Incubation Centre
- mobile and broadband sector

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20 The calculations by the national expert are based on the data extracted from Federal Budget 2020–21 and other financial documents by the Government of Pakistan.
• public e-Governance sector, including big data related to e-Government services such as National Database & Registration Authority, Federal Bureau of Revenue, Accountant General of Pakistan Revenue, ICT Administration, etc.

• health and agriculture

• broadcast media

• banking

In the recruitment process, employers consider the degree major, the rank of the educational institution from which the degree has been obtained and job-related skills of the candidate. The following ICT-related majors are in demand at the labour market: AI, data science, VR, IoT and AR, web engineering (Java, PHP and Python), UX/UI, networking, data modelling, business logic, API layer, user interface and IT management [16].

There are 175 universities offering degree studies in ICT: 105 are public and 70 are private. The most frequent ICT majors in public universities are computer science, mathematics, information technology, software engineering, library and information science; whereas at private universities these are computer science, software development and engineering, information technology, mathematics, electronic engineering and computer engineering.

The most popular courses related to ICT in TVET institutions include computer applications, computer and information technologies, electronics applications, AutoCAD, computer hardware and networks, web design and development and graphics design [12]. The number of students enrolled in ICT-related courses at private institutions exceeds that at public ones, which is proportional to the shares of relevant private and public institutions [10, p. 33]. Skills for All Programme implemented across Pakistan envisages training of 50,000 youth in high tech: advanced electronics, 3D printing, AI, augmented reality, blockchain, intelligent vehicles, robotics and mechatronics.

IT professionals trained in Pakistan often meet not only the national labour market needs but also actively contribute to the international labour market, including the development of software products, smartphone apps, etc. During the inaugural ceremony of the 19th ITCN Asia 2019, Pakistan’s Minister of IT and Telecommunication mentioned that Pakistan’s universities produce around 25,000 IT graduates but merely 5,000 of them get employed at leading local IT companies [17]. “Pakistan was ranked the 3rd country for freelancing in the world, and Pakistani IT companies are providing products and services to the world’s largest companies. Pakistan’s ICT industry has been a resounding success story for Pakistan, having achieved a stellar remittance inflow growth rate, and being the largest net exporter in the services sector” [18].

The survey conducted by BrightSpyre proves that IT companies mostly hire people in core programming. The survey also shows that there is a huge demand in mobile application developers and software engineers [19]. The companies need skilled employees in C#, Java, PHP and Python.

According to a study by Gallup Pakistan [20], 100 percent of graduates from the top universities, such as LUMS and NUST, are employed by the industry, but companies find only 10 percent of the graduates from lower-tier universities employable. Weak programming skills and English are major drawbacks stemming from the lack of qualified teachers and modern curriculum at all levels of education.
The major initiatives aimed at promoting the use of ICT in higher education and TVET are the Allama Iqbal Open University (AIOU), the Virtual University of Pakistan (VU) and the Information Technology University.

Established in 1974, AIOU is centred in Islamabad and offers courses throughout Pakistan and the Middle East. The university has over 40 regional campuses, regional centres, and academic centres to assist over one million students. It offers quality higher education to Pakistani citizens residing in rural and isolated regions. AIOU works under a mandate similar to open universities, with a particular emphasis on keeping enrolment costs low. The university focuses on providing opportunities for females: the number of female students at AIOU is now higher than that of male students [21].

VU is the first Pakistani university based completely on advanced ICT. Its course materials are available through the website, broadcast television, on DVDs and at YouTube. Since 2002 the University has been using a custom-built full-fledge LMS which includes video conferencing features for live lectures. The system has been piloted by HEC for the use at other public Pakistani universities. Together with the National Technology Fund “Ignite” supported by the Ministry of Information Technology & Telecom, VU launched the online DigiSkills Training Programme, which is freely accessible across the country to train one million people for future jobs involving technology.

The Information Technology University was established in 2012 to maintain close collaboration with ICT industry and develop strong ties with government funding agencies. The University uses a project-oriented and design-centered approach to education and focuses on cross-disciplinary applied research, as well as the cultivation of entrepreneurship in teaching and research [22].

The use of ICT solutions in higher education and TVET is expanding. Among the solutions applied by educational institutions there are both in-house and imported software/platforms. The use of Campus Management Systems (CMSs), including those developed by universities themselves, has increased dramatically. In particular, almost all universities manage academic activities, control process flows and provide access to online platforms [22]. HEIs in Pakistan have not achieved the total independence in developing in-house ICT platforms, they use third-party solutions for LMS and video conferencing (e.g., Zoom, WebEx, Adobe Connect, etc.).

During coronavirus pandemic, HEC issued the COVID 19 — Technology Support: Committee Working Paper, in which HEIs were recommended to provide online education to all students using LMS [23].

**Technical Assistance to Higher Education and TVET and Partnership Programmes**

UNESCO Global Education Monitoring Report states that the total aid to education in 2018 was 380 million USD (of which direct aid was 379 million USD), including 118 million USD for post-secondary education (of which direct aid was 96 million USD) [8]. The main donors for higher education are the European Union; the Foreign, Commonwealth and Development Office (UK); the World Bank; the British Council and governments of Asian countries. Examples of recent projects include South Asia Country Research Fund (covering Afghanistan, Bangladesh, Burma, India, Nepal and Pakistan), Pak-UK Education Gateway, Asi@Connect Project, etc.
There are numerous international initiatives focused on TVET and supported by such donors as UNDP; UNPF; UN OCHA CERF; UNTFHS; the European Commission; governments of Germany, Norway and Japan; Foreign, Commonwealth and Development Office (UK); ADB; USAID; Australian DFAT; Ministry of Commerce of the People's Republic of China; GIZ (Germany); JICA (Japan), etc. Some examples of the ongoing projects include Skills Development Programme, Balochistan SDGs Accelerated Delivery Project, Stabilisation and Development Programme, Kamyab Jawan: Youth Empowerment Programme, Global Project Build4Skills, etc.

Pakistani nationals are eligible for scholarships and fellowships offered by the following donors:

- European Union (Erasmus Mundus Scholarship Programme)
- Chinese Government (PhD and MSc programmes)
- Alliance of International Science Organizations (ANSO)
- Chinese Academy of Sciences (CAS)
- China-Pakistan Joint Research Centre on Earth Sciences (CPJRC)
- Youth of Excellence Scheme (YES CHINA) and Xi’an Jiaotong University (MSc and PhD programmes)
- China Road and Bridge Corporation (CRBC) and the Chinese National Development and Reform Commission (postgraduate level programmes in transportation)
- Government of the Kingdom of Saudi Arabia (graduate and postgraduate programmes)
- New Zealand Commonwealth Scholarships
- UK Foreign, Commonwealth & Development Office (Commonwealth Medical Fellowships)
- Mexican Government Scholarship
- Lee Kuan Yew School of Public Policy of the National University of Singapore (MSc programmes)
- Moroccan Public Institutions of Higher, Technical and Vocational Education
- The Government of Sri Lanka Scholarship Programme for foreign students and Asian students at Sri Lanka universities
- Azerbaijan Government Scholarship
- Government of Brunei Darussalam Scholarship
- Islamic Development Bank Merit Scholarship Programme

Partnership between educational institutions and the industry is also of significant importance. Pakistani universities collaborate with Huawei in establishing ICT Academies, which will provide training and certification opportunities on cutting-edge technologies with hands-on lab experience in the field of ICT for undergraduate and graduate students, as well as for the professionals from the respective industry to excel their skills and acquire market driven certifications in routing/switching, network security and cloud computing, etc. [24].
Conclusions and Recommendations

ICT has become one of the major industries worldwide. There is great growth potential for ICT industry in Pakistan. This sector should benefit from provision of a common platform where public and private sectors can collaborate to ensure a steady supply of highly trained computer scientists and engineers.

Education policies should be revised to focus efforts on using/integrating ICT for quality lifelong learning opportunities for all, in all settings and at all levels of education. ICT should be harnessed to strengthen education systems, knowledge dissemination, information access, quality as well as effective learning and service provision. Strategic objectives related to the current challenges of the educational system are related to the use of ICT to extend the reach of educational opportunities and strengthen the quality of teaching.

- ICT in education should be promoted in line with the Ministry of Education’s “National Information and Communication Technology Strategy for Education in Pakistan”.
- ICT should be utilized creatively to assist teachers and students with a wide range of abilities and from varied socio-economic backgrounds.
- ICT should be used to strengthen the quality of teaching and educational management.

The following measures would enable Pakistan to integrate latest ICT-related knowledge, especially for such emerging technologies as 5G/AI/Cloud technologies, into higher education and TVET:

- Stronger commitment to implementation of policies: not only systemic, practicable, effective and target-oriented ICT policies should be developed, but implementation activities as well.
- Adequate provision of technological resources: technological infrastructure, affordable internet connectivity and teleconferencing facilities, availability of the latest ICT, free access to digital libraries, etc.

Among major challenges of higher education the Ministry of Federal Education and Professional Training [25] mentioned low participation rate; concentration of universities and their campuses in urban centres and more developed regions of the country; incompatibility of the quality of higher education with international standards; lack of research culture; disproportion between budgetary allocations for higher education and the needs of the country; weak linkages between universities and industry, etc. Proposed measures should to be taken to meet the challenges are as follows:

- increasing GER at higher education level
- expanding the number of world class universities (Tier I and Tier II)
- improving the quality and relevance of higher education offered at affiliated colleges or Tier III HEIs
- expanding higher education to district level by establishing community colleges affiliated with Skill Universities for preparing technical and vocational staff to meet the need of skilled manpower
- enhancing the ratio of PhD faculty at universities
• developing a model governance framework, supported through legislative backing, for addressing management and administrative issues at the university level

The major challenges faced by TVET system are related to quality and relevance of training, articulation between different streams of TVET, inadequate skills of educators, and mismatch between the supply of and demand for qualified human resources. To meet these challenges, a framework should be established to ensure the “paradigm shift from supply-led, time-bound and curriculum-based training to demand-driven, flexible and competency-based training and assessment system” [25]. Special emphasis should be placed on the involvement of business and industry associations in planning and implementation of TVET. In addition, stronger TVET-industry linkages should enhance workplace experience.

Another important issue that needs to be addressed is gender disparity and inequality in provision of higher education and TVET to ensure economic empowerment of women. Furthermore, there is a need to remove imbalances in provision of education and training across the country.

The first step to improve the ICT talent ecosystem is to improve the quality of education beginning from the school level. Developing scientific approach and enhancing critical skills are vital for improving the quality of ICT ecosystem. Careful scrutiny of the current state of educational institutions, including curriculum, pedagogy, infrastructure, capacity-building, educational content and financing is also vital for supporting the ICT ecosystem in Pakistan.

References


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**STATE OF QATAR**

<table>
<thead>
<tr>
<th>Population (000, 2020)</th>
<th>2,881</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density (per km², 2020)</td>
<td>248.2</td>
</tr>
<tr>
<td>Surface area (km², 2017)</td>
<td>11,607</td>
</tr>
<tr>
<td>Sex ratio (m per 100 f)</td>
<td>302.4</td>
</tr>
<tr>
<td>Gross domestic product (billion, current US$, 2020)</td>
<td>144.41*</td>
</tr>
<tr>
<td>GDP growth (annual %, 2020)</td>
<td>-3.6*</td>
</tr>
<tr>
<td>GDP per capita (current US$, 2020)</td>
<td>50,124.39*</td>
</tr>
<tr>
<td>Unemployment (% of labour force, estimate)</td>
<td>0.1</td>
</tr>
<tr>
<td>Labour force participation rate (female / male population %, estimate)</td>
<td>56.8 / 95.1</td>
</tr>
<tr>
<td>Population growth rate (average annual %, 2015-2020)</td>
<td>2.3</td>
</tr>
<tr>
<td>Government expenditure for education (% of GDP, 2020)</td>
<td>3.2*</td>
</tr>
</tbody>
</table>

*Sources: United Nations Statistics Division (2020); *The World Bank (2020).*
Back in 2013, Qatari ministries joined their efforts to accelerate the country’s progress towards efficient e-government. With the adoption of a new e-government strategy stating that “all individuals and businesses will benefit from connecting online with Qatar’s more open and efficient government” [1], Qatar confirmed its determination to invest into digital transformation. Today, Hukoomi, Qatar official e-government portal, offers more than 1,450 services to all people.

According to ITU’s country profile, 100% of the population uses the internet and almost 95% of the households have access to the internet [2]. Qatar was one of the first countries to deploy commercially available 5G networks [3]. In terms of critical infrastructure, e.g., transportation, its development received a significant boost when Qatar was announced to host the 2022 FIFA World Cup [4].

Concerning its education sector, Qatar managed to re-use its previous experience when adapting for online learning during the pandemic [5]. In 2017, the country was a subject to an embargo by other Gulf states, and students from these countries, who were enrolled in Qatari university courses, had to study at distance. Thanks to this experience, the Government was fast to ensure the continuity of education when the COVID-19 pandemic struck [6].

Policies and Regulations Related to ICT Use in Education

The Qatar National Vision 2030 was developed to serve as a roadmap for the country’s future. The Vision defines guidelines for economic, social, human and environmental development of the country. One of the priorities of the human development thrust is educated population. The following goals are set to support this priority [7]:

1. A world-class educational system that equips citizens to achieve their aspirations and to meet the needs of Qatar’s society, including:
   • educational curricula and training programmes responding to the current and future needs of the labour market
   • high-quality educational and training opportunities which are appropriate to each individual’s aspirations and abilities
   • accessible lifelong learning programmes

2. A national network of formal and non-formal educational programmes that equip children and youth with the skills and motivation to contribute to society, fostering:
   • a solid grounding in Qatari moral and ethical values, traditions and cultural heritage
   • a strong sense of belonging and citizenship
   • innovation and creativity
   • participation in a wide variety of cultural and sports activities
   • well-developed, independent, self-managing and accountable educational institutions operating under centrally-determined guidelines
• effective funding system for research shared by the public and private sectors and conducted in cooperation with specialized international organizations and leading research centres

• a significant international role in cultural and intellectual activity and scientific research

Qatar’s Second National Development Strategy 2018–2022 was published in 2018. Among other goals, it aims to promote human development through quality education and training. Within the framework of this Strategy, a number of intermediate outcomes are suggested for postsecondary education:

• Provide all learners with equitable access to high-quality postsecondary education and training programmes regardless of sex, age and ability.

• Improve student outcomes and graduation rates in tertiary and postgraduate programmes as well as in post-secondary TVET programmes.

• Increase all postsecondary learners’ awareness and pride of Qatar’s values and heritage, while promoting tolerance, understanding and respect for other culture.

• Improve the quality and performance of postsecondary education and training staff.

To ensure sustainable and innovative access to education, the Ministry of Education and Higher Education (MOEHE) developed the Education Strategy 2018–2022 [8], its main objectives are as follows:

1. Equitable opportunities for all learners to enrol into quality educational programmes.

2. Learners whose skills and competencies allow them to move through levels of education and join the labour market.

3. Skilled workforce recognised for its performance and commitment to work ethics.

4. Educated people with awareness and pride in Qatari values and heritage, and respect for other cultures and peoples.

5. Modern and efficient management systems for education.

Each of the objectives breaks down into specific goals, for example “raise the enrolment of high school students in science and engineering (STEM) majors or the scientific track in public or private schools that follow the national curriculum” and “providing and expanding enrolment opportunities for qualified students, citizens and residents, to enrol in local universities in all specialisations”.

A more recent higher education strategy was published by the Qatar Foundation (QF) which aims to build “Multivercity”, an ecosystem encapsulating institutions at all stages of education, research entities, incubators and supporting infrastructure. The focus is to ensure quality and personalised learning in an inclusive and innovative environment [9].

Qatar Research, Development and Innovation (QRDI) Council is responsible for the implementation of the QRDI 2030 — an ICT-related strategy defining five thematic areas of national importance. These areas are energy, health, resource sustainability, digital technology and society. The latter one sets a goal to “enhance the nation's ability to address current and future needs of all communities in Qatar, preserve cultural values and empower the next generation” [10].
The Ministry of Transport and Communications (MOTC) is in charge of developing roadmaps, policies and regulations for digital transformation of the society. Among the documents published by the Ministry, there is Qatar e-Government 2020 Strategy, National Artificial Intelligence Strategy for Qatar, National Cyber Security Strategy and TASMU Data Policy. Additionally, MOTC released the guidelines on digital ethics, a Guide to Ethical Responsibility in a Digital World. The Ministry ensures the implementation of several Digital Society programmes.

| Mobile-cellular subscriptions per 100 inhabitants | 132 |
| Fixed (wired)-broadband subscriptions per 100 inhabitants | 10 |
| Mobile-broadband subscriptions per 100 inhabitants | 120 |
| Households with a computer (%) | 87 |
| Households with internet access at home (%) | 95 |
| Individuals using the internet (%) | 100 |

Source: ITU (2020).

Qatar ranks 35th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 66th (out of 193) in the E-Government Development Index and 77th (out of 193) in the E-Participation Index (UN, 2021) and 42nd (out of 130) in the Network Readiness Index.

### Higher Education and TVET

The Ministry of Education and Higher Education is a public agency supervising education in the country. MOEHE is responsible for establishing the State’s educational policy, developing and overseeing the implementation of the education plan. Although the Ministry manages all levels of education, other bodies are engaged as well. For example, the Civil Aviation Authority, the Ministry of Defence, the Ministry of the Interior, the Ministry of Administrative Development, Labour and Social Affairs participate in the development of TVET policies in various capacities [11].

ISCED levels for higher education correspond to Bachelor’s, Master’s and Doctorate programmes in universities and colleges. Technical and Vocational Bachelor’s programmes and a Short-Cycle Diploma programmes refer to a mixed type of education. At lower levels, learners are offered to take such programmes as Advanced TVET programmes, Technical and Commercial Certificate programmes [11]. Since 2020, a more formalised qualification framework has been developed to align national education system with international standards and support lifelong learning [12].

| Inequality in education (%) | 11.8 |
| Unemployment, youth (% ages 15–24) | 0.4 |
| Youth not in school or employment (% ages 15–24) | 10.5 |
| Gross enrolment ratio, tertiary (% of tertiary school-age population) | 18 |

Source: UNDP (2020).
The largest public higher education institution is Qatar University, which is the only Qatar university listed in international rankings. As for the private postsecondary education, there were 9 universities registered in the Education City and 10 universities and colleges registered outside of it in the academic year 2019–2020 [13]. There are a few more public postsecondary HE and TVET institutions, including police and military colleges.

Enhancing TVET is one of the priorities in Qatar’s education development policies [14]. The new TVET centres continue to appear reflecting the demands of the local job market. The College of the North Atlantic — Qatar (CNA-Q), which is a UNEVOC Network member, is the largest TVET centre in the country. The college offers some higher education programmes as well.

According to the Planning and Statistics Authority (PSA), the number of students enrolled in both public and private universities and colleges rose between the academic years 2015–2016 and 2019–2020. In 2014–2015, 21,917 students were enrolled in public educational institutions, 16,140 of which were female students (279 per 100 males). In 2019–2020, the number reached 27,777, while 21,201 of them were female (322 per 100 males) [13].

In the academic year 2015–2016, there were 6,751 students enrolled in private universities and colleges, of which 3,305 were female (96 per 100 males) [15]. In 2019–2020, the total number reached 9,335, while 5,068 of them were female (119 per 100 males) [13]. In general, the larger proportion of female students might be partially explained by the fact that young men in Qatar may choose studying abroad or attending military schools [16].

In 2019–2020, top five degrees issued by public universities and colleges in terms of the number of graduates were B.A. in Art and Science, B.Sc. in Administration and Economics, B.Sc. in Engineering, B.A. in Education and B.Sc. in Law [13].

Training for residents of Qatar is available through government, mixed and private training centres. In 2019, 471,491 students were enrolled in all three types of educational institutions, with 190,387 of the trainees being female (68 per 100 males). Five most popular fields of training are occupational safety and security, air transport and related operations, administration, electronics, ICT, oil and gas [17].

### ICT in Education

<table>
<thead>
<tr>
<th>Individuals with basic ICT skills (%), 2020</th>
<th>47</th>
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</thead>
<tbody>
<tr>
<td>Individuals with standard ICT skills (%), 2020</td>
<td>30</td>
</tr>
<tr>
<td>Individuals with advanced ICT skills (%), 2020</td>
<td>5</td>
</tr>
</tbody>
</table>

*Source: ITU (2020).*

MOTC has launched several Digital Society programmes to bridge the digital divide, enhance ICT education and promote the development of ICT vocational and professional workforce [18].

The largest TVET provider, CNA-Q, reports that Schools of Engineering Technology and Information Technology were in top three largest schools in academic year 2018–2019, with the largest being the School of Business studies [19]. As for training and upskilling, electronics and ICT were the fourth and eighth most popular fields of study among the
trainees of the governmental, mixed and private training centres. In total, 30,673 students received training in these fields, with 11,422 of them being females (59 per 100 males) [17].

In 2019–2020, ICT-related university and college majors with the largest number of graduates were engineering, such as electrical, mechanical, computer engineering, industrial and system engineering, and computer science. In 2019–2020, even if the total number of new students on scholarships halved in comparison to two previous academic years, there were almost as many students choosing to study computer science as before. This major is the fifth most popular field of study over a three-year period [13].

Graduates are employed across all sectors, and in terms of relative distribution of labour force, ICT is the fourth most popular economic activity in the country among Qatari males and the sixth among Qatari females. 3.5% of each gender group is involved in this economic activity. Additionally, 0.6% of non-Qatari males and 0.7% of non-Qatari females are engaged in this sector [20].

**Partnership and Collaboration Programmes**

In 2021, with the shrinking State Budget, Qatar’s education expenditure dropped from 10.5% [21] of the total government expenditure to 8.9% [22]. This expenditure mostly covers projects implemented by the Qatar Foundation for Education, Science and Community Development, the Ministry of Education and Higher Education and Qatar University (QU).

Vocational secondary and TVET institutions at the post-secondary level, including the Community College of Qatar and the College of the North Atlantic — Qatar, are government-funded, though students at the postsecondary education level, as well as the students attending private TVET institutions, are often sponsored by employers [11].

At the tertiary level of education, QU and QF are two major institutions helping develop a competitive tertiary education sector [23]. A number of QF’s projects refer to private higher education, e.g., the Education City, which hosts the branch campuses of a number of international colleges and universities and the recently established Hamad bin Khalifa University (HBKU). In 2017–2018, the share of graduates of QF’s tertiary educational institutions reached 50% of the total number of students enrolled in private universities [17]. The Qatar Science and Technology Park (QSTP), another QF’s initiative, serves as an incubator of science and technology businesses [24].

Qatari nationals are eligible to government scholarships, including those for education abroad and certain scholarships programmes are funded by major Qatari businesses, e.g., Qatar Petroleum or Qatar Airways. Additionally, Qatar is a Partner country of the Erasmus+ Programme [25]. Programmes run by Qatar Career Development Center (QCDC), another member of QF, target pre-university and university students, as well as recent graduates and help them explore their career opportunities, including through Arabisation of career guidance resources [26].

**Conclusions and Recommendations**

Major Qatari HEIs are relatively well-funded which may be one of the reasons why some of them, especially QU and QF, function almost independently. The lack of coherence in their actions is one of the issues to be addressed, since it often results in duplication of effort and inefficient education spending [27]. This incoherence also impacts the accessibility
of educational data, which is a challenge for the TVET sector as well. Consolidated and comprehensive data on all kinds of TVET is not available [11].

In terms of enrolment, the rates for tertiary education are rising. Qatari females generally outnumber males, though highly educated Qatari women might experience difficulties finding relevant jobs both in private and public sectors [28]. At the TVET level, the difficulty to attract and retain Qatari nationals is observed, often due to perception of TVET as a second-choice option [11].

The fact that the majority of Qatari economically active population works in public administration [20] might amplify the image of TVET as an unclear career opportunity among citizens of Qatar. Dissemination of successful case studies as well as campaigns to promote TVET are advised.

It is also important to develop a local research community, since Qatar, like other GCC countries, relies on attracting foreign researchers for national universities [5]. The share of Qatari teaching staff in public universities and colleges was only 22% in 2019–2020, while there were even fewer of them working for private higher educational institutions [13].

References


<table>
<thead>
<tr>
<th><strong>KINGDOM OF SAUDI ARABIA</strong></th>
<th>المملكة العربية السعودية</th>
</tr>
</thead>
</table>

| **Population (000, 2020)** | 34,814 |
| **Population density (per km², 2020)** | 16.2 |
| **Surface area (km², 2017)** | 2,206,714 |
| **Sex ratio (m per 100 f)** | 137.1 |
| **Gross domestic product (billion, current US$, 2020)** | 700.12* |
| **GDP growth (annual %, 2020)** | -4.1* |
| **GDP per capita (current US$, 2020)** | 20,110.32* |
| **Unemployment (% of labour force, estimate)** | 5.9 |
| **Labour force participation rate (female / male population %, estimate)** | 22.3 / 78.7 |
| **Population growth rate (average annual %, 2015-2020)** | 1.9 |
| **Government expenditure for education (% of total state expenditure, 2021)** | 19** |

Sources: United Nations Statistics Division (2020); *The World Bank (2020); **KPMG (2020).
The Kingdom of Saudi Arabia (KSA) has demonstrated robust growth since the early 1980s. The significant increase in oil export revenues and the government strategy aimed to convert the windfall oil gains into the economic and social development resulted in massive transformation of the country [1]. To ensure sustainability, steps are being taken towards economy diversification and enhancement of the role of the private sector.

The Government of Saudi Arabia considers ICT as a priority sector and increasingly dynamic element of the economy. National programmes and projects have been initiated to expand the telecommunication system, create new high-tech and smart industries, scale up investments in the development of the digital content and media, expand e-government services and enhance e-commerce. The Government also works towards collaborating with the private sector in order to set up new ICT infrastructure, strengthening the regulatory framework to enable new innovative investments and building the ecosystem to support entrepreneurs and digital talents [2]. In March 2021, a new SAR 5 trillion programme “Shareek”, a cooperative government framework led by His Royal Highness Prince Mohammed bin Salman bin Abdulaziz, Crown Prince, Deputy Prime Minister and Chairman of the Council of Economic and Development Affairs, was launched to provide support to private sector till 2030 via various pillars, including financial, monetary, operational and regulatory cooperation and asset investment [3].

The ICT infrastructure is among the top priorities: the amount of USD 3 billion has been invested to prepare the country for taking lead in AI [4]. The Industrial City Communication Infrastructure Initiative is focused on such infrastructure as optical fibre and wireless networks in industrial cities, which allow for modern technologies such as 5G and IoT to enable digital transformation of the economy and support Industry 4.0 [5]. Over the recent years, an increase in mobile phone and internet penetration has been observed: 99.27% of households gained access to cell phones and 92.77% — to the internet [6]; optical fibre broadband coverage with a focus on rural areas has expanded (60% of households were covered) [7, p. 30]; the internet speed increased to 77.5 Mbps [8, p. 43]; 5G networks deployment continued along with rollout, upgrade and optimization of 4G and 3G [8, p. 30].

The ICT sector undergoes significant change and expansion, which is reflected in a number of indicators. In 2019, the ICT market amounted to SAR 107 billion (USD 28.5 billion) [9]. ICT companies provided employment to 269,690 people, of whom 36,600 were females, which is 13.5% of the total ICT employment [5]. Major national and international telecommunication and IT players include Saudi Telecom Company; Mobily; Zain Saudi Arabia; Integrated Telecom Company; Dawiyat; GO Telecom; ZTE Corporation; Ciena Corporation; Cisco Systems, Inc; CommScope, Inc; Fortinet, Inc; Fujitsu, Ltd; Huawei Technologies Co., Ltd; Juniper Networks, Inc; Honeywell; Hewlett Packard Enterprise; IBM; SAP, etc.

**Policies Related to ICT and Education**

In 2016, the Government of Saudi Arabia launched an ambitious long-term development programme Vision 2030, which articulates 24 specific goals and 18 commitments. Vision 2030 is built on three main pillars: “a vibrant society”, “a thriving economy” and “an ambitious nation” [10]. The first pillar aims to lay a strong foundation for economic prosperity; the second one seeks to build an education system aligned with market needs and to create

The State shall provide public education and commit itself to the eradication of illiteracy.

*Basic Law of Governance of the Kingdom of Saudi Arabia, Article 30*
economic opportunities for all; and the third one is focused on “effective, transparent, accountable, enabling and high-performing government” [10]. Particularly, the Vision outlines plans to bolster education and employment by establishing new educational institutes and funding overseas studies of Saudi Arabian youth; investing massively in research and development to strengthen the country's world-class technological universities; encouraging and promoting entrepreneurial ideas; cooperating closely with the private sector to ensure higher education outcomes are in line with the requirements of the job market; increasing women's participation in the workforce [11]. Digital transformation is seen a key enabler for implementing Vision 2030.

In 2017, the Government of Saudi Arabia established the National Committee for Digital Transformation and the National Digital Transformation Unit. The former is mandated to develop policies and strategies related to digital transformation as well as plans and programmes aimed at their implementation, while the latter serves as the executive arm of the National Committee and has the responsibility to accelerate digital transformation and work towards achieving the goals of Vision 2030.

To drive economic diversification and sustainability necessary to achieve Vision 2030, the Government of Saudi Arabia developed the Digital Economy Policy [12], which establishes the guiding principles for government agencies to leverage the digital economy: access to digital infrastructure, data and platforms; technology adoption and use; innovation; human capital; social prosperity and inclusion; trust in the digital ecosystem; and open market. Among other things, the Policy aims to:

- Make high-quality internet accessible to all sectors and segments of society across the country, at affordable rates and in a dependable manner.
- Promote knowledge and increase the capacity of the national talent pool in STEM skillsets through supportive programmes and policies.
- Promote digital culture and equal educational opportunities for all to ensure effective and productive participation in the digital economy of all groups of population, including those living in rural areas and people with disabilities.
- Create valuable and productive jobs through the digital economy and improve practices and workplace conditions, and upskill national talent to address future job requirements.
- Increase women's participation in the labour force and reinforce their role in achieving the digital economy aspirations of the country.
- Support scientific research across all fields of technology guided by a drive to produce distinguished deliverables that serve society and create innovative solutions that add economic value.

The Government of Saudi Arabia defined 15 key areas that should be in the focus of digital transformation: communications, data, digital government, emerging technologies, education, transport and logistics, finance and insurance, industry and health, agriculture, city development, commerce, sports and entertainment, media, tourism [5]. For the development of these areas over 20 regulatory documents and policies were elaborated to fill the national gaps and remain consistent with the international standards and practices [5]. Among these policy initiatives are Individual Profile, Once-Only Principle, Geospatial Data Governance, Cloud First Policy, Updating the Information and Communications Technology Law, National Spectrum Strategy 2025, Internet of Things
In 2019–2020, the Saudi Data and Artificial Intelligence Authority (SDAIA) and its three sub-entities — the National Centre for AI, the National Data Management Office and the National Information Centre — were established to develop regulatory framework. In particular, the National Strategy for Data and Artificial Intelligence was elaborated to strengthen the position of the country as a global hub for data and AI technologies and increasing the share of the ICT sector in GDP. The document is focused on the ambition (joining top 15 countries in the development and application of AI by 2030), skills (training and hosting more than 20,000 data and AI specialists and experts by 2030), partnerships (collaborating with leading AI nations, international organisations and private sector institutions), investments (increasing to over USD 20 billion in Data and AI), regulation (fostering a business-friendly regulatory environment based on international best practice), ecosystem (more than 300 active data and AI start-ups by 2030, and world-class regulatory sandboxes for the development and deployment of AI-powered technology) [13].

The Cybersecurity Regulatory Framework (CRF) for Service Providers in the Information Technology and Communication Technology and Postal Sector, developed by the Communication and Information Technology Commission and introduced in 2020, aims to provide the requirements for better management of relevant risks through a consistent approach in line with international best practices and local regulations.

### Mobile-cellular subscriptions per 100 inhabitants
Mobile-cellular subscriptions per 100 inhabitants: 124

### Fixed (wired)-broadband subscriptions per 100 inhabitants
Fixed (wired)-broadband subscriptions per 100 inhabitants: 23

### Mobile-broadband subscriptions per 100 inhabitants
Mobile-broadband subscriptions per 100 inhabitants: 119

### Households with a computer (% 2019)
Households with a computer (% 2019): 96

### Households with internet access at home (% 2019)
Households with internet access at home (% 2019): 99

### Individuals using the internet (% 2019)
Individuals using the internet (% 2019): 98

Source: ITU (2020).

Saudi Arabia ranks 56th in the Global Inclusive Internet Index 2020 (The Economist, 2021), 43rd (out of 193) in the E-Government Development Index and 66th (out of 193) in the E-Participation Index (UN, 2021) and 40th (out of 130) in the Network Readiness Index.

### Higher Education and TVET

All education-related decisions are made by the central government since Saudi Arabia is an absolute monarchy and a unitary state. The main governmental body responsible for TVET is the Technical and Vocational Training Corporation (TVTC), which administers technical colleges and secondary vocational schools and develops national standards and TVET curricula. Higher education is steered by the Universities Affairs Council [14] and governed by the Ministry of Education (MoE). The Ministry is in charge of developing and implementing the policy for secondary and higher education, scientific research and innovation; elaborating strategic and operational plans; setting standards and guidelines for teacher recruitment, national curriculum and textbooks; ensuring the effectiveness, sustainability and quality of the educational process; funding; coordinating the implementation of national
educational initiatives and projects related to Vision 2030. MoE supervises public and private higher education institutions.

<table>
<thead>
<tr>
<th>Educational Indicator</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inequality in education (%)</td>
<td>18.0</td>
</tr>
<tr>
<td>Unemployment, youth (% ages 15–24)</td>
<td>28.6</td>
</tr>
<tr>
<td>Youth not in school or employment (% ages 15–24)</td>
<td>16.0</td>
</tr>
<tr>
<td>Gross enrolment ratio, tertiary (% of tertiary school-age population)</td>
<td>68</td>
</tr>
</tbody>
</table>

*Source:* UNDP (2020).

Formal TVET in Saudi Arabia is delivered as:

- Three-year specialized vocational training at the upper secondary level offered by specialized vocational secondary institutions under MoE and TVTC. The curriculum is typically a combination of general academic disciplines and vocational training in agriculture, commerce (e.g., accounting, sales, secretarial studies, etc.) and industry (e.g., construction, engineering technology, computer technology, etc.).

- 2.5-year technical training at the post-secondary non-tertiary education level offered by technical and vocational training institutions under TVTC. Technical Diploma and Associate degree programmes are offered in accounting, business administration, computer technology, mechanical engineering technology, etc. Some of them offer five-year Applied Bachelor’s programmes at the tertiary level.

There are also other types of technical and professional training programmes in various fields and at multiple levels offered as non-formal TVET programmes by non-governmental (for-profit) training centres and institutes established by the private sector under the supervision of TVTC.

According to the UNESCO-UNEVOC International Centre, 260 technical and vocational training institutions worked under TVTC in 2020, including 161 technical colleges, 64 secondary industrial and 35 strategic partnership institutions [15]. In 2019, 123,461 students were enrolled in male colleges of technology, 30,963 students were enrolled in female colleges of technology and 9,594 were enrolled in strategic partnership institutes [16].

To strengthen TVET system within the Vision 2030 agenda, the Government of Saudi Arabia establishes new technical institutions, encourages more students to join TVET, invests into training programmes that facilitate finding job, adapting and tackling the challenges and changes in the labour market [16]. The Government builds strategic partnerships with business sector and encourages investment in private technical and vocational training [16]. To ensure the compliance with world-class TVET standards, the Saudi Skills Standards (SSS) initiative was launched by TVTC and Human Resource Development Fund (HRDF). Within the initiative, the National Occupational Skills Standards were developed according to labour market needs to assess and certify trainees based on competences defined in the standards, and to assign grades to employees and train evaluators within a quality framework. Colleges of Excellence is another initiative aimed to build partnerships with international TVET providers to offer training in multiple disciplines focusing on Saudi private sector needs. Colleges of Excellence enable to obtain world-class qualifications in business administration, hospitality and tourism, fashion and beauty, IT and electrical technology.
The higher education system in Saudi Arabia includes three levels: Bachelor’s, Master’s and Doctorate degree studies. Bachelor’s degree studies last for four years in humanities and social science majors, while in medicine, pharmacology, engineering and applied sciences it takes five to six years to obtain a degree. Master’s degree studies last for two years. Doctorate studies last for three years and require a completion of a dissertation based on independent research. According to the UNESCO Global Education Monitoring Report, 1.6 million KSA students were enrolled in tertiary education out of two million people of the appropriate age group (2018) [17, pp. 348–349].

Higher education in Saudi Arabia is provided by public and private universities. Public universities are large multi-faculty research institutions, while private universities tend to be smaller, more specialized and less research-oriented. Public universities offer mostly degrees in computer science and information technology, medicine, engineering, education, Islamic studies, science, arts and humanities, Arabic and applied sciences. Private universities mainly offer programmes in business administration, marketing, accounting, finance, law, medicine and health science, information systems, computer engineering, computer science and architectural engineering.

In 2020, there were 30 public universities, 14 private universities and 42 specialized private colleges [18]. Most universities included in international university rankings are public: King Abdullah University, King Fahd University of Petroleum & Minerals, King Saud University, King Abdullah University for Science and Technology (KAUST), Umm Al Qura University, Imam AbdulRahman Bin Faisal University, King Khalid University, Princess Nourah Bint Abdulrahman University, King Faisal University, the Islamic University, King Saud Bin AbdulAziz University for Health Sciences and Qassim University. Three private universities are also represented: Prince Mohammad Bin Fahd University, Alfaisal University and Prince Sultan University.

The Government of Saudi Arabia seeks to decentralize the system of higher education. KAUST, established in 2009, became the first totally autonomous co-education university [19]. As one of the most generously funded universities worldwide, KAUST represents an attempt to “build a world-class research centre and university” [20]. Another example is King Saud University that was allowed in 2011 to adopt a more participatory model of governance, which engages the staff, students and external stakeholders from local and business communities. Foreign universities are also allowed to open branch campuses in Saudi Arabia, given they comply with the same regulations as Saudi private HEIs and are duly recognized and accredited in their home countries. In 2019, KSA approved new universities bylaw and announced the independence of three universities in accordance with the new system [14].

The education system in Saudi Arabia is still segregated by gender. There are many specialized institutions for females in both TVET (colleges of technology) and higher education (universities and colleges). Most colleges for women offer undergraduate studies and only some offer Master’s and Doctorate programmes. In 2008, several colleges for women merged to become the first public university for women in Saudi Arabia: Princess Nourah Bint Abdulrahman University is considered to be the largest female university in the world. One of the best private female universities is Effat University.

Education is one of the top priority sectors for the Government of Saudi Arabia and usually accounts for a large share of the state budget allocation. According to the data provided by the Ministry of Finance of Saudi Arabia, the actual education expenditure in 2019 amounted for 19.07% (SAR 202 billion) of the total public expenditure which slightly decreased by 0.3% compared to 2018 (19.37% or SAR 209 billion) [8, p. 34; 7, p. 21].
ICT in Education

<table>
<thead>
<tr>
<th>Individuals with basic ICT skills (%), 2019</th>
<th>61</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals with standard ICT skills (%), 2020</td>
<td>64</td>
</tr>
<tr>
<td>Individuals with advanced ICT skills (%), 2020</td>
<td>21</td>
</tr>
</tbody>
</table>

*Source: ITU (2020).*

The ICT sector provides a wide range of opportunities contributing to Saudi Arabia economic diversification and growth, innovation and entrepreneurship development and job creation. The share of information and communication industry together with four other sectors — manufacturing, transportation and storage, finance and insurance, wholesale and retail — amounts to 74% of non-oil GDP and 49% of total employment. The ICT industry is expected to create 86% of jobs by 2022 [22].

However, these opportunities impose new challenges and unemployment rate, particularly among the youth and women, is still high [22]. The gap between the skills requested by the labour market, including STEM and ICT, and those taught at educational institutions is significant, which does not create enabling environment for growth and expansion of ICT companies [23, p. 50; 24, p. 8]. Saudi citizens tend to work in the public sector, as it provides higher wages, more comprehensive benefits and greater job security than the private sector [25, p. 8]. Consequently, Saudi nationals are underrepresented in most private sector industries [25, p. 11]. When it comes to the ICT sector, Saudi employees are less represented in such areas as manufacturing (including the manufacture of electronic components and boards, computers and peripheral equipment, communication equipment, consumer electronics, magnetic and optical media), software production, data processing and hosting, website development and maintenance, satellite telecommunications [25].

According to the Saudi Jobs Market Needs Assessment Study [22], the most demanded professions are software developer, cyber security expert, business intelligence specialist, IoT product manager and quality assurance inspector. The most required ICT skills include Oracle & ERP, MS Office, Robotic Process Automation (RPA) tools, Autodesk software (CAD, AutoCAD, Inventor and Vault) and programming languages.

To address the issue of the shortage of ICT professionals, the Government seeks to develop an ICT talent pool by increasing the number and improving the quality of ICT graduates and professionals through strengthening the level of their ICT and non-ICT skills. A centralized student database will be developed to track students from early childhood to K-12 and beyond into TVET and higher education in order to improve education planning, monitoring, evaluation and outcomes [10].

Higher education and TVET institutions play the critical role in supplying skills and adding qualified individuals to the ICT labour market. Special emphasis is given to the design of curricula for ICT skills development consistent with rigorous standards and best practices, launch of new ICT disciplines and courses.

According to the data of the Ministry of Education, out of 52 universities offering ICT degree studies in 27 are public and 25 are private [18]. The most frequent ICT-related majors in public universities are computer science, engineering, information technology, mathematics, computer engineering; whereas at private universities these are information
systems, computer engineering, computer science, information technology and graphics design.

The major initiatives aimed at promoting the use of ICT in higher education and TVET are the Saudi Electronic University and the Arab Open University. Established in 2011 by the Royal Decree as a governmental education institution, the Saudi Electronic University (SEU) is the only distance learning university in Saudi Arabia to offer graduate, undergraduate and lifelong learning programmes. Founded in 2000 in partnership with the Open University (UK), the Arab Open University (AOU) offers a range of academic programmes taught in a blended learning format in English and licensed in Saudi Arabia. Many other institutions, such as King Faisal University, Al Imam Muhammad Ibn Saud Islamic University and others, offer e-learning programmes as well. Considering the large size of the country and the wide dispersal of potential students, distance learning may help to make education in Saudi Arabia more accessible and inclusive. As long as ICT infrastructure is in place, this learning method can potentially bring many more people into higher education and TVET.

Other examples of initiatives related to the promotion of use and development of ICT skills in higher education and TVET include:

- **Saudi Digital Academy**, one of the key national initiatives established by the Ministry of Communications and Information Technology (MCIT), aims to develop digital capabilities of the youth in the field of modern and advanced technologies: data science, AI, natural language processing, cloud computing, web development, blockchain, gamification, AR and VR. As the initiative is implemented in partnership with the private sector, a special place in the curriculum is reserved for apprenticeship and employment.

- **Think Tech** is an initiative launched by MCIT to introduce Industry 4.0 technologies and share digital knowledge between international and local experts. It serves as a platform for training, awareness raising and promotion of capabilities in the areas of emerging technologies such as blockchain, AI and IoT.

- **Attaa Digital** is a MCIT initiative aimed to enrich Arabic content and spread digital culture in order to cover the knowledge needs of Arabic speakers around the world using various means and tools.

- Training programmes aimed to raise digital awareness and equip with skills in the field of emerging technologies: Tuwaiq Youth Bootcamp, Tuwaiq Cyber Security Bootcamp, Data Science Bootcamp, etc.

- Major events and hackathons are organized: the World Robot Olympiad, the Saudi IoT Conference, etc.

- **Digital Transformation Pioneers Foreign Scholarship Programme** supports five-year studies abroad in AI, Machine Learning, IoT, AR and VR, Data Science, Tech Business Entrepreneurship, Robotics, Digital Forensics.

In 2021, the main national projects in higher education are aimed at establishing the National Academy of Artificial Intelligence, shifting towards digital education to support student and teacher, encouraging foreign universities to open branches within KSA and awarding scholarships to 10,000 students for undergraduate, graduate and postgraduate studies in the world-class universities [8].
Higher education and TVET institutions apply the third-party ICT solutions (Blackboard, Moodle, Microsoft Teams and Zoom) for LMS and video conferencing. For online learning, the Arab Open Education Platform Rwaq was developed to provide free, high-quality academic study materials in Arabic in a wide variety of fields and disciplines, provided by distinguished academics from all over the Arab world.

**Cooperation and Partnership Programmes in HE and TVET**

Various cooperation and partnership programmes with national governments and international private companies have significantly contributed to the promotion of the innovative use of ICT in higher education and TVET, and helped to adjust KSA education system to international standards. Essential financial and technological support in this area has been obtained from the United States and the United Kingdom [26, pp. 176–194].

Strategic partnerships with the private sector such as apprenticeship providers, skills councils from industry and large private companies also contribute to the development of KSA technological capacities and human capital. Special attention is paid to partnerships with leading multinational corporations:

- **Partnership with SAP through its Young Professional Programme** aims to develop ICT talent and bridge digital skills gap. The programme is a three-month training and development opportunity for unemployed or underemployed local university graduates that equips with technical and functional knowledge of the latest technologies, along with soft and future skills. Participants graduate as SAP associate consultants with globally recognized certifications. The programme is implemented within collaboration between the National Information Technology Academy and SAP.

- **Collaboration with IBM through IBM Skills Academy programme** includes trainings delivered via leading universities and vocational training institutes to address the local skills shortage in the ICT sector and to increase the level of understanding of tech-related issues. The programme seeks to train and certify both educators and students in various ICT areas, including mobile computing, cyber security, business analytics, big data, cloud computing, cognitive computing, etc. Once candidates pass the exam, they obtain the IBM Open Badge Certificate. Collaboration is implemented within the agreement between MCIT and IBM.

- **Partnership with Hewlett Packard Enterprise** aims at optimizing the national IT ecosystem, nurturing and leveraging the latest technology innovations, and investing in national transformation. Within the MoU with Saudi Arabian General Investment Authority, the company works with ministries and entities responsible for human capital development to provide citizens of KSA and people around the world with IT knowledge and skills required to meet the future needs of the labour market.

- **Collaboration with Huawei within its Saudi Talent Enabling Programme (STEP)** aims to nurture 10,000 local talents by 2023. The programme focuses on training and promoting ICT talent through three pillars: building a talent alliance, setting talent standards and communicating talent value. STEP includes nine other initiatives, several of which have recently been unveiled — long-running Seeds for the Future Initiative, Huawei ICT Skills Competition, Huawei Future Leaders Initiative, Huawei ICT Academy, etc. As part of the strategic agreement, Huawei will also support the National Centre for Artificial Intelligence to train Saudi AI engineers and students, to explore the creation of
AI capability platform to localize technical solutions, and to map out a comprehensive strategy to develop AI skills and capabilities in line with Vision 2030.

- Within the MoU between Cisco and TVTC, Cisco Networking Academy courses are included in computer science academic programme offered through TVTC and other partners. Cisco offers programmes designed for Saudi IT students and delivers the on-the-job training in KSA. To encourage diversity and address the gender divide Cisco launched several initiatives to train Saudi females.

- The agreement between Google and the Saudi Federation for Cyber Security and Programming implies the development of five Google Innovation Hub centres in different KSA regions. The first centre in Riyadh is positioned as the largest of its kind in the world, with the capacity to accommodate 40,000 trainees annually. The partnership aims at incorporating local talent in the production of prototypes, mobile applications and AI. It will provide educational and technical materials and advanced technology curricula, as well as a training laboratory where local IT professionals will receive support and guidance for the development of advanced software and AI.

- Within the partnership agreement between Samsung and Misk Academy, Samsung Innovation Campus initiative, aimed to support and nourish young Saudi talents, was launched in 2020. The programme had a particular focus on IoT and AI and sought to help young people find long-term success by equipping them with advanced and professional skills. The e-learning programme included 240 hours of comprehensive lectures, practical exercises and a capstone project over 12 weeks.

Both higher education and TVET institutions invest actively in partnerships with the private sector. According to UNESCO-UNEVOC data, TVTC collaborates with leading ICT companies within training academies, including Cisco (56), Oracle (18), Microsoft (70), Huawei (2), SAP (20) and Adobe (18) [16].

To bridge capacity shortages and develop the human capital, the Government, through its King Abdullah Scholarship Programme, provides Saudi citizens with opportunities to pursue degrees at higher education institutions abroad. According to UNESCO statistics, Saudi Arabia is among top 10 countries sending young people to study abroad [27]. Early programmes were small in scope and focused on undergraduate studies, but later they expanded significantly and shifted increasingly to postgraduate studies. Among the top destination countries for studies are the United States, Canada, the United Kingdom, Australia as well as neighbouring countries, e.g., the United Arab Emirates [28].

Saudi Arabia has also become a popular international study destination [28]. The growth of the higher education system and the establishment of more universities in recent years has helped accommodate a rising number of students from Arab region (Yemen, Syria, Egypt, Jordan and Palestine) and other countries (Pakistan, India, Nigeria). The key motivation factors for prospective students are a variety of English-taught programmes, good quality of the university education and generous scholarship programmes for international students, which cover full tuition support, free housing, medical care and living allowance.

Finally, Saudi Arabia invests its efforts to improve education the world over, affirming its local, regional and international commitment to the right of education for all as a cornerstone of development worldwide. OECD states that total official development assistance on a grant-equivalent basis, including aid to education, stood at USD 4.4 billion in 2019, representing 0.56% of Saudi Arabia’s gross national income [29].
Conclusions and Recommendations

KSA Government has demonstrated political will and made considerable effort to advance digital transformation, including enormous investments and various initiatives launched to develop the network infrastructure and access to ICT, improve the use of ICT in the society and strengthen the ICT capability. However, strong trend towards digital transformation puts pressure on the local job market and exacerbates the issue of shortage of the suitable skilled ICT workforce in the country, which leads to new challenges for higher education and TVET systems.

To address these challenges, government agencies, educational institutions and private sector companies are recommended to further join their efforts. Education policies, initiatives and programmes should be both good in intent and properly planned in order to achieve sustained results in talent development. Government agencies should continue to keep ICT talent development on the agenda for overall human capital development and initiate programmes and projects in the field of ICT and STEM education. Measures should be undertaken in making high-quality internet accessible for education purposes across the whole country.

Higher education and TVET institutions should be more flexible, agile, impactful and relevant to contemporary market needs in order to produce the workforce equipped with higher-order thinking skills and competencies of leadership, innovation, creativity and complex decision making. University and TVET curricula should be fully aligned and updated to ICT industry requirements. To help students stay up to date with the latest technology developments, educational institutions should focus on using and integrating ICT, diversifying their teaching methodologies and strengthening collaboration with the ICT industry. Students and young professionals should also have opportunities for practical and advanced trainings as emerging technologies continuously demand new skills. In addition, higher education and TVET institutions should activate their career offices and strengthen partnerships with recruitment agencies.

In order to grow the ICT talent pool further, it is important to draw more young people, both males and females, into ICT jobs. Awareness programmes at educational institutions of different levels could help to foster interest in science and technology career paths and encourage young people to take up employment in the ICT sector.

References


<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td>Population (000, 2020)</td>
<td>9,890</td>
</tr>
<tr>
<td>Population density (per km², 2020)</td>
<td>118.3</td>
</tr>
<tr>
<td>Surface area (km², 2017)</td>
<td>83,600</td>
</tr>
<tr>
<td>Sex ratio (m per 100 f)</td>
<td>223.8</td>
</tr>
<tr>
<td>Gross domestic product (billion, current US$, 2020)</td>
<td>358.90*</td>
</tr>
<tr>
<td>GDP growth (annual %, 2020)</td>
<td>-6.1*</td>
</tr>
<tr>
<td>GDP per capita (current US$, 2020)</td>
<td>36,284.50*</td>
</tr>
<tr>
<td>Unemployment (% of labour force, estimate)</td>
<td>2.4</td>
</tr>
<tr>
<td>Labour force participation rate (female / male population %, estimate)</td>
<td>52.5 / 93.6</td>
</tr>
<tr>
<td>Population growth rate (average annual %, 2015-2020)</td>
<td>1.3</td>
</tr>
<tr>
<td>Government expenditure for education (% of GDP, 2019)</td>
<td>3.1*</td>
</tr>
</tbody>
</table>

The United Arab Emirates (UAE) is a dynamically evolving liberal economy [1]. The country’s authorities are committed to foster the knowledge economy and ensure digital transformation. Artificial intelligence, big data and 3D printing — along with virtual reality, blockchain and other emerging technologies — are seen as promising drivers of sustainable development and included in a number of national strategies for this decade and beyond.

To accelerate the economy and increase its competitiveness, the UAE invests into talent acquisition and development as well as into creation of the enabling environment for innovation. Its economic diversification strategy is based on stimulating the industries focused on research and development. Some of the industries that the country seeks to stimulate are aerospace and space science, automotive, pharmaceuticals, robotics and automated transport, energy storage, advanced water and environmental technologies, and advanced manufacturing. Such recently launched organisations and initiatives as the Mohammed Bin Rashid Space Centre, the Dubai Future Foundation, the UAE National AI Programme, Sharjah Research, Technology and Innovation Park are aimed to support these industries.

In terms of connectivity, annual increase in the number of fixed (14.45% annually) and mobile-broadband (35.36% annually) subscriptions to the public internet was observed in the country between 2010 and 2019 [2]. The increase in online presence provides an opportunity to transform government services and build an effective online partnership of public and private sectors. Currently, the UAE Government portal provides 4,000+ federal and local e-services and the goal to reach 100% of the bureaucratic procedures being available online and 24/7 is articulated in the UAE Strategy for Government Services [3].

**Policies related to ICT use in education**

The importance of capacity building, especially in science, technology, engineering and math (STEM) is indicated in a number of government initiatives and policies. Vision 2021 and National Agenda launched in 2010 and 2014, respectively, provided the roadmap for the period till 2021 and emphasised that a high-quality education system and knowledgeable and innovative Emiratis are one of the national priorities. UAE Centennial Plan 2071 serves as a long-term strategy for five decades after 2021 and aims at preparing the future generations to face rapid changes. It re-emphasises the importance of quality education as a key priority for the development of the country.

Three federal strategies and initiatives that directly refer to education, namely the Ministry of Education Strategic Plan 2017–2021, National Strategy for Higher Education 2030 and National Advanced Sciences Agenda 2031, indicate fostering innovation and entrepreneurship in science and technology as one the key directions for the upcoming years. Another federal strategy that emphasises the importance of entrepreneurship for building a knowledge-based economy is the National Employment Strategy 2031. It also focuses on the skills relevant to the labour market and the increase of the number of researchers and developers.
Capacity building for the future labour market is one of the goals of the National Strategy for Artificial Intelligence 2031. It is aimed to equip all staff involved into AI-related activities with a necessary skillset and ensure capacity building for the jobs that would be enabled by AI. This strategy assumes better access to local data infrastructure and funding for projects to facilitate its implementation.

To address the issue of personal data security and protection, the Telecommunications Regulatory Authority developed the National Cybersecurity Strategy that describes the country’s aspirations for a safe and resilient cyber infrastructure. The Standard Information Security Policy initiated by the Authority defined as a set of standards, guidelines and procedures that specify the appropriate use of data and network infrastructure. Other legal frameworks related to personal data security and protection are collected on the official government portal in the Cyber laws section.

To go beyond data management and to define the roles and responsibilities of educational stakeholders online, the Ministry of Education developed Students’ Behaviour Management — Distance Learning 2020 — a set of guidelines and instructions that reflects the disruption caused by the COVID-19 pandemic.

### Mobile-cellular subscriptions per 100 inhabitants
- **186**

### Fixed (wired)-broadband subscriptions per 100 inhabitants
- **33**

### Mobile-broadband subscriptions per 100 inhabitants
- **224**

### Households with a computer (%)
- **98**

### Households with internet access at home (%)
- **100**

### Individuals using the internet (%)
- **100**

*Source: ITU (2020).*

The UAE ranks 40th in the Global Inclusive Internet Index 2021 (The Economist, 2021), 21st (out of 193) in the E-Government Development Index and 16th (out of 193) in the E-Participation Index (UN, 2021) and 34th (out of 130) in the Network Readiness Index.

### Higher Education and TVET

The Ministry of Education regulates all levels of education across the country. To regulate national TVET system, the National Qualifications Authority (NQA) was established in 2010. This federal entity which develops and maintains a national qualifications framework, conducts a range of quality assurance processes in vocational education and training, and mediates between the TVET system and the labour market. The function to accredit TVET providers is assigned to two organizations: the Abu Dhabi Centre for Technical and Vocational Education and Training (ACTVET) for TVET providers in Abu Dhabi or northern emirates and the Qualifications and Awards in Dubai (QAD) for Dubai-based providers. QAD is a department of the Knowledge and Human Development Authority (KHDA), though its awarding body functions are regulated by the NQA.

Technical and vocational education and training in the UAE begins at the secondary school level when students may choose to follow a technical secondary school track. Upon completion of the track, they are awarded with a Technical Secondary Diploma [4]. Graduates of secondary technical schools who wish to continue their education and enter
a university have to meet the same admission requirements as graduates from other secondary schools.

In addition to TVET, KHDA ensures the quality of all private education institutions in Dubai, including private higher education. The Department of Education and Knowledge (ADEK) is assigned the similar functions in Abu Dhabi. The organization that operates on the federal level is the Commission for Academic Accreditation (CAA). CAA is a UAE federal government quality assurance and accreditation agency for higher education.

The Qualification Framework in the UAE includes Certificates, Associate Degree (Diploma), Higher Diploma (Advanced Diploma), Bachelor (Applied Bachelor), Post Graduate Diploma (Applied Graduate Diploma), Master (Applied Master) and Doctoral Degree [5].

| Inequality in education (%) | 18.2 |
| Unemployment, youth (% ages 15–24) | 7.3 |
| Youth not in school or employment (% ages 15–24) | 11.2 |
| Gross enrolment ratio, tertiary | 53.7* |

Sources: UNDP (2020); *UIS (2020).

According to the data presented at the official portal of the UAE Government, there are three public higher education institutions in the country [6]. As for the private universities, CAA listed 71 accredited universities [7]. Additionally, the Higher Education Classification 2019–2020 by KHDA and QS Quacquarelli Symonds provides information about 17 branch campuses of international universities located in the Free Zones of Dubai [8], which are tax-free areas established by the Emirate to attract technology companies, among others [9]. These types of private institutions may choose to be licensed by KHDA, which is responsible for private education in Dubai. Since 2010, the number of universities in the country has almost doubled [10].

Both private and public universities most often offer degree studies in business administration, law, media and mass communication, information technology, mechanical engineering, electrical and electronics engineering, banking and finance, computer science and engineering, Islamic studies, medical, dentistry and pharmacy. The majority of leading universities listed in international university rankings are private, which reflects the fact that most HEIs are private: Abu Dhabi University, Ajman University, the American University in Dubai, the American University of Sharjah, Khalifa University and the University of Sharjah. Public universities listed in international rankings are UAE University and Zayed University.

According to the Federal Competitiveness and Statistics Center (FCSC), 295,626 students were enrolled in higher education in the academic year 2018–2019. There is an increase in the total number of students as compared to 191,794 enrolled students in 2016–2017 [11]. A separate census of branch campuses of international universities in Dubai Free Zone by KHDA indicates that there were 30,031 students in 2019–2020, 29,989 in 2018–2019 and 28,972 in the academic year 2017–2017 [12].

There are private and public TVET institutions in the United Arab Emirates. The majority of private training institutions are located in the Emirate of Dubai. As of April 2021, the KHDA directory of registered private education institutions listed 1,153 training providers [13]. One or several categories are assigned to each of them, with most frequent being management training (523 organisations), accounting and finance training (288), human
resources training and development (277), social and behavioural training (276), sales and marketing training (264). The National Qualification Authority endorses both private and public TVET education on the state level. Between 2016 and 2020, it granted a Registered Training Provider (RTP) status to 23 institutions.

Public TVET providers often include several entities or institutions located in various cities and even emirates. Among the most advanced TVET providers are Abu Dhabi Vocational Education & Training Institute (ADVETI), which works under the umbrella of ACTVET, and the Centre of Excellence for Applied Research and Training, a commercial arm of Higher Colleges of Technology (HCT) [14]. They offer training in such disciplines as applied media, business, education, engineering, information technology and computer science, health and safety, etc. Both ACTVET and HCT are the UAE members of the UNEVOC Network, UNESCO’s global network for institutions specialized in TVET [15].

ACTVET is also responsible for regulating non-formal TVET programmes. There is a great number of public and private institutions providing non-formal TVET, based on occupational standards and the needs of the labour market. All licensed training providers are regulated and monitored, and if they meet the quality standards set by the Vocational Education and Training Awards Council (VETAC), they are allowed to deliver National Vocational Qualification programmes, thereby becoming integrated into the formal TVET system.

According to FCSC, the number of students in post-secondary non-tertiary vocational education amounted to 26,967 or 2.0% of the total number of students involved into general education in the academic year 2018–2019 [16]. Between 2015 and 2020, 2,624 graduates completed education offered by training providers registered by NQA, 1,533 of them were female graduates (141 per 100 males) [17].

**ICT in Education**

<table>
<thead>
<tr>
<th>Type of ICT Skill</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Basic ICT skills</td>
<td>79</td>
</tr>
<tr>
<td>Standard ICT skills</td>
<td>69</td>
</tr>
<tr>
<td>Advanced ICT skills</td>
<td>17</td>
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</table>

*Source: ITU (2020).*

ICT education depends on the track that students decide to take. If high school students choose to follow the Vocational and Technical Education track, they have to take introductory courses on electronics and engineering, programming of micro-controllers and robotics, computer-aided design, web-development etc. Applied stream — another high school track — provides students with an option to study in programmes affiliated with such technical institutions as HCT or ADVETI. This track allows students to earn course credits that are recognised by local universities and colleges. This stream assumes such ICT-related subjects as computer science, electrical and mechanical maintenance, technology and applied media.

According to the data of the National Qualifications Authority, the most popular post-secondary non-tertiary qualifications that were awarded in the country between 2016 and 2020 were engineering technology and mechanical maintenance. Other ICT-related majors include information technology (networks), electronics and mechanical engineering, technical laboratory analytics [18]. As for the private training institutions
endorsed by KHDA, the number of institutions providing “Computer Skills Training” is 184 (out of 1,153) [13], and it is only the tenth most popular activity for private training institutes in Dubai.

Out of 74 universities endorsed by CAA, 35 higher education institutions offer degree studies in ICT. Among 17 branch campuses of international universities located in the Free Zones of Dubai and accredited by KHDA, 12 universities offer degree studies in ICT-related majors. The most frequent ICT majors in both private and public universities are information technology, mechanical, electrical and electronics engineering, computer science, aeronautical engineering, computer engineering and information systems.

According to FCSC, 6.4% or 18,977 of all higher education students were enrolled into majors related to ICT in 2018–2019 academic year, of them 6,898 were female (57 per 100 males). The number of students is increasing, as 12,696 students were enrolled in Information and Communication Technologies majors in the academic year 2016–2017.

Conducted in 2019, FCSC’s labour force survey revealed that 2.2% of the UAE residents aged 15 years and above are dealing with ICT as their major economic activity. The share of people employed in this sector is rising as there were 1.7% of residents listed in this group in 2017. In general, both public and private sectors recruit students majored in ICT-related fields. In order to satisfy all needs of the labour market, the UAE ICT sector — as all the other sectors in the economy — engages non-Emirati employers. In 2019, 2.2% of the whole registered non-Emirati workforce was engaged in the Information and Communication sector [19].

As the COVID-19 pandemic forced the UAE to shift education towards distance learning for a certain period of time, teachers and instructors had to get additional ICT training to ensure quality and continuity of education. In order to ensure that all the educators are equipped with relevant ICT skills, Hamdan Bin Mohammed Smart University launched a free online course “Be an online tutor in 24 hours” in coordination with the UAE Ministry of Education. The course provides educators with the skills of operating online classrooms and is available in Arabic, English, French, Russian and Spanish.

In terms of emerging technology, the country is determined to develop its capacities in this field. AI is included into the majority of the country’s policies and strategies for the future, and it is reflected in the country’s education system. For example, topics related to AI are being integrated into the curriculum of the UAE schools — students of upper secondary school take computer science lessons that cover basic machine learning algorithms and applications of artificial intelligence to daily life tasks [20]. Recently, it has been reported that CAA issued a requirement that AI-related subjects must be included in all ICT curricula of all universities.

**Cooperation and Partnership Programmes**

Since the increase of the federal budget allocations for the education sector to AED 10.2 billion in 2017 (as compared to AED 6.526 billion in 2016), the funding for general (including postsecondary non-tertiary) and higher education have remained relatively stable. The total federal budget decrease in 2019 and 2020 did not have an impact on the allocations for education, which stayed within the range of AED 10–10.5 billion [21]. The federal budget 2021 concludes the five-year general budget plan for 2017–2021, and the amounts allocated for education in 2021 are close to the above-mentioned values. Out
of AED 9.6 billion, AED 6.2 billion are assigned to general education and AED 3.4 billion to higher education or 10.2% and 5.5% of the total federal budget, respectively [22].

The goal to develop information and communication technology industries — along with space science and technology, medical research, 3D printing, nuclear science and technology — is set for education as the government of the UAE acknowledges their importance for the todays and future economy. To establish the infrastructure needed to achieve this goal, the country creates free zones — currently, there are eight free zones [9] — to attract technology companies to the UAE and the Middle East markets and to provide graduates, including those with ICT-related degrees, with more career opportunities.

The UAE is one of the countries that have started deploying 5G networks and is currently assessing the results of the first trials [23]. The project is supervised by the Telecommunications Regulatory Authority (TRA), which maintains a knowledge bank on the topic including resources by Ericsson, Huawei, Nokia, Qualcomm and other technology providers. As for the general public, it was reported that 5G is available to the UAE residents since 2019 [24].

Telecommunications and Digital Government Regulatory Authority (TDRA) also supports the sector through its Virtual Academy (TRAVA), UAE Hackathon and ICT Fund.

- TRAVA is a learning platform with courses in information technology, data and business analytics for anyone.
- University and high school students, entrepreneurs, employed people and IT experts are engaged into the UAE Hackathon to use open data for the sake of the country.
- ICT Fund provides scholarships and grants to talented students, invests into research and development and sets up incubators.

Other initiatives aimed to support ICT-sector with scholarships and grants are Collaborative Research Programme Grant and Betha Scholarship Programme.

In order to support research in the local language and to promote science and technology in the Arab world, Dubai Future Foundation launched the Mostaqbal Portal. The portal allows Arabic-speaking people to learn about the latest studies in artificial intelligence, virtual reality and other emerging technologies. Another initiative that supports learning in Arabic is One Million Arab Coders initiative, an educational platform with programming courses that were subbed or dubbed for Arabic-speaking learners.

In order to integrate the UAE nationals into the private sector of the economy and correct the misperceptions related to working in the private sector, Emirates Nationals Development Programme was launched to coordinate jobseekers and private companies and corporate organizations. The programme aims to cooperate with companies based in Dubai, though the participants can work anywhere in the UAE.

Conclusions and Recommendations

When graduates enter the labour market in the UAE, they are expected to have prior experience in the field. The government’s plan to ensure that students receive it before graduation is reflected in the National Strategy for Higher Education 2030. The Expanded Professional Experience initiative is one of the 33 key initiatives of this strategy and is aimed to ensure opportunities for obtaining necessary skills through on-campus work, job shadowing, joint ventures and vocational trainings [25].
Most local universities and TVET institutions themselves often attempt to support their students by arranging internships within public and private sectors, though more efforts in this direction are required. To facilitate partnership between educational entities and employers, it is advised to create additional incentives for the former. The need to extend partnership between TVET education providers and industry representatives is confirmed by NQA [26]. While exploring local and international trends in certification, recognition of prior learning and developing required skills through benchmarking studies, its R&D department also emphasised the need to improve the society’s general perception of TVET.

Addressing this issue will help the country attract more talented students and educators into TVET. Providing adult learners with opportunities to receive more applied qualifications will contribute to talent acquisition as well. Equipping TVET with the elements of lifelong learning is advised to improve the accessibility of TVET. Another step to attract these categories of students would be to formulate a framework for recognition of previous learning achievements. Such framework is articulated for higher education [27], and the same is needed for TVET as it will enable students’ progress towards higher academic achievements.

The basis for this framework already exists within the UAE higher school system, which provides students of vocational and applied tracks with an opportunity to reuse their course credits on further levels of education [28]. To shape this framework, it is suggested to foster partnership networks of education providers that will enable consultations and mutual agreements.

Enhancing women’s participation rates in ICT-related industries — including artificial intelligence, space, digital transactions and advanced science — is considered to be one of the country’s priorities. In order to reach these goals, more actions to localise training materials into Arabic seem to be a promising approach to engage all residents of the UAE, both males and females. As only some higher education institutions are public, it is advised to arrange more scholarships to students of ICT-related majors. Since AI is going to be applied in all government and private sectors, particular attention to students willing to take AI specialisation should be paid.

References


Annex II. Questionnaire

**Introduction**

1) Please describe the national Higher Education system, including public and private higher education.

2) Please describe the national TVET system, including public and private education.

3) What digital transformation trends are currently observed in your country? To the best of your knowledge, describe its influence on the education sector?

**Policies and Regulations**

4) What policies support digital transformation in your country, both at national and institutional levels (explicit policies supporting digital transformation / indicating a commitment to digital transformation, policies that are supportive of increased collaboration, the level of these policies (national, regional, organizational, etc.), the scope, applicability/audience, relation to economy sector, financial commitment to policies, implementation plans related to policies)?

<table>
<thead>
<tr>
<th>Name of policy (add URL if available)</th>
<th>Level (national, regional, organizational, etc.) and sectoral focus of policy</th>
<th>Brief overview of policy's main purpose/scope of coverage</th>
<th>Summary of financial commitments contained in policy (if any)</th>
</tr>
</thead>
</table>

5) What policies support digital privacy and protection? Are there any additional regulations that specifically address students' and educators' data privacy and protection?

<table>
<thead>
<tr>
<th>Name of policy (add URL if available)</th>
<th>Level (national, regional, organizational, etc.) and sectoral focus of policy</th>
<th>Brief overview of policy's main purpose/scope of coverage</th>
<th>Summary of financial commitments contained in policy (if any)</th>
</tr>
</thead>
</table>

6) What is the national policy on equity and inclusion? Are there any policy refinements for Higher Education and TVET?

<table>
<thead>
<tr>
<th>Name of policy (add URL if available)</th>
<th>Level (national, regional, organizational, etc.) and sectoral focus of policy</th>
<th>Brief overview of policy's main purpose/scope of coverage</th>
<th>Summary of financial commitments contained in policy (if any)</th>
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</table>

**Education Expenditure**

7) What is the share of GDP amount invested into Higher Education by the government?

8) Were there any recent investments into Higher Education (e.g., technical assistance programmes, intergovernmental organisations, e.g., World Bank, etc.) to support ICT infrastructure and ICT use in education?
9) What is the share of GDP amount invested into Technical and Vocational Education and Training by the government?

10) Were there any recent investments into TVET (e.g., technical assistance programmes, intergovernmental organisations, e.g., World Bank, etc.) to support ICT infrastructure and ICT use in education?

**ICT in Education**

11) What ICT tools are typically used for education purposes by local educational institutions (e.g., LMS, CMS, MOOC platforms, distance learning infrastructure, cloud platforms and video-conferencing)? Are they mostly open or commercial / developed locally or imported?

12) Do you think educational institutions use their own (or related to responsible ministry) IT specialists to support ICT infrastructure or contract vendors / third party companies to provide technical support?

**Internal and External Cooperation**

13) What cooperation programmes are open for local HE and TVET universities and colleges (e.g., World Skills, Erasmus, etc.)?

14) What kind of cooperation is observed between educational institutions and ICT-related industry representatives within ICT-related education? Please consider any jointly developed textbooks, open courses on emerging technologies by industry representatives, training centers within educational institutions, etc.

**ICT-related Education**

15) Which sectors of economy employ the majority of graduates with ICT-related degrees?

16) Please list ICT-related majors that are in demand at the labour-market.

17) To the best of your knowledge, respond whether the current number of graduates with ICT-related degrees meet the needs of the economy.

18) What is your opinion on the skills of graduates in relation to employers’ expectations and requirements? Please consider the scope, level, etc.

**Conclusions and Recommendations**

19) What 2–3 actions do you think could enable your country to integrate latest ICT-related industry knowledge, especially for such emerging technologies as 5G/Al/Cloud technologies, into Higher Education and Technical and Vocational Education and Training more effectively?

20) What might educational institutions do by themselves to improve the quality of education and enrich local ICT learning platforms with ICT-related educational materials?

21) What might educational institutions do to contribute to national activities on ensuring equity in access to the educational resources?

22) In your opinion, what measures should be taken for further development of ICT talent ecosystem in the country?
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