The Jordan STEM Education Landscape

A Report for the British Council

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Glossary

ACI	Amman Chamber of Industry
CADER	ChangeAgent for Arabic Development and Education Reform
CAQA	Centre for Accreditation and Quality Assurance
ETVET	Employment, Technical and Vocational Education Training
GDP	Gross Domestic Product
GNP	Gross National Product
HEAC	Higher Education Accreditation Council
HR	Human Resource
IAEP	International Assessment of Educational Progress
ICT	Information and communication technology
JCI	Jordan Chamber of Industry
JICA	Japan International Cooperation Agency
JV 2025	Jordan Vision 2025
MoE	Ministry of Education
MoHESR	Ministry of Higher Education and Scientific Research
MoL	Ministry of Labour
MoPIC	Ministry of Planning and International Cooperation
MSME	Micro, Small and Medium Enterprises
NAfKE	National Assessment for Knowledge Economy
NCHRD	National Centre for Human Resource Development
OECD	Organisation for Economic Co-operation and Development
PISA	Programme for International Student Assessment
QRTA	Queen Rania Teacher Academy
STEM	Science, Technology, Engineering and Mathematics
TIMSS	Trends in International Mathematics and Science Study
UK	United Kingdom
UNESCO	United Nations, Educational, Scientific and Cultural Organisation
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency for International Development
USD	United States Dollar
VET	Vocational Education and Training
VTC	Vocational Training Center

Executive Summary:

The specific objectives of this paper is to map the STEM (Science, Technology, Engineering and Mathematics) sector in Jordan and identify policies and priorities which are in line with the Vocational Education and Training (VET) sector in Jordan. Additionally the paper is to identify the stakeholders and their roles in the VET and STEM sectors in Jordan and how the different actors link together, including the involvement of the following institutions:

- Ministry of Education
- Ministry of Higher Education and Scientific Research
- Ministry of Labour
- Ministry of Social Development
- Centre for Accreditation and Quality Assurance (CAQA)
- Chambers of Commerce and Industry, Professional Syndicates, Unions
- Donors and international actors providing support to VET and STEM and their expected outcomes.

Additionally, the report is to identify gaps and quality issues related to STEM provision in Jordan. This is to include STEM provision to marginalized groups (women and disabled) as well as success stories in demand led VET and STEM education and identification of social partners and private sector actors.

Findings

In Jordan, the educational system is generally isolated from the economy. As such, the educational system is conceptualized and managed as an independent silo. Economic sectors are also generally managed as isolated silos. Thus, there is little interaction between local economic sectors and education, particularly at the school (secondary) level and vocational training levels. To a great extent this has been facilitated by the following:

1. The majority of registered companies (99.6%) are micro, small and medium enterprises with little added value. These companies do not have well developed organizational structures which include an HR function. As such, there is little perceived/documented knowledge of skills and competencies as an input to production.
2. The majority of Jordanian companies are trade based. Thus they have little defined technical, vocational and STEM requirements. As such, general national consciousness regarding STEM's importance and utility is weak. It is for this reason that the role of unions, chambers and syndicates are generally weak in promoting STEM and VET.
3. The dominant employer in the country is the government. This has been true for years. Recent studies have indicated that anywhere from 42% - 52% of the work force are public sector employees. Government employment favours university graduates. Government favoritism has created a national attitude towards education, where university education is perceived as being the only education worth pursuing. Little thought is put into identifying the economic utility of education and making an educational decision based on that. As such, Jordan suffers from a poor public perception towards technical and vocational training as well.
4. Jordanian economic and social development is a victim and beneficiary of continuous donor support. External support facilitates adoption of solutions without having a clear national understanding of the problems the solutions address. Examples of this include:
    a. The importance of STEM education and VET has been articulated by numerous donors over the years. Jordan has adopted measures of STEM performance (PISA and TIMSS) in which we seek to

compete, without deeply understanding the relevance of the tests and/or their utility for economic development. This is particularly true at the economic level (educators may have a theoretical understanding).

b. The necessity of public institutions and initiatives to address issues. Numerous institutions such as NCHRD, CAQA, ETVET Fund, VTC and initiatives such as the National Employment Strategy, JV 2025, and the National Agenda have all been created to address important issues related to education and economic development and employment. However, none of them have defined the economic utility of VTE and STEM in education and demonstrated clear links with economic development and/or competitiveness. As such, although they are impressive works, they are often conceptual wish lists that do not affect education and training or do not define specific areas of intervention to make an economic impact. Overtime, the institutions become ineffective stakeholders in identifying and implementing effective interventions and often times become barriers themselves.

5. There is a general understanding of the importance of STEM education, but little specific understanding of its utility for industry and the economy . As such STEM is easily discussed among academia but not linked with the economy or implemented in a useful manner.
6. Public institutions which regulate and oversee institutions of vocational, technical and higher education (CAQA, MoHSR, HEAC) are effective in organizing and regulating the delivery of theoretical constructs and standards. They also have very poor understanding of private sector economic needs and the role they can play in improving the economy.
7. Chambers of Industry and other sectoral associations are generally unable to identify specific competencies and skills required by companies within general industry and specific sectors. This inability leads to opaqueness in the link between general educational outputs and the economy. This of course includes the relevance of specific STEM education outputs and results and economic and competitive needs.
8. There are a few sectors such as ICT and renewable energy that have some knowledge of the importance of educational outputs. These outputs for the most part are at the post-secondary and university level. As such, these sectors can identify specific technical knowledge (e.g. C++ programming, i-Phone programming, PV cell installation, etc.) that they need without understanding the backward linkages into general STEM knowledge and competency.
9. Jordanian schools, particularly public schools, provide education for specific subcomponents of STEM (physics, chemistry, biology and mathematics). These same schools have access to ICT and the internet. What does not commonly exist though, is the blended and active learning which is required for effective STEM education.

Conclusions**:**

The importance of STEM in Jordan is understood in broad terms by government (MoE and MoHESR) academia. Details of why STEM is important are not generally understood by government, economy or industry.

There is a need to help facilitate an understanding of the linkages between STEM competencies with general learning, technical education, vocational education, university education and fundamental economic requirements. Few Jordanians understand the strong linkages between STEM and learning ability with sustainable competitiveness.

As such, it is important to work with individual sectors, plan out a competitive direction, identify the required skills to sustainably succeed in that direction and communicate these linkages to industry and academia and the

government. Only after demonstrating and linking the utility of STEM education to businesses within identified economic sectors, will businesses and economic sectors demand effective STEM education in a proactive manner.

Additionally, there is a national requirement to retrain secondary school teachers to teach STEM subjects in an integrated manner such that students learn in an active and interdisciplinary manner. Changing the manner in which STEM subjects are taught will improve students' problem solving skills as well as improve their creativity. Efforts are being made currently with the QRTA to improve teacher skills to be in line with STEM requirements.

Key Issues Facing the STEM Sector in Jordan:

STEM education stands for education in Science Technology Engineering and Mathematics. STEM education is an increasingly important national development tool. STEM is more and more considered a developmental standard as it affects how future citizens perceive and understand with the world. As such, STEM is an increasingly necessary educational paradigm for a progressively competitive global economy.

STEM's importance is generally understood in Jordan by academia. This understanding is derived from reading and researching new trends in education, by government agencies and academia, without fully understanding the details or rationale behind the presented conclusions relating to STEM's utility. This lack of understanding is blatantly apparent by the fact that all the recent development initiatives such as JV 2025, the National Employment Strategy (2011 – 2020) do not explicitly refer to STEM education as an objective or a necessary input for sustainable economic development. Therefore, little direct and focused effort is likely to be made in the near future with regards to STEM development.

A crucial part of this national dilemma is that Jordan's economy is dominated by micro, small and medium sized enterprises. The majority of these enterprises have very little value adding activities. As such, the majority of the economy does not understand or value the potential economic implications of improved STEM and vocational education and training on their individual businesses. Because there is little perceived value, and an actual inability to exploit such skills, the private sector demands inexpensive labour input instead of competent labour (a function of low value adding operations). If the private sector valued skilled technical and vocational labour and STEM competencies, the private sector would be an effective proponent for effective VET and STEM education in schools.

What is STEM

STEM's philosophy is based on problem solving using an interdisciplinary and multi-dimensional perspective. Well-developed STEM methodologies seek to integrate a variety of subject matter knowledge and skills in problem definition and problem solving. As such, STEM skills and competencies can be effectively used to address problems and challenges in economic, environmental, regulatory, technical and scientific areas. Thus, STEM is a developmental tool with which to harvest the creativity and opportunity resulting from multi-disciplinary intersections.

For STEM education to be effective, its subject delivery must be blended such that students experience the interconnectivity of the various subjects. Therefore, there is a move away from industrial revolution era specialization by subject (physics, chemistry, mathematics, etc.) to a more holistic and integrated education.

It is believed that the required educational transition will be facilitated through the design of a new academic day through which students will comfortably and confidently "linger and learn" at the intersections of the various individual subject areas such that they formulate their own questions and collectively, as a group, bring their cumulative knowledge to bear on addressing the formulated questions and challenges/issues under scrutiny.

Historical Context**:**

Jordan has historically invested in the education and training of its people. To a great extent this was the philosophy of King Abdullah the First, the nation's founder, to overcome Jordan's developmental challenges resulting from the country's lack of natural resources. This philosophy remains to this day.

Recent educational reform started in the early 1990s. The educational reform process has continued and accelerated under King Abdullah II. The recent economic objective of the educational reform process was to make Jordan a regional technology hub and a proactive player in the global economy. The Vision and Mission for Jordan's national education was developed and endorsed towards the end of 2002. Three national consultative documents helped shape the national vision and set directions for the required educational reform initiative. These documents were the 2002 Vision Forum for the Future of Education Jordan and Jordan Vision 2020.

More recently, several national initiatives such as the Jordanian National Employment Strategy and the Jordan Vision 2025 (JV 2025) and numerous sectoral studies undertaken by the National Centre for Human Resource Development (NCHRD) have all indicated to various extents sectors with growth potential and some reference to university level skills. None of these studies refer in detail to STEM education, student competency or the economic linkages with STEM. This is indicative that there are no or very weak links between national human resource development requirements and STEM. Thus despite the prevalence of numerous national institutions tasked with education, vocational/technical training, employment and national economic development, their linkages with the national economy and the private sector are weak. The weak linkages are because most Jordanian businesses are micro, small and medium enterprises, individually and collectively unable to identify their skill needs and requirements. As such, there is little practical understanding of the linkages between STEM and economically relevant skill sets and competencies.

National Human Resource Development activities are based on the myriad number of studies developed and executed over the past several years. These studies include the National Employment Strategy, the Jordan National E-TVET Strategy and the UNDP/JICA study The Labour Market: The Case of Vocational Training in Jordan. Collectively none of these studies mention STEM as an area of interest. Two studies refer to components of STEM, mathematics and Science, only as variables (through the TIMSS and PISA tests) which need to be measured for the sake of comparison with other countries. Additionally, these studies identify general and broad labour gaps in the market without defining in specific details of the skills ad competencies required to develop, grow and support promising economic sectors. As such, an actionable national human resource development strategy does not exist.

Moreover, and based on discussions with the Ministry of Education, it is apparent that Ministry employees view the STEM components as individual separate silos. Mathematics, Physics and other sciences are viewed as individual materials which need to be improved not integrated. This may be a result of how teacher competency is evaluated.

These subject areas are not viewed as an integrated or blended set of skills which are elicited from the individual components and are useful for problem solving. In Jordan, STEM components are valued by their individual content and students are evaluated on their narrow subject performance. Little understanding was demonstrated on the integrated sets of skills and competencies derived from STEM literacy. As such, the vocational academic stream believes that the mathematics and physics/science literacy is generally poor for those wishing to enter the vocational secondary stream. This indicates a general weakness in STEM delivery until grade 10. Practical vocational training students suffer the same weaknesses in STEM education.

STEM Drivers:

The drivers of STEM education are:

1. A national recognition that STEM education is a competitive tool and an educational necessity to drive innovation and sustainable competitiveness and growth within the economy.
    a. This recognition translates into educational policy initiatives to drive educational reform in the country.
    b. This recognition translates into improved teacher training focusing on blended and active learning.

2. Trained and certified teachers who are able to integrate STEM subjects and facilitate interdisciplinary and interactive learning among students which is focused towards real world problem solving.

3. Relevant and periodic student testing to measure meaningful achievements within STEM education at the school, VET and university level. International comparisons with the educational outputs of knowledge economy countries. Continued PIPSA and TIMSS testing.

4. Relevant and periodic teacher testing to identify existing teaching skill levels and competencies and relate these with STEM achievements at the school, VET and university level. Periodic comparisons of Jordanian teacher skills with teachers of knowledge economy countries.

5. A well-developed private sector that seeks to compete internationally and recognizes that skilled and STEM educated labour is a necessary input to production. This same private sector becomes a cognizant beneficiary, proponent and supporter of quality STEM instruction at the school, VET and university levels.

6. An organized private sector able to identify and articulate their labour needs in terms or competencies and skill levels, such that the relevance of STEM education is obvious. Organizing the private sector may be through existing chambers and/or sector specific business associations in cooperation with HR development professionals.

7. Develop and fund linkages between the private sector, educational sector (secondary, VET and university) and government as a forum to improve economic performance (education – labour market linkages).

8. Recognition by universities, VET programmes/centres that proper STEM education is a necessary output of national schools (secondary level education).

9. Availability of funding to link the labour market with educational output and facilitate STEM improvements at select schools, VETs and universities to create real life success stories to be replicated elsewhere.

10. The Higher Council for Science and Technology (HCST) through the National Center for Human Resource Development has participated and completed numerous studies relating to human resource development and sectoral labour studies. None of these studies refer to STEM education outputs nor set STEM education objectives. As such NCHRD is potentially an important player in helping defining STEM requirements by economic sectors. Of particular interest is the Al-Manar project, which developed a national Human Resource Information System. Regretfully Al-Manar's donor funding came to an end.

This indicates that Al-Manar's output was either not economically relevant to private sector companies or was poorly promoted to potential users. Many of the studies carried out by NCHRD are now out of date.

11. The Scientific Research Fund at MoHESR is not a driver of STEM education. The Scientific Research Fund is reactive to the needs and advances of national researchers. It is not an effective proactive tool to assist in socioeconomic development.

Projected Demand for STEM Based Jobs:

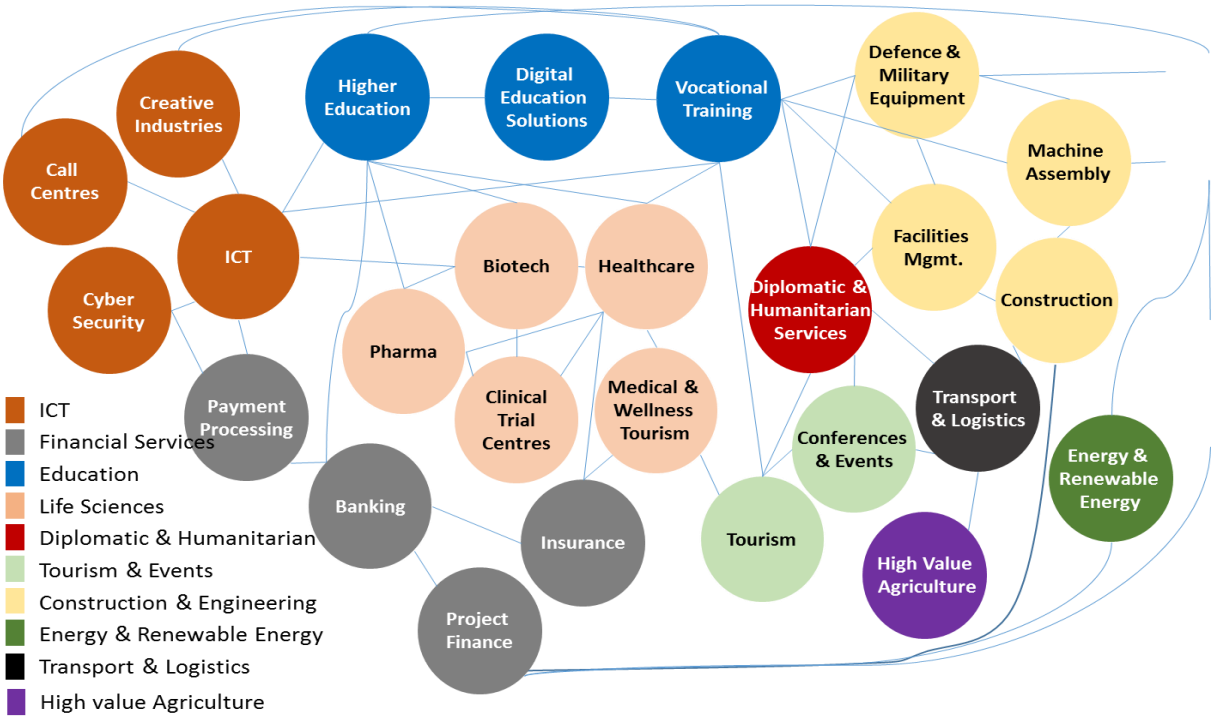
The Jordanian economy is a poor generator of STEM based jobs. The National Employment Strategy states that there is a mismatch between labour supply and demand in terms of quality and quantity. Part of the NES focus was on identifying the key quantity and quality labour supply and demand mismatches. Every year, approximately 120,000 students sit for the high school *tawjihi* exam, of which approximately 60,000 pass. Of those who pass, about 45,000 go to Jordanian universities and 6,000 go to community colleges. National Jordanian universities graduate approximately 40,000 students per year.

The National Employment Strategy also stated that the Jordanian economy created approximately 76,000 jobs created in 2009. Of these jobs only about 24,000 went to university graduates, while 6,500 went to community college graduates. The balance of the newly created jobs, around 46,000, went to workers with high school or lower levels of education. Thus, around 15,000 fresh university graduates find themselves without jobs every year. This indicates a national economy which has low value added processes and little need for knowledge and educated labour.

For the economy to improve, it is imperative that economic sectors move towards increased value adding processes and increasing competitiveness. Without such an economic objective, STEM education and VET are likely to remain irrelevant.

The Jordan Vision 2025 has identified individual economic sectors/clusters as drivers of economic growth. These sectors are (Jordan Vision 2025 –Page 99, Fig. 30):

Existing, Emerging and High-Potential Clusters for Growth



A cursory review of the identified sectors indicates that many are in fact STEM sectors. The following table summarizes the potential job opportunities by designated cluster as defined in JV 2025 (pages 99 – 106).

Sector/Cluster (STEM)	Subcomponents	Existing Jobs	Estimated Annual Growth Rate (%)	Estimated Job Opportunities
ICT	Creative industry, Cyber Security, Call Centers	80,000 (direct & indirect)	5.0	4,000
Life Sciences	Pharmaceuticals, Life Sciences, Clinical Trials, Biotechnology, Healthcare and Medical and Wellness Tourism	55,000 (healthcare) 8,000 (life sciences)	4.5	2,475
Construction & Engineering	Defense and Military Equipment, Facilities Management, Construction and Machine Assembly.	60,000	3.0	1,800
High Value Agriculture	N/A	1000 (estimate)	6.4	64
Transport and Logistics	N/A	120,000	2.3	2,760
Energy & Renewable Energy	N/A	2,500 (estimate)	0.9	250
Education	Vocational Training, Higher Education and Digital Education Solutions	103,000 (2011 estimates –MoE website)	7.8	8,034
Financial Services	Banking, Insurance, Project Finance, Payment Processing	31,450 (2012)	1.4	440

As such, demand for STEM based jobs are expected to increase approximately 19,823 annually. This figure is likely to increase in a more dramatic manner if:

1. The Jordanian economy is able to improve the competitiveness of these sectors/clusters and aggressively export their products and services.
2. The interaction of developing STEM sectors with each other will facilitate additional positive cross sectoral growth (i.e. high value agriculture and transportation and logistics).
3. Interaction of STEM sectors with non-STEM sectors which facilitates cross sectoral growth (i.e. tourism with ICT).

STEM Education in Jordan**:**

The Jordanian educational system at the primary and secondary level covers subjects in science and mathematics. These subjects are physics, chemistry, biology, and mathematics. Most schools also have access to the internet and information technology. As such, several of the STEM components are formally covered in Jordan's public and private schools.

National Interest**:**

There is a national interest in the outcomes of science and mathematics education. This is clearly seen in Jordan's participation in international testing protocols such as PISA and TIMSS. There is also a national recognition that teaching methods facilitate the desired STEM outcomes as much as subject matter competency. This national recognition is the foundation of recent efforts by QRTA in providing training for STEM education delivery.

STEM Provisioning in VTCs:

VTCs currently suffer from the quality of students which they receive from the national educational system (either at grade 10 or after grade 12). No or very weak attempts are made to address weaknesses in fundamental STEM knowledge. There are three subcomponents related to STEM provision. The first subcomponent is that students who are directed towards VTCs are viewed nationally as damaged (sub-par) students and as such are not viewed as potentially productive or beneficial. Therefore, little effort and resources are directed towards addressing STEM within VTCs. The second subcomponent is that the VTCs themselves and the professionals working there have not or cannot link specific STEM competencies to defined and needed vocational outputs. Thus, functionally, STEM and vocational training are treated as isolated silos. The third subcomponent is that VTC output is generally evaluated on the quantity of output rather than the quality of output. The lack of objective quality evaluation of VTC outputs determines that quality STE provisioning is neglected.

STEM and Marginalized Groups:

The Ministry of Social Development is responsible for addressing the educational needs of marginalized groups. This is particularly true for marginalized groups (orphans, physically and mentally challenged) who are able to continue education in the vocational and/or academic stream. The Ministry often works through existing NGOs such as the Al-Aman Fund for Orphans to help place orphans in university, community college or vocational training institutes. As such marginalized groups are equal beneficiaries/victims of the national education system with regards to STEM. There is no effort to help provide career guidance to marginalized groups.

Institutions**:**

Jordan has established many of the institutions to study, recommend, regulate, monitor and intervene to maintain and improve education at the primary, secondary, vocational, and technical and university levels. These institutions include the following:

1. Ministry of Education (primary, secondary, vocational, technical)
2. Ministry of Higher Education and Scientific Research (Community Colleges, Universities)
3. Ministry of Labour (Vocational Training Centers)
4. Center of Accreditation and Quality Assurance (CAQA) – (Primary, Secondary and Vocational Education)
5. Higher Education Accreditation Council (HEAC) – (community colleges, universities)
6. ETVET Fund – Linkages between employers and providers of technical and vocational education and training.
7. NCHRD – Studies and recommendations human resource development requirements to achieve socioeconomic needs
8. QRTA – Queen Rania Teacher Academy – Training and certification of Teachers

Thus, Jordan also has the institutional framework to manage the educational infrastructure at the primary, secondary, vocational, technical community college and university levels.

What is lacking**:**
Jordan has a good theoretical background of what STEM education is and why it is important. Jordan also has the ability to deliver on many of the important subcomponents of STEM education. What is lacking though are:

1. Recognition and identification of the economic utility of STEM education in the economy as defined by individual economic sectors.
2. A proactive private sector which is seeking to develop its competitiveness and can recognize the economic utility of quality STEM education at all levels. This same private sector must seek to develop and maintain linkages with national institutions such as CAQA, NCHRD, HEAC and the ETVET Fund to continuously seek to identify and develop needed skills to maintain socioeconomic development. These linkages can formally be developed through private sector institution such as Chambers of Industry and sector specific business associations.
3. Teachers who are regularly trained and evaluated on the delivery of physics, chemistry, biology and mathematics in an interdisciplinary and integrative fashion using ICT and the internet to enrich the learning and application process. New methods of training STEM subjects need to be internalized and delivered by the educational system at primary, secondary, vocational, technical and university levels.
4. Improvement of the social perception of the importance and utility of vocational and technical training.

Key Issues:

Despite achieving impressive improvements in the education system, Jordan needs to address several of the persistent challenges in the sector. The growing youth population has put pressure on the Jordanian government to guarantee that the quality of education and standard of skills taught can enable youth in competing effectively at the national and international level.

There currently exist numerous problems:

1. Poor understanding of STEM education as a cluster of interrelated and symbiotic skills,
2. Poor ability to blend the various STEM subjects (currently isolated silos),
3. Mismatch of skills taught and the perceived skills required by the employers,
4. Recent jobs which have been created for Jordanians are of low skills,
5. Current use of outdated teaching concepts and methodologies;
6. Insufficient teacher training and
7. Limited technology use.

All of these challenges have been exacerbated in recent years with the inflow of Syrian and Iraqi refugees. The large numbers of additional students has put great strain on the national educational infrastructure and capabilities.

With regard to STEM education at the secondary school level, the weakness in STEM education only becomes apparent at 10^{th} grade. The Ministry of Education evaluates all students entering secondary school whether they should continue with Academic Education (Sciences, Arts or Vocational Secondary) or divert to an entirely vocational (practical) stream.

The issue is that when students are evaluated, it is too late. There are many cases of illiterate students at the 10^{th} grade. Regretfully, this challenge is only caught at 10^{th} grade. Thus, effort should be made to address weaknesses in grade eight and grade nine and even earlier. This will require some form of structured intervention.

An essential part of the intervention may be the adoption of international standards STEM curriculum by the Ministry of Education combined with training and certification of MoE teachers to deliver the STEM material in a blended manner.

The teachers teaching STEM subject material are not trained on modern teaching methods nor on the delivery of blended STEM material in particular. Effort must be made to upgrade teacher skills as well as improve their familiarity with the STEM material at the eighth, ninth and tenth grade levels. Such intervention will lead to higher quality inputs for both the academic secondary and purely vocational streams.

Additionally, education in Jordan has become increasingly content heavy. Students are not given sufficient time in their primary years to develop functional competencies in the 3R's (reading, writing, arithmetic) because they are overloaded with content which is irrelevant to develop their learning competencies. Thus, when more serious learning is required, such as STEM, students have not developed sufficient foundational competency in learning and the resulting STEM education is crippled. Basic educational fundamentals/competencies are much more important than the content being taught. As such, Jordan should focus on the developing and testing basic competencies instead of learning content.

Several other challenges are faced at the intersection of secondary and vocational education (whether academic or purely vocational). The first challenge is the public perception of vocational training and vocational education. Insufficient effort is made to demonstrate the importance of vocational capabilities. Vocational students are perceived as intellectually defective and therefore of lower societal standing than university graduates regardless of whether they can find a job or not.

Moreover, students who are relegated to practical vocational training have no way of bridging into university education. As such, vocational training is seen as an aspirational dead end for students. A bridging mechanism should be designed and implemented to attract students into vocational training and education and then allow them to enter university should they desire. Such a mechanism could also help existing universities attract more mature students with life skills and experience, thereby improving the quality of the academic classroom in universities as well.

An additional challenge is that quality vocational education is inherently more expensive and costly than academic education. Vocational education may be viewed as a drag on national education resources (both monetary and skill wise). The government needs to prioritize education spending and make specific long-term budgetary commitments for vocational training and education. Long term budget allocation and commitment is necessary to develop and modify training/education techniques as well as provide the necessary time to demonstrate efficacy of the delivered training/education to students and the economy.

Budget allocation for vocational training and education is important because the physical environment, particularly for vocational training is generally poor. Infrastructure (physical and educational) for students needs to be upgraded and maintained. This includes classrooms as well as training infrastructure. Many centers have damaged and unusable desks as well as irrelevant training curriculum. Instead of being trained on the maintenance of modern fuel injected or hybrid automobiles, VTCs train on carburetor fueled cars which at best are 30 years old.

Government spending on higher education needs to increase to address to the increasing demand for higher education. The fact is public spending over the past few years for higher education has declined. Higher education spending by government is currently 14.7% of overall education expenditures (0.65% of GDP). This is low compared to middle income countries and to the Organization of Economic Cooperation and Development (OECD) average of 1.6 % of GDP.

Currently, the government of Jordan spends approximately USD 750.00 per student per year, whereas, competing mid-level OECD countries spend USD 7500.00 per student per year. This has led to deterioration in primary and secondary schooling. Moreover, the Government of Jordan has not spent enough on the training and qualification of primary and secondary teachers. This is also combined with a relative decline in teachers' salaries as well as the management capabilities of public schools. The decline in education spending is likely to be a result of the increased spending on the military and security after the start of the Arab spring. Although, seemingly justified in the short term, the government must recognize the long term impact on national development resulting from this re-allocation of resources.

Jordan's education system was more successful in the past as requirements were more basic and static and because Jordan had little or no education. With the dynamic nature of today's world, the current Jordanian

education system is unsure how to evolve. Does the education system focus on basic skills (reading, writing and arithmetic) or evolve to address perceived national and economic development needs?

The new education curriculum has introduced too much content thereby displacing the necessary time allocated to the development of fundamental competencies. Additionally, the current MoE is trying to adopt and adapt international curriculum without understanding the impact contextual gaps between the Jordanian/Arab context and a western context have on learning. These contextual gaps make learning the subject material difficult and further promote rote learning instead of competency development. It would be better for Jordanian curriculum developers to understand the learning objectives and concepts desired in "western" education and develop curriculum based on the local/regional context to develop fundamental competencies. This will help in STEM development in later years.

The traditional systems and methods of instruction as well as the content (curriculum) are insufficient to address modern STEM needs. Training and qualification of teachers, instructors and management must focus on "managing a dynamic" instead of delivering a static set of knowledge. Current curriculum is too content dense to insure adequate development of integrated fundamental STEM competencies and learning skills.

Proposed Solutions

The proposed solutions related to quality delivery of STEM education in Jordan are related to three main themes. These themes are:

Educational/Instructional Theme**:**

1. Improved instructional capability among teachers and instructors within schools (primary and secondary), vocational and technical training centers and universities such that students learn to work in groups, learn to integrate knowledge from several disciplines and apply their knowledge of individual disciplines to address and solve problems. Technology and ICT needs to be integrated into the learning process to expedite self-learning among students. Only through developing the ability to learn independently can Jordan ever expect to address the continuous change of the modern world. This can be furthered by QRTA.

2. Development and delivery of project based learning within primary and secondary schools, vocational and technical training centers and universities, which forces/facilitates integrative learning. Such learning structures are vastly different than typical and conventional lesson plans which existing instructors are used to delivering. This also can be facilitated through QRTA.

Economic Development and Linkages Theme**:**

1. Assist SMEs within select economic sectors with high added value opportunities to define their expected skill and competency needs. These needs can be identified through the use of HR consultants to help define needs of specific sectors. These sectors can only identify the needs and labour inputs they require to improve their competitiveness in export markets. Chambers of Industry and sector specific business associations can help organize companies within individual sectors to interact with HR consultants to define the competencies required and communicate these with the CAQA, NCHRD, HEAC. It is only through a formal engagement with industry which has an economic development objective(s) such that

HR consultants will be able to define specific competencies and skills which are required and necessary to achieve the objective(s).

2. Improve linkages between industry and the educational sector such that the needs of the economy are communicated and acted upon by the educational sector. These linkages can be between the Chamber of Industry and specified sector associations with the NCHRD.

Organizational Theme**:**

1. Linkages between industry through NCHRD, with the MoL (VTC), MoE (primary, secondary, vocational and technical) and MoHESR (universities) must be formalized, organized and monitored to safeguard educational output to serve the economy. This will require identifying the type, standard and quality of outputs from and between the above mentioned institutions to enable proper measurement of the impact of STEM education on national development. This also requires a specific and detailed identification of metrics to be measured in a regular manner.

Gap Analysis**:**

Based on the research relating to the delivery of STEM education in Jordan, the following gaps have been identified. These gaps are prioritized by the author within specific categories as follows:

Societal Attitudes and Awareness**:**

1. Towards Competitiveness: Business owners do not have an aggressive attitude towards developing their businesses, seeking to improve the level of added value to make their businesses more competitive and export capable.

2. Towards Vocational and Technical Training: Society does not have an appreciation for vocational and technical training and certification. If this attitude is changed the practical utility of STEM education will transcend that for only university level education.

3. Government entities (MoE, MoHESR, NCHRD, MoL, HEAC, CAQA, ETVET Fund) are not aware of the importance or the specific linkages between STEM competencies, educational requirements as defined by economic development objectives and downstream educational requirements (i.e. the linkage between primary and secondary education, linkages between secondary and vocational and technical education and training and linkages between secondary and university education).

STEM Delivery**:**

1. STEM Classroom Delivery: Current curriculum subject matter is delivered in a traditional silo methodology where Mathematics, Physics, Chemistry and Biology are delivered individually and separately. Instructors need to be trained on how to integrate and deliver the material to students and facilitate project based, integrative group work where student learn to inquire and learn by themselves.

2. Lesson Planning: Teachers and instructors need to develop competency in designing and delivering interdisciplinary, integrative project based learning.

3. Evaluation of Teaching Outputs: There is insufficient national competency in evaluating the quality of teachers' lesson plans and STEM delivery methods for the purpose of modification if necessary as measured by the educational output of students.

Linkages between Industry/Economy and Education**:**

1. Labour Competency and Skill Identification: Current economic sectors do not recognize labour competency and skill as an input to production and a driver of competitiveness. Chambers of Industry and Sector based associations do not assist registered Jordanian companies (mostly MSMEs) in identifying and articulating their skill and competency requirements. As such, MSMEs are incapable of effectively articulating and communicating their labour needs with any national organization responsible for delivering educational outputs. It is imperative that economic sectors be evaluated to identify their short, medium and long term educational requirements to achieve defined sectoral economic and business objectives.

2. Linkages between Industry and Education: No formal linkages exist between Chambers of Industry and sectoral associations to communicate actionable recommendations to modify, improve and deliver STEM education outputs for the purpose of improving the labour inputs they receive from educational institutions.

Defining National Development Objectives and Sector Contributions and Requirements**:**

1. Linking Educational Requirements with Sector Development Requirements: Individual economic sectors do not define their growth objectives in a regular, studied and structured manner. Without defined

growth objectives individual economic sectors cannot identify their labour input requirements. The educational system can never deliver what is not identified.

Conclusions**:**

This report has set out to describe the the reality of STEM education in Jordan and shed light on the reasons for the weakness in STEM delivery. Jordan's performance in STEM education has been poor and not improving over the past several years.

Jordan's poor educational performance as relates to STEM is the result of:

1. Inadequate focus on developing fundamental learning competencies in the primary education years (grades 1-10).
2. Difficulty in grasping STEM education competencies in later years is the result of a weakness in fundamental literacy and numeracy.
3. Displacing of fundamental skills and competencies, particularly in the primary learning years.
4. Adoption and adaptation of new curriculum and learning objectives without the required accompanying development of teacher skills or the displacement of traditional curriculum.
5. Curriculum which has been delivered is too dense. Thus, students are spending insufficeint time in developing basic competencies.
6. Efficacy of education has been hindered because the material has been localized without taking sufficient care to insure contextual correctness.
7. Localized material is difficult and often foreign and awkward to teach and learn. The knowledge was meant to be delivered was in fact not imparted.
8. Teachers and instructors have not been trained on organizing, structuring and delivering STEM education (group work, integrative, multidisciplenary) and facilitating self learning and discovery for students.
9. Teachers and instructors are not leveraging and exploiting the opportunities afforded them through ICT (including mobile phones) for lack of training and their own lack of knowledge on its use and power.
10. Teachers have not been trained on how to evaluate the learning outcomes of STEM students.

There also exist several structural problems related to the linkages between the economy (specific economic sectors) and education. Several of the structural problems can be summarized as follows:

1. Private sector's poor understanding that labour skill and competency is an input to production.
2. Private sector's timid attitude towards sector and business growth and its poor desire and ability to compete in international markets.
3. Private sector's inability to identify and articulate the labour skills and competencies it requires to develop and prosper.
4. The unresponsive role of chambers of industry and many sector associations in assisting industry sectors in identifying the skills and comepetencies needed in labour.
5. Inability of government in linking STEM performance at primary and secondary levels with downstream eduactional competency and economic competitiveness. The rationale of education is missing.
6. Ineffective linkages between industry and government entities responsible for delivering STEM education and relevant quality primary, secondary, vocational, techical and university education.
7. Primary and secondary education are seen as only essential for obtaining a university degree. There is little association between STEM education and quality vocational and techical training.
8. There is little recognition of the importance of vocational and technical training as a means to improve company and economic competitiveness.

The following recommedations address these challenges.

Recommendations and Action Plan:

Teacher training and certification to deliver STEM curriculum

1. Identify talented and committed teachers within the public and private sectors.
2. Contract with them to send on teacher training and certification trips to the UK or elsewhere to learn about effective delivery of STEM education.
3. Have these teachers train others in Jordan to deliver STEM material. Of particular concern is the integrative aspect of quality STEM education among subject areas (blending).

Responsible Parties and Stakeholders:

a. MoE
b. MoPIC
c. QRTA
d. International and multinational donors

Curriculum development to make the context in which it is presented by teachers relevant to Jordanian students.

1. MoE to adopt international standard STEM curriculum.
2. Local MoE curriculum developers develop local material to achieve desired learning outcomes (instead of localizing existing imported material) in the local context to improve its efficacy.

Responsible Parties and Stakeholders:

a. MoE
b. MoPIC
c. QRTA
d. International and multinational donors

Monitor, evaluate and improve STEM training.

1. Monitor and evaluate the impact of the teacher training on the STEM skills (TIMSS, PISA). Pre and Post curriculum teacher training and certification.
2. Monitor and evaluate the impact of the curriculum adoption and adaptation on the STEM skills (TIMSS, PISA). Pre and Post curriculum adoption, adaptation.
3. Make necessary adjustments to teacher training and the curriculum if necessary.

Responsible Parties and Stakeholders:

a. MoE
b. MoPIC
c. QRTA
d. International and multinational donors

Effective communication with citizens on the work opportunities afforded by vocational training and education.

1. Identify positions in economic sectors and starting salaries that can be filled with vocational training and degrees.
2. Communicate where the degrees/training can be obtained.
3. Publish the number and salaries of vocationally educated individuals who get placed in jobs and their average salary as well as high and low salaries.

4. Advocate with the government to advertise preferential employment for individuals with vocational education and training certification over those with academic degrees.

Responsible Parties and Stakeholders:

a. Chamber of Industry
b. Sector Business Associations
c. MoL
d. MoPIC
e. Civil Service Bureau
f. VTC
g. Community Colleges
h. International and Multinational Donors
i. Private Companies
j. Communication companies

Educating citizens on the need for continuous education and certification:

1. Write and publish articles in newspapers on the necessity for continuous education instead of single degree education for both the public and private sectors.
2. Write and publish videos on you tube on the necessity for continuous education instead of single degree education.
3. Hold public seminars with the public and private sectors on the changing face of employment globally and the implications it has on education and vocational training and education in particular.

Responsible Parties and Stakeholders:

a. Consultants
b. Reporters
c. Chamber of Industry
d. Sector Business Associations
e. MoL
f. VTC
g. Community Colleges
h. Civil Service Bureau
i. Private Companies
j. Communication companies.

Identify skills and competencies required to develop more competitive economic sectors.

1. Work with the private sector (Chamber of Industry or sector association) and MoPIC to identify the skill sets and competencies required by the sectors identified in the Jordan Vision 2025 initiative.

Responsible Parties and Stakeholders:

a. Chamber of Industry
b. Sector Business Associations
c. MoPIC
d. International and multinational Donors
e. Private Companies.

Prioritize which sectors to focus on in the short term.

1. Hire an HR specialist or consultant to help identify the required skills and competencies because the majority of businesses are Micro, and Small companies and are unable to do so themselves.

Responsible Parties and Stakeholders:

a. Chamber of Industry
b. Sector Business Associations
c. MoPIC
d. International and multinational Donors
e. Private Companies.

Make necessary investments to deliver the required training, education and certification.

1. Based on the selected sectors and the defines skills and competencies seek out funding from the government budget, foreign donors, and private local companies to initiate the vocational training, education and certification and maintain it for several years to prove its economic utility.

Responsible Parties and Stakeholders:

a. Chamber of Industry
b. Sector Business Associations
c. VTC
d. MoPIC
e. MoE
f. International and multinational Donors
g. Private Companies

Monitor the impact of the trained, educated and certified employees on the companies which employ them. Identify areas of weakness and modify the curriculum if necessary:

1. Develop base lines measurements for companies who will employ trained and certified vocational graduates.
2. Measure the impact on the baseline measurements 2 4, 6, 8, 10 and 12 months after employing trained and certified vocational graduates.
3. Identify areas of improvement for vocational training and certification if any.
4. Make necessary modifications to the vocational curriculum, training methods and vocational infrastructure if required.
5. Develop new baselines and measure improvement of company performance.

Responsible Parties and Stakeholders:

a. Chamber of Industry
b. Sector Business Associations
c. MoPIC
d. MoE
e. CAQA
f. VTC
g. International and multinational Donors
h. Private Companies.

Facilitate cooperation between target economic sectors, the VTC, MoE and MoPIC to provide relevant vocational education:

1. Hold annual meetings in which the efficacy of vocational training is measured by companies within the pre-designated sectors on their economic performance and suggest improvements to be made to further develop and sustain the sectors.

Responsible Parties and Stakeholders:

a. Chamber of Industry
b. Sector Business Associations
c. VTC
d. MoPIC
e. MoE
f. Donors
g. Private Companies.

Annex 1: Background Information

Approximately 55% of Jordan's population is below the age of 24. Roughly 35% are 15 years or younger. Jordan's gross and net enrollment/attendance rates (2008 – 2012) in pre-school, primary school and secondary school for males and females are indicated in the below table.

Category	Statistic
Female Pre Primary Gross Enrollment	31.4%
Male Pre Primary Gross Enrollment	33.4%
Female Primary Gross Enrollment	91.8%
Male Primary Gross Enrollment	92.2%
Female Primary Net Enrollment	90.7%
Male Primary Net Enrollment	90.8%
Female Secondary Gross Enrollment	88.2%
Male Secondary Gross Enrollment	83.2%
Female Secondary Net Attendance	88.8%
Male Secondary Net Attendance	85%

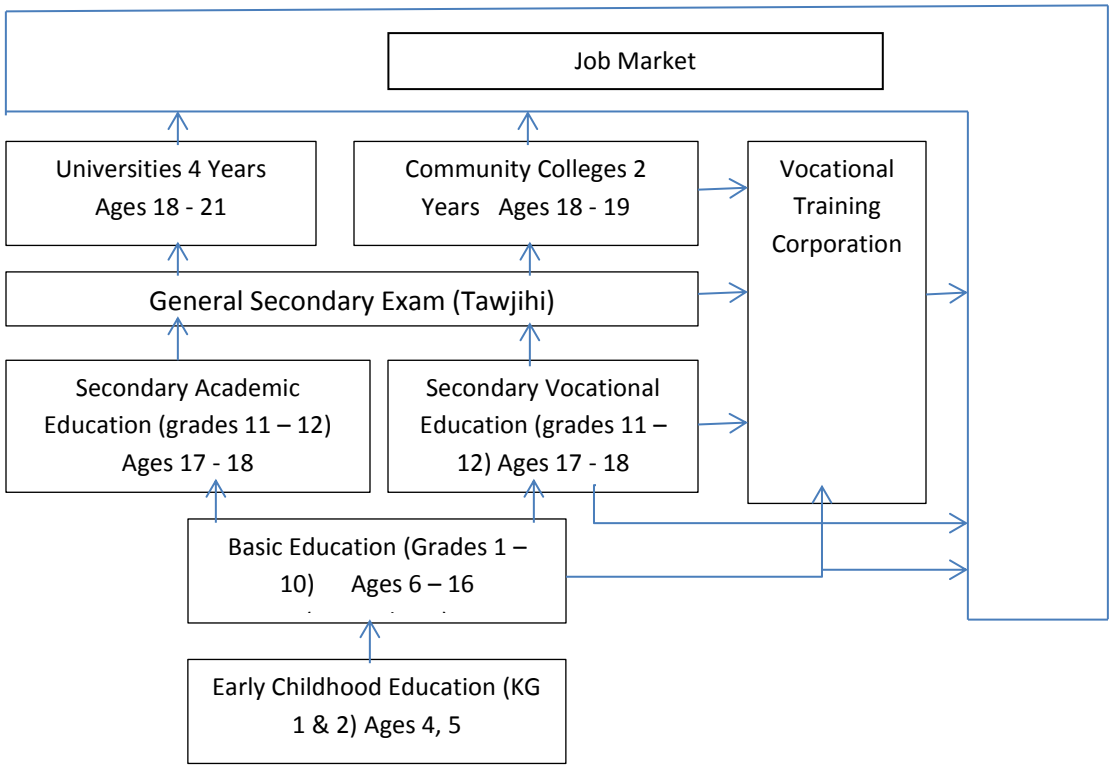
Jordan has a high level of gender parity in access to educational services. The gender parity index for gross enrollment ratio in primary education is 0.98. Jordan is also one of the few Arab countries that have a small disparity in primary school attendance between urban and rural areas. This is primarily due to the fact that public financing for basic education is more pro-poor than that any other level of education.

Jordan's educational system currently consists of:

1. A two-year cycle of pre-school education,
2. Ten years of compulsory basic education, and
3. Two years of secondary academic or vocational education after which students sit for a national General Certificate of Secondary Education Exam.

Discussions with the Ministry of Education (vocational secondary stream) yielded results that up to 2015, students seeking a vocational secondary degree were taught mathematics and physics at a lower level compared to the academic secondary stream. This attracted many students as they could achieve higher academic grade averages and be accepted into the University for doing less demanding academic work (lower mathematics and physics). This created a mismatch, and the vocational secondary education has been upgraded in 2016 to deliver physics and mathematics at the same level as the scientific stream. The downstream implication of such a change may reduce the number of students seeking vocational secondary education, as it no longer represents an easy entry into higher education. Nonetheless, the Ministry believes that vocational secondary education will continue to attract above average students as it reduces the academic strain by displacing some materials such as biology and earth sciences with drafting and other technical skills. The reduced work load allows students to focus more effort on improving their understanding and knowledge of mathematics and physics.

The Current Education Structure in Jordan is as depicted below:



Annex 2: Education System Performance in Science and Technology:

Jordan has participated in the TIMMS (Trends in International Mathematics and Science Study) evaluation and the PISA (Programme for International Student Assessment). PISA is a mathematics literacy test. PISA requires students to apply their mathematical knowledge to solve various real-world problems. To solve problems, students are required to make use a number of mathematical competencies, as well as an extensive range of mathematical content knowledge. Alternatively, TIMSS, measures more traditional classroom content including testing the understanding of fractions and decimals and the relationship between them. Both these tests are used as a proxy to measure STEM competencies.

Jordan's assessment of student learning outcomes using international comparisons started in 1991. Simultaneously with the launch of the International Assessment of Educational Progress (**IAEP II**), Jordan began reviewing its education system and considering educational reform. Jordan has participated in several major international education assessments. These include:

- 1991 in International Assessment of Educational Progress (IEAP),
- 1999 in Trends of International Mathematics and Science Study (TIMSS-R),
- 2003 TIMSS,
- 2006 Program of International Student Assessment (PISA),
- 2007 TIMSS, and
- 2009 PISA.
- 2011 TIMSS
- 2015 TIMSS
- 2015 PISA

Jordan has used these tests and assessments as proxies to benchmark the country's STEM performance. IAEP was used to assess science and math performance at the end of the primary education cycle. TIMSS assessment focused on 8th grade science and math performance in parallel to education reforms. PISA and (National Assessment for Knowledge Economy skills) NAfKE assessments were used to perform structural diagnostics of skills at the end of the compulsory school stage (grade 10).

The early 1991 IEAP results were alarming. Jordan ranked 18 out of 19 countries. The IAEP II assessment not only provided critical data on national educational performance but also created the opportunity to acquire assessment techniques (sample selection, test administration, implementation monitoring). As such, IAEP was instrumental in building Jordan's capacity in conducting surveys of student achievement.

The IAEP II assessment showed that Jordan's students ranked near the bottom. These results were shocking as nearly 75% of mathematics students and 67% percent of science students scored lower than the international average. Jordan ranked third from the bottom in mathematics and science amongst 20 participating countries.

Student performance (PISA 2015)

- The average performance in reading of Jordanian 15-year-olds is 408 points, compared to 493 points in OECD countries. Girls perform better, with a statistically significant difference of 72 points (OECD average: 27 points higher for girls), than boys.
- The average mathematics score for 15-year-olds was 380 points compared to 490 points in OECD countries. This was the main topic of PISA 2012. Girls perform better, with a statistically significant difference of 14 points (OECD average: 8 points higher for boys), than boys.
- The national score in science literacy for 15-year-olds was 409 points compared to 493 points in OECD countries. Girls perform better, with a statistically significant difference of 39 points (OECD average: only 3.5 point higher for boys), than boys.

The result of the 2015 TIMSS evaluation is as follows:

		Percentage Reaching TIMSS International Benchmarks			
Category	Average Score	Advanced	High	Intermediate	Low
4th Grade Math	388	0%	5%	21%	50%
4th Grade Science	386	N/A	N/A	N/A	N/A
8th Grade Math	386	0%	3%	18%	45%
8th Grade Science	426	1%	9%	34%	63%

The TIMSS scale is out of a thousand points. Jordan's score is below the TIMSS center point of 500 points in both mathematics and science. There appears to a marked improvement between 4th and 8th grade science scores but little movement in mathematics scores. This may indicate an improvement in science instruction between 4th and 8th grades and little improvement in mathematics.

Only 1% of tested Jordanian students score in the advanced category for TIMSS Science, while zero percent score in the advance category in mathematics for both 4th and 8th grades. The general poor performance in the TIMSS and PISA, indicate a weakness in STEM education until grade 10.

Regardless of the PISA and TIMSS scores, Jordan's continuous participation in these assessments indicate a national acknowledgement of the importance of foundation science and mathematics education at the primary and secondary levels as well as a desire to improve. There are several challenges facing Jordan among which are:

1. Meeting and/or exceeding international scores,
2. Transitioning from secondary education to tertiary education (academic or vocational) where economically relevant skills can be obtained. This particular challenge reflects the private sector's inability to identify and articulate its required labour competencies and skills as well the educational sector's ability to adapt/change to provide these skills.

The vocational secondary stream typically attracts less competitive students and therefore has to struggle with poor levels of Mathematics and Physics. Students entering the secondary vocational stream had difficulty with mathematics and physics even through the subject material they were requested to learn was simpler/easier than the scientific stream. This validates a general STEM weakness up till grade 10.

Education Management:

Primary Education:
The government provides free, basic education until the 10th grade. Education is compulsory through the age of fifteen. The Ministry of Education also distributes standard books to students.

Jordan has both public and private schools. The private education sector serves more than 31% of the primary and secondary school population in Amman. This private education sector is still heavily taxed, despite it shouldering a large portion of the government's burden. Private school fees are relatively high, when compared to the average family incomes.

Secondary Education:

Secondary students are required to take nine to ten subjects:

1. Arabic,
2. English,
3. Mathematics,

4. Social Studies,
5. Computer Studies,
6. Earth Science,
7. Chemistry,
8. Biology,
9. Physics and
10. Islamic religion is mandatory for all except Christian students.

The secondary education level consists of two years' study. Typically, students are between the ages of 16 to 18 and have completed the basic ten year primary education cycle. Secondary education includes two major tracks - academic and vocational.

- Upon completion of the two-year secondary education period, students sit for the general secondary examination in the appropriate branch. Those who pass the secondary education exam are awarded the General Secondary Education Certificate). Students who pass the academic secondary stream exam are qualified for entrance to universities. Students who pass the vocational or technical education secondary stream exam are qualified to enter Community Colleges, universities (provided they pass the two additional subjects) or enter the job market.

- Applied secondary education is managed by the Vocational Training Corporation (VTC). The VTC provides vocational training and apprenticeship. Vocational training leads to the award of a certificate. Practical training is accomplished through on-the-job apprenticeship. This is different from vocational secondary vocational education where practical training is acquired in school work shops.

Up until 2015/2016 the vocational secondary mathematics and physics was less demanding than scientific stream secondary education. Moreover, some curriculum items such as Earth Science, Biology and Chemistry are displaced with vocationally focused subjects (drafting, etc.). The reduction in academic rigor has made the vocational secondary stream attractive to students who wish to enter the university. This reduction of academic standard for vocational secondary students has created unfair competition at the local university level. As such, the Ministry of Education, recently, harmonized the physics and mathematics requirements between vocational stream and scientific stream secondary education. While the harmonization is necessary to create a level playing field at the university level, it does not reflect the required mathematics and physics competencies in the vocational stream.

Thus, the initial changes to the secondary vocational stream implemented by the Ministry of Education helped improve Jordan's optics with regard to vocationally oriented students, with the vast majority of these students seeking university degrees not vocational jobs.

These changes to the vocational stream curriculum reflect university requirements not economic or labour market needs. As such, vocational secondary education is a less academically rigorous secondary path to a university degree instead of a path to developing marketable vocational competencies in students. Thus, the economy is still not and is unlikely to be supplied with competent and capable vocationally trained people in the numbers required.

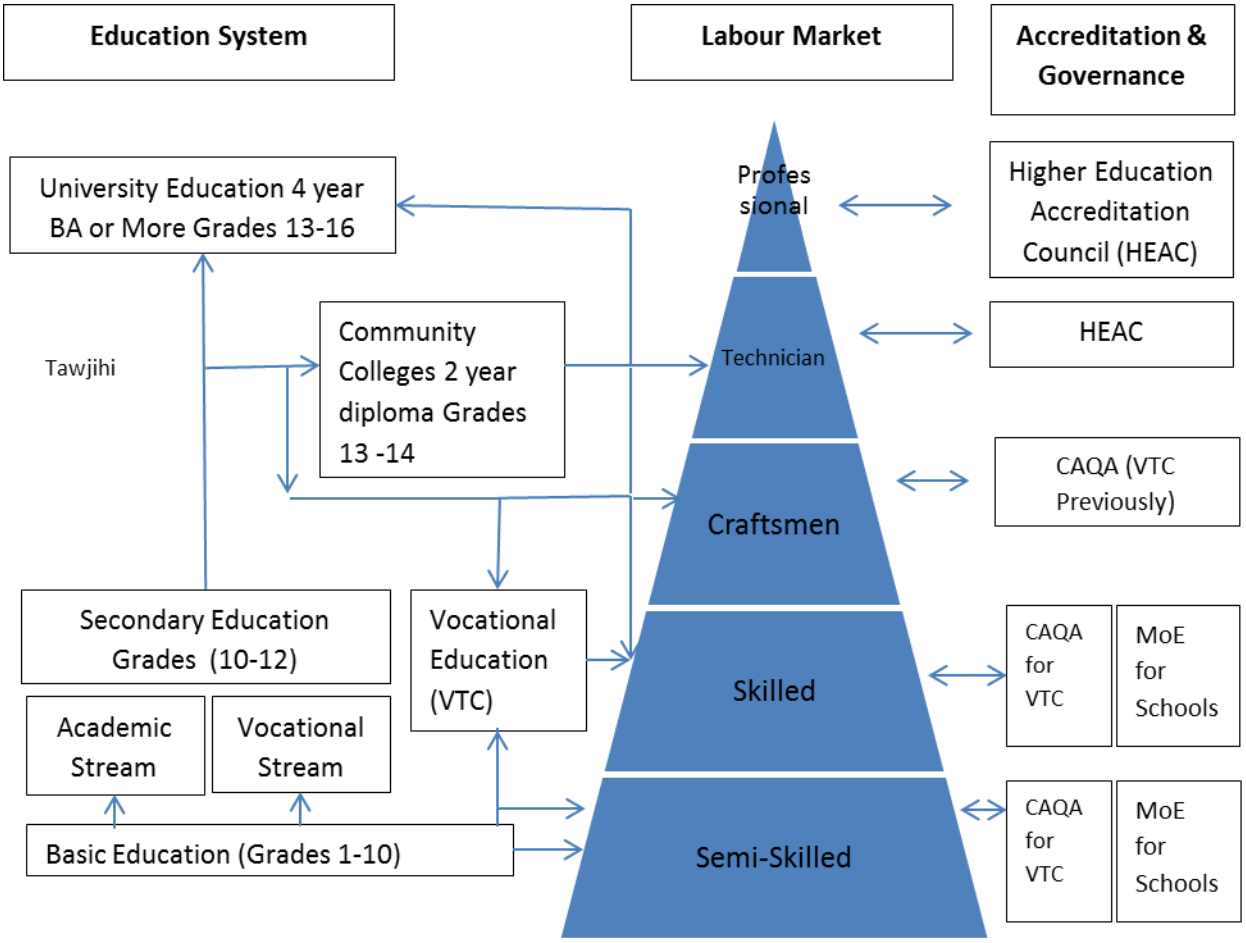
Certification of the vocational streams, both vocational secondary and practical vocational (VTC and private vocational colleges) are through the Center for Accreditation and Quality Assurance (CAQA). CAQA is responsible for measuring the outputs of vocational education and training to provide the appropriate certification for competencies which have been mastered/achieved.

One of CAQA's main comments on vocational training and education is that vocational training does not reflect current market needs with much of the curriculum dating back to the 1970s and 1980s. Additionally, there is a stark difference between the academic scores (grade averages) between secondary academic vocational students

and practical vocational students with a clear difference in mathematics and science fluency between them. This validates the weakness in general STEM education up to grade 10.

Diagram of the structure of the TVET system in Jordan

The diagram below indicates the structure of the TVET system in Jordan:



The Ministry of Social Development (MoSD) does have some intervention with regard to vocational training. MoSD is responsible for assisting individuals with special needs as well as orphans and children/students who are victims of broken homes and domestic violence. However, MoSD's responsibility is to try and guide students and help them navigate the vocational training system after compulsory education (grade 10). MoSD does manage vocational training centers in Irbid and Ruseifa for students with special needs.

Societal Challenges

> The society in Jordan is not nurturing to education. Jordan has an issue in how society perceives women. This is to an extent derived from unqualified and feeble religious interpretations. If women are perceived as a lesser gender, particularly by males and 62% of secondary teachers are in fact women, then their ability to be effective is diminished by an unhelpful and destructive view of women and their competencies. Such a perception has only recently developed in Jordan and other Arab societies. The societal context is wrong for proper teaching due to socially accepted and communicated Islamic principles.

The Ministry of Social Development (MoSD) does have some intervention with regard to vocational training. MoSD is responsible for assisting individuals with special needs as well as orphans and children/students who are victims of broken homes and domestic violence. However, MoSD's responsibility is to try and guide students and help them navigate the vocational training system after compulsory education (grade 10). MoSD does manage vocational training centers in Irbid and Ruseifa for students with special needs.

Higher Education:

Currently there are 27 registered universities in Jordan of which 17 are privately owned. There are also 51 registered community colleges. The latest figure for the number of enrolled students in both public and private universities is approximately 236,000 of which approximately 28,000 are from Arab or foreign nationalities.

Higher education institutions fall under the purview of the Ministry of Higher Education and Scientific Research (MoHESR). MoHESR supervises the higher education sector in Jordan through:

1. The Higher Education Council (HEC) which assumes the responsibility of establishing the general policy for the higher education sector,
2. The Scientific Research Support Fund and
3. The Higher Education Accreditation Commission (HEAC) which is responsible for "maintaining the quality" of higher education in Jordan.

The main challenge with MoHESR, the Higher Education Council and the Higher Education Accreditation Council is the linkage between higher education (universities and community colleges) in all their forms (vocational, technical, and academic education) and identified economic needs.

The role of higher education accreditation has gone through several stages. Accreditation of Higher Education was first handled by the Higher Education Council over the period (1990-1999), followed by the Education Accreditation Council for the period (1999-2007). It was during the latter period where the public and private accreditation higher education standards were drafted. These standards were drafted to be adopted by private universities to adjust and unify the quality of higher education. The Higher Education Accreditation Council was also responsible for monitoring and supervising private universities to ensure continued compliance with these standards and instructions.

On March 25, 2007 the Government of Jordan issued the Higher Education institutions Act No. 20 of 2007 dated which created the Higher Education Accreditation Commission to replace the Accreditation Council. This was the last governmental episode, confirming its support for higher education and ensuring the level and quality of higher education to meet local and international standards.

Despite the existence of the numerous accreditation councils within the MoHESR (from 1999 till today), accreditation has evolved into a theoretical process. Accreditation in Jordan follows international education standards which do not reflect economic realities in Jordan. As such, there has been long term frustration that the outputs of higher education do not meet the needs of the economy or plans for the economic development.

Higher education is linked to match international standards (US and Western European Universities) without consideration of the existing level of added value in the local economy.

Thus, the MoHESR and the HEAC have developed a robust accreditation methodology which mirrors international universities, but does not identify or address current or aspirational local economic development needs. Without a solid foundation in identifying economic market needs, Jordan is cursed with an impotent bureaucratic process which produces irrelevant results at an international standard. Moreover, changing curriculum within universities has become intricate and complicated, making it difficult for universities' to modify their course offerings to address current market needs and opportunities.

Thus, talented Jordanian graduates may be more suited to more developed economies. An additional indication of the irrelevance of higher education is the mismatch between technical, vocational and academic education. According to the 2011-2020 National Employment Strategy (NES) approximately 120,000 students take the general secondary high school exam (Tawjihi), of which 60,000 pass. Approximately 45,000 of the general secondary graduates attend Jordanian universities. Roughly 6,000 general secondary graduates go to community colleges.

Job creation and labour mismatch:
Out of the roughly 76,000 jobs created in 2009, only 24,000 went to university graduates and 6,500 went to community college graduates. The remainder, approximately 46,000, went to workers with high school or lower education levels. Therefore, about 15,000 new university graduate, every year, find themselves without jobs.

Linkages between the Economy and Education**:**
Generally speaking, the demand for STEM education in all its forms is the result of defined economic demand. Economic demand is defined by the requirements of industry. The challenge in Jordan is that most companies are considered micro, small and medium enterprises (MSMEs) with generally less than ten employees. Recent statistics indicate that 98% of registered companies are considered MSMEs , the majority of which have less than 19 employees. Because of their limited size, the output of these companies has low added value. As such, these companies (and owners/management) do not consider or recognize knowledge as being an input to production. Therefore, there are poor linkages between industry and companies and education.

National Qualification Framework: There is a necessity to establish a national qualification framework to organize the TVET sector. Currently no framework exists and thus technical and vocational education and training is delivered without a defined objective or set of standards to achieve. A qualification framework will provide clarity to what vocational and technical training centers as well as community colleges must provide in terms of output as well as provide the Center for Accreditation and Quality Assurance (CAQA) clarity in what should be measured in terms of skills and competencies. A National Qualification Framework needs to be developed with the private sector to define required skill sets and competencies for designated sectors as well as define standards for semi-skilled, skilled and craftsman level labour.
(**Source**: Ms. Nadera Al-Bakhit, Ex USAID Workforce Development, Ex-Minister of Education Advisor on ETVET. Interview December 27, 2016)

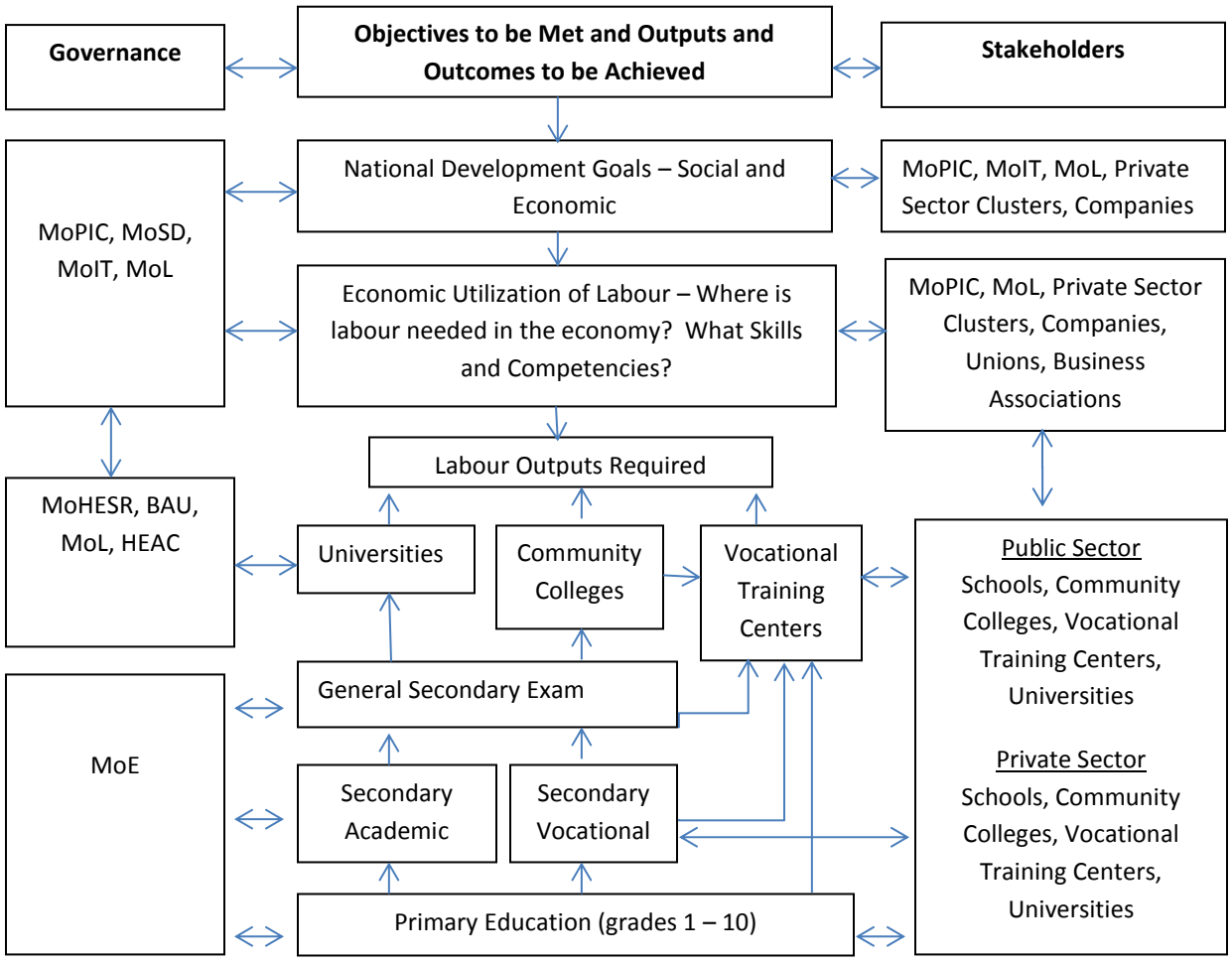
Moreover, the investment/business environment in Jordan has not been sufficiently conducive to attract substantial domestic or foreign investment. This has led to companies of small size with poor added value. If a larger number of industries can be established and/or larger companies can be formed both categories of which are export oriented, then it is likely that these larger companies or clusters of companies will be able to define in detail the competencies and skill sets which they desire to be effective.

Additionally, because of the predominance of MSMEs, these companies do not have an established Human Resource (HR) function and as such, the largest category of registered companies do not have an ability to technically define the competencies and skill sets which they need. As such, they do not have an ability to consistently engage educational institutions in a studied and formal manner.

There is a need for a public sector intervention to help define the HR requirements of sectors/clusters to enable them to improve the level of added value. Identification of the required competencies needed by sector/cluster will help identify and validate the need for specific STEM skills in education. As such, effort should be made to identify at a sector or cluster level those essential skills and competencies to develop and maintain sustainable economic competitiveness. This can be done by assigning an HR expert to evaluate the existing skill and competency levels among sector/cluster firms and compare them with what is required for sustained economic growth. The identified gaps between what is needed and what exists will be the primary driver for promoting more aggressive STEM education in addition to vocational and technical education. These gaps need to be re-evaluated every few years to take into account changes in the competitive landscape and the evolving requirements of the sector/cluster.

Although Jordan has established what seem to be all the required institutions to organize and govern the development and training of a demand driven labour market, the level of dialogue and interaction between the various institutions remains immature. The below schematic suggests and summarizes the types of linkages which may be required.

Suggested Market Linkages to Facilitate a Demand Driven Labour Market



Annex 3: List of Individuals and Organizations Consulted

Institution Name	Individual Consulted	Position	Date
Ministry of Education	H.E. Dr. Ibrahim Badran	Ex-Minister of Education	November 30, 2016
Philadelphia University, Royal Consultative Committee on Education	H.E. Dr. Marwan Kamal	President, Member of the Royal Consultative Committee on Education	December 4, 2016
Al-Quds Community College & Lu**minus** Group	Mr. Ibrahim Safadi	Chairman	December 5, 2016
Ministry of Social Development	H.E. Reem Abu Hasan	Ex-Minister of Social Development	December 5, 2016
CADER	H.E. Dr. Muhieddin Touq	General Manager, Ex-Dean of Education and President of Philadelphia University. Ex-Director of UNRWA/UNESCO Department of Education, Jordan, Syria, Lebanon, West Bank and Gaza	December 15, 2016
USAID Workforce Development Programme	Mr. Isam Othman	Senior Career Counseling Specialist	December 26, 2016
USAID Workforce Development Programme, Ex-Ministry of Education	Ms. Nadera Bakhit	Advisor on ETVET (MoE)	December 27, 2016
Ministry of Labour	Mr. Mohammad Khair	Head of CAQA	January 10, 2017
Ministry of Education	Mr. Isam Malkawi	Curriculum Department	January 18, 2017
Ministry of Education	Mr. Nowaf Dughmi,	Head of Curriculum Department	January 18, 2017
Ministry of Education	Mr. Ahmad Hasan	Curriculum Department	January 18, 2017
Ministry of Education	Mr. Isam Malkawi	Vocational Curriculum Department	January 18, 2017
Ministry of Social Development	Mr. Mahmoud Al-Jbour	Manager of People with Special Needs Department	January 22, 2016
Ministry of Education	H.E. Dr. Omar Razzaz	Minister of Education, Author of the Jordanian National Employment Strategy	March 23, 2017
Hussein Technical University	Dr. Wael Masarweh	President	April 5, 2017
Hussein Technical University	Dr. Ibtisam Attiyat	Head of Social Development Department	April 5, 2017

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