The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2021

Volume 23, Pages 15-24

IConSE 2021: International Conference on Science and Education

Integrating STEM in to TVET Education Programs in QATAR: Issues, Concerns and Prospects

Ziad SAID
College of the North Atlantic - Qatar

Abstract: Qatar TVET education system faces unique challenges in that the percentage of vocational secondary school students constitute only 1.4% compared to world average of 15% due to the poor perception of TVET as lesser pathway than other academic-based education. This low perception is associated with sociocultural, economic and institutional factors. Another challenge is the poor link between vocational and general education and the link to labor market. Further challenge is how TVET institutions can develop new curricula, which can respond to the needs of the 21st century skills. This paper will discuss how STEM can help promote TVET education and what are the possible changes required to overcome those challenges. A survey on "Improving and enriching the Human Capital of the State of Qatar through Identification and Development of 21st Century Skills", explored perceptions of both employers and TVET program leaders toward the skills needed for economic and social developments in a changing world by Meeting Human Capital Needs through 21st Century Skills including the perceptions on needed STEM and cognitive skills. A total of 85 managers and professionals (from more than forty establishments) completed the survey, together with 35 TVET program leaders located in one national university and six government TVET institutions together with 32 semi structured interviews. Descriptive statistics analysis showed a major mismatch between the perceptions of TVET program leaders and employers' managers and professionals in many aspects., employers perceive the social skills as more important while TVET consider mathematical reasoning as more important employers perceive technological skills such as digital literacy as more important than what TVET leaders perceive. This presentation will identify several approaches to integration and discuss the advantages and disadvantages of the approaches employed. The presentation addresses the various planning approaches and resources required to effectively integrate STEM in TVET programs and curricula.

Keywords: TVET, STEM, Digital Literacy, Skills Gap, Integrative STEM, Curriculum

Introduction

Qatar's growing economy has high growth rate in both economic and social development. Qatar National Vision 2030 (QNV 2030) emphasizes the importance of knowledge and skills of its citizens to achieve a knowledge-based economy. Qatar, however faces a variety of skills shortages and education must take the challenge to develop programs to meet these needs and promote the acquisition of the 21st century skills that are necessary for students to master in order to succeed in work and life.

TVET (Technical and Vocational Education and Training) programs are very important to prepare students and adults for a wide range of skills that are demanded in the labor market which are oriented around science, communications, information and engineering technology. Demand for these competencies is increasing all over the world with wide range of education and training skills in knowledge technologies such as software systems, knowledge management e.g. data mining and retrieving, modeling, simulation, 3D printing, etc. participation of students in technical and vocational education programs in Qatar is among the lowest compared to other countries standing at a total of about 1% of secondary school students only (UNESCO 2020).

STEM (Science, Technology, Engineering and Mathematics) is integral to many of the required knowledge and how they are integrated is a new 21st century skills that TVET students should acquire. The understanding of STEM components and how they are connected helps students develop better and deeper understanding of their TVET program contents. However, STEM is still taught in a traditional approach i.e. in silos which only refers

As Qatar diversifies its economy, there is an increasing emphasis, in higher education, on subjects that propel a knowledge economy, such as math and science. One among the key challenges to tackle to achieve QNV2030 as stated in Qatar National Strategy Development 2011- 2016 is: *Raising the achievement of Qatari students at all levels, especially in math, science and English and, through that, increasing educational attainment"* (p.124). For a transition to a knowledge-based economy to take place in a relatively short period, a truly exceptional educational system is required. More specifically, it's Science, Technology, Engineering & Mathematics (STEM) education that must be uniquely exceptional to forge graduates who will be active and meaningful contributors to this new economy. In short, without excellence in STEM education, one of the main goals of QNV 2030 simply will not take place.

Third National Human Development Report NHDR (2012) stated: *"declining enrolment in science and mathematics needs to be reversed to better fulfill the needs of knowledge-based economy industries" (p.52).* Second Qatar national strategy 2018-2022, call for increasing average score of Qatari students in PISA and TIMMS by 30 points in each cycle and the MEHE strategy 2017-2022 put an ambitious target of an average score of 500 points by 2022 (currently it is 418 in PISA and 423 in TIMMS).

Qatari students' performances in international tests such as PISA and TIMMS that assess skills in science, mathematics and readings, have significantly improved over the last decade as was reflected in the published results of these tests (Said, 2016; Said et al., 2018).

In high quality advanced TVET programs today, the 21st century skills require more rigorous content than traditional TVET curriculum provides. They should include skills and knowledge required for these competencies such as critical thinking, problem solving, effective communication and collaboration, project–based learning with high technology skills. STEM is integral to many of the required knowledge and how they are integrated is a new 21st century skills that TVET students should acquire. The understanding of STEM components and how they are connected helps students develop better and deeper understanding of their TVET program contents. However, STEM is still taught in a traditional approach i.e. in silos which only refers to science and math with little reference to engineering and technology. Therefore, those involved in development of TVET curricula and teaching TVET programs must also gain a good understanding of STEM and STEM education.

What distinguishes STEM from traditional science and math education is the blended learning environment that is centered on teaching students how the scientific method can be applied to everyday life by connecting learning to outside the classroom and using technology to engage students in scientific and engineering practices and projects that require deep science and math conceptual knowledge.

There is a particular need in Qatar for educators, employers and government to promote and to include 21st Century skills in curricula, workplace training programmes and policies. The second Nationl Development Strategy, NDS-2 (2018-2022) identified the importance of 21st century competencies for life and employability and defined it as the *"… Range of knowledge, skills, attitudes, and personal qualities believed to play a crucial role in success in today's world, especially in higher education programmes, modern professions and workplaces. Generally speaking, the 21st century competencies can be applied to all disciplines of academic and educational knowledge, functions and civil frameworks throughout the student's life."* (Ministry of Development Planning, 2018).

21st Century skills have been identified as central to the development of human capital for the diversified, green knowledge economy envisaged in Qatar National Vision 2030 and related strategies for education and training by Ministry of Education and Higher Education. In addition to embedding QNV 2030 values, principles and goals with related subject areas, the NDS-2 cited the need for the contribution of all partners in the education process.

However, the challenge has been that these skills are not well integrated within education and training. Few assessment policies or practices are in place to assess them in many countries. UNESCO argues to focus on the five pillars of education in the Twenty-First Century. They are *learning to know; learning to do; learning to be; learning to live together and "learning to transform society and change the world* including the skills and

knowledge needed to work collaboratively for community well-being, social development, peace, and the transition to a low carbon economy and sustainability" (UNESCO 2014).

TVET and Applied Learning in Qatar and the challenging role of TVET

TVET programs are very important to prepare students and adults for a wide range of skills that are demanded in the labor market which are oriented around science, communications, information and engineering technology. Demand for these competencies is increasing all over the world with wide range of education and training skills in knowledge technologies such as software systems, knowledge management e.g. data mining and retrieving, modeling, simulation, 3D printing, etc. According to UNESCO report: Education for People and Planet (UNESCO 2016), participation of students in technical and vocational education programs in Qatar is among the lowest compared to other countries standing at a total of 0.9 % of secondary school students only.

Qatar has 7 secondary vocational schools (1 technical, public for boys, 1 technical public for girls, 2 business and banking 1 for boys and one for girls both public, one school, international private co-education (Debakey and 2 STEM schools public, one for boys and other for girls). There are six postsecondary universities and colleges, which provide TVET graduates, four public and three international including American, Dutch, and a Canadian universities (Ministry of Education and Higher Education 2018).

In addition, a professional training center is located in Qatar petroleum, which supplies the energy sector with trained workforce (secondary school graduates) to meet the increasing demand of the sector in both technical and administrative fields by offering specific internationally recognized vocational programs to assume technical and administrative jobs at QP and its subsidiaries (Qatar Petroleum n/d).

One factor contributing to the skill shortage is that oil and gas production, the main economy sector, uses increasingly advanced technologies and production techniques, which require a workforce with a continually increasing level of skills. Demand for skilled workers at the higher end of the skills range is rising very fast. However, these are the professions where the skills shortage is the largest. Employment of semi-skilled local workers has been declining as the demand for higher skills has increased (Fien and Guevara 2013). High level of STEM knowledge is the basis for such skills.

Qatari students' performances in international tests such as PISA and TIMMS that assess skills in science, mathematics and readings, have significantly improved over the last decade as was reflected in the published results of these tests (Said, 2016; Said et al. 2018 & OECD 2019). However, despite this progress, these results are still below the average of the participating countries in those tests.

Scope of this Study

Low levels of engagement between industrial and educational institutions continues to prevent curriculum improvement and development of industry-relevant curricula. Linkages between Qatar's industry and post-secondary education are not strong enough and often give rise to neglected or duplicated human capital development. Therefore, most development efforts of human capital occur in isolation involving outmoded programs with many faculty complacent and unaware of new technologies and developments in relevant industrial sectors.

Part of this project, was a survey on "Improving and enriching the Human Capital of the State of Qatar through Identification and Development of 21st Century Skills", explored perceptions of both employers and TVET program leaders toward the skills needed for economic and social developments in a changing world by Meeting Human Capital Needs through 21st Century Skills. A total of 85 managers and professionals completed the survey, together with 35 TVET program leaders located in one university and five government TVET institutions (the survey was adapted to fit the context of TVET institutions). Thirty-two industry managers and professionals were from Hydrocarbon and Energy, 26 from Built & Environment and 27 from Banking & Finance sectors. Furthermore, 32 semi-structured interviews were conducted.

Method

The survey titled "Improving and enriching the Human Capital of Qatar Through Identification and Development of 21st Century Skills" was distributed online to more than 50 TVET program leaders and 150 senior managers and professional employees from different companies and enterprises in three sectors specifically

- Hydrocarbon and Energy sectors
- Built and environment sector
- Finance and banking sector

35 responses received from TVET sector and 85 from industry sectors among them 32 from Hydrocarbon and energy sector, 27 from Built Environment sector, and 26 from financial service sector. In addition to 32 semi-structured interviews.

This survey was intended to explore the perception of both industry employers and TVET program leaders toward the needed skills for economic and social developments in a changing world by meeting Human Capital Needs through 21st Century Skills.

The survey was divided into six sections, four major sections, in addition to a section on demographic information about the person filling the survey and his/her company or institution (section-1), and another section for general comments and open ended questions (section-6). The survey was a structured questionnaire with both close and open-ended questions. Responses to statements were chosen either on a 5-point Likert-type scale (ranging from 1-very unimportant /very insignificant to 5-very important/strongly significant, section-1); or on a 4-Likert scale (section-2) with one section includes multi answers. The surveys were translated to Arabic using the back-translation method.

The six sections of the survey are:

1. Information about the surveyed, and the company
2. Drivers of Changes
3. Environment, Social, Health and Safety planning and practices
4. Skills Required for/and in, the Workplace
5. Training, Research and the Changing World of Work
6. General comments

This paper will discuss responses relevant to the subject of this paper mainly sections 4, and 5.

Results and Discussion

Skills Required in the Workplace

Data collected from the survey were analyzed using SPSS software version 24. Selected quotations are added to give more insights on the perceptions of the respondents from both groups.. Table-1 summarizes the descriptive statistics of findings from both employers and TVET. Effect size factor (ES) is used to compare the perceptions and practices of employers with those of TVET providers although statistical significance (p-value) is also used as an approximate indicator to the existing difference because when a difference is statistically significant, it does not necessarily mean that it is very important, or helpful in decision-making. It simply means that we are confident that there is a difference. To know if an observed difference is important or meaningful, we need to determine how effective this difference is (Cohen 1988) Cohen suggested a scale to interpret the value of effect size, which is widely used by social scientists based on a general guide developed by Cohen. The scale is shown below.

- ES < 0.1 = trivial effect
- ES 0.1 - 0.3 = small effect
- ES 0.3 - 0.5 = moderate effect
- ES > 0.5 = large difference effect

Table 1. Required 21st century skills, descriptive statistics (employers -TVET perceptions)

		Employers		TVET		
No.	Skill Description	M	SD	M	SD	ES (Hedge)
1.	Learning to learn	4.388	0.722	4.286	.957	0.063
2.	Creativity and Innovation	4.380	0.779	4.2000	.677	0.240
3.	Critical Thinking	4.590	.854	4.1429	1.061	0.490
4.	Mathematical Reasoning	3.930	0.943	3.974	.781	0.173
5.	Information literacy	4.310	0.983	4.0857	1.07	0.241
6.	Personal presentation and self-awareness	4.541	0.712	4.0286	.891	0.668
7.	Conscientiousness and perseverance	4.518	0.696	3.9714	.923	0.711
8.	Communication	4.565	0.643	3.9714	.923	0.807
9.	Social Skills: Collaboration	4.812	0.701	3.9714	.954	1.075
10.	Leadership	4.682	0.799	3.9429	1.211	0.789
11.	Technological skills: Digital or IT literacy	4.310	0.736	3.8857	1.022	0.51
12.	Technological: Use of Monitoring equipment	4.110	0.841	3.8857	1.051	0.247
13.	Technological Skills: Interpretation of data	4.42	0.709	3.7714	1.139	0.758
14.	Generic Technological Skills: Adapt to new technologies	4.450	0.711	3.7429	1.146	0.823
15.	Civic Responsibility: Citizenship – local and global	4.33	0.703	3.6857	1.183	0.742
16.	Civic Responsibility: Cultural awareness and sensitivity	4.39	0.630	3.6571	1.083	0.93
17.	Civic Responsibility: Environmental responsibility	4.33	0.663	3.600	.946	0.966

From the above table, it is shown that there is a clear skill gap between the TVET institutions' programs and the requirements of these skills as per employers' perceptions despite the fact that both sectors consider these skills as essential and critical; however, they differ in the degree of importance of these skills to be acquired by their employees. For all these skills employers show higher perception than TVET leaders, in other words, employers require higher level skills than what are provided by TVET institutions. For example, employers consider the degree of personal and social skills: Collaboration (factor 9) as of high importance compared with that required by TVET programs (ES=1.075) despite that the latter also show its significance as shown from the high mean and relatively low standard deviation among respondents. On the other hand, critical thinking skill is perceived as highly important by both sectors but it is much more important for employers than for TVET program developers (ES = 0.49).

In an interview of one employer from an oil company, who ranked critical thinking as one of the top needed skills said "Critical *thinking is a highly valuable skill because it is the basis for innovation and problem-solving. When properly developed in students and in the workplace, it can help individuals and teams overcome challenges and meet business goals"*. Although both employers and TVET leaders consider mathematical reasoning skills (factor 4) as important with little or insignificant difference (ES= 0.173), it is not considered as a high priority. Mathematical reasoning is the only skill that employers perceive as less important than what TVET providers perceive although little difference exists between the two sectors. This is because mathematical skills are considered, by employers, as classroom activities while in the workplace it is considered as one among other tools in achieving a desired outcome (Fitzsimons, 2013). Figure.1 compares the priority ranking of required skills among employers and TVET providers.

As can be seen from the figure, for both sectors, rankings of social and interpersonal skills outperform those of job –relevant skills (technical and discipline related skills). However, there are different perspectives among different sectors of employers. The increasing demand for skilled workers to fill jobs required by the 21st century skills (critical thinking, communication skills and collaboration) is motivating education systems to put more emphasis on increasing graduates who are competent in these required skills such as STEM and other non-cognitive skills which TVET institutions are their major providers of these skills, to further achieve the 2030 sustainable development goals especially SDG4 of quality education (UNDP2015). As can be seen from figure 1, and table-1, the results show that clear gaps exist between the perceptions of employers and TVET providers.
Knowledge-Based Economy

Knowledge Economy is an economy in which knowledge is the main instrument of economic growth. It is an economy where knowledge is acquired, created, disseminated and effectively used to enhance economic development (Chen and Dahlman 2006). The survey asked employers and TVET leaders on the impact of shift to knowledge economy on their organizations. TVET leaders consider this shift as highly important (69%

reported as significant and 23% as highly significant) compared with employers of whom 39% reported as fairly significant and 23% as highly significant). Figure-2 compares the mean average perceptions of all sectors with TVET providers.

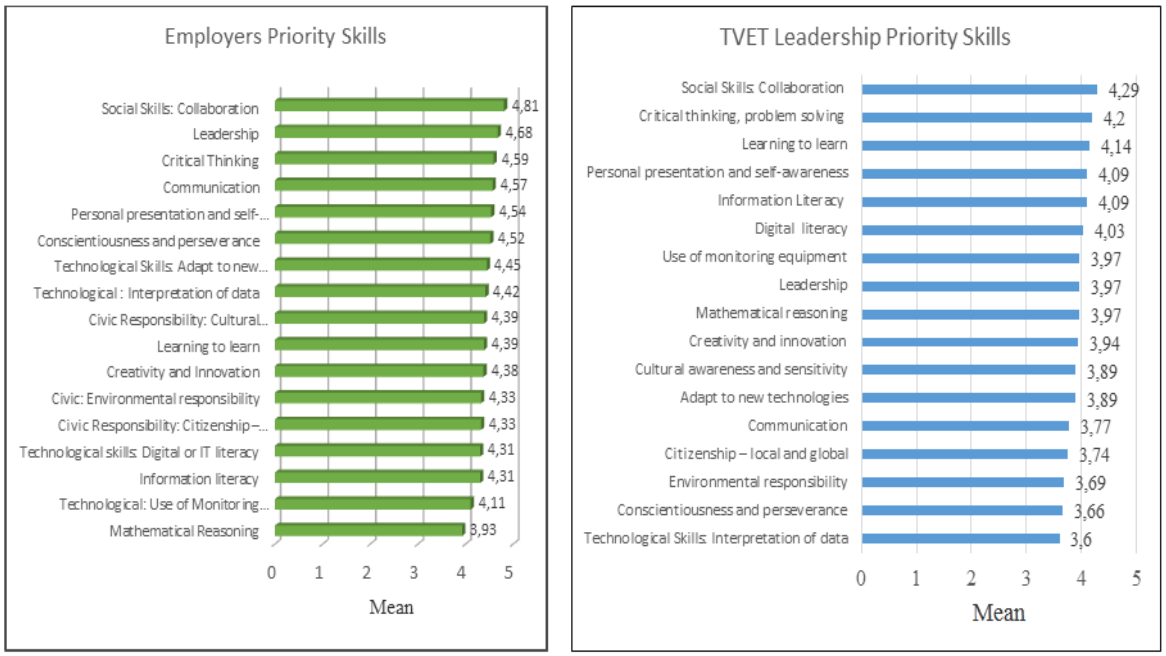

Figure 1.Required skills: Perceived, priority ranking by employers and TVET providers

Among the three sectors, employers of Hydrocarbon & Energy sector consider the impact as highly significant as it is also perceived by TVET providers. The reason for this was indicated by one survey respondent from industry who wrote a comment saying that: 'Hydrocarbon sector is the main sector that sustains Qatar competitive economy; oil and gas companies support, financially and technically, academic and applied research that help improve their production processes to keep abreast of the latest technological development and also in mitigating the negative environmental impact of their industry. More jobs need applying cutting-edge technologies and demand deeper knowledge of math and science in positions that most people don't think of as STEM-related, including machinists, electricians, auto techs, , plumbers and pipefitters. Recently digital oil fields become popular in the businness. The enrgy business needs more workers skilled in STEM fields, the future of innovation in energy sector and other business depends on STEM-graduates pipeline".

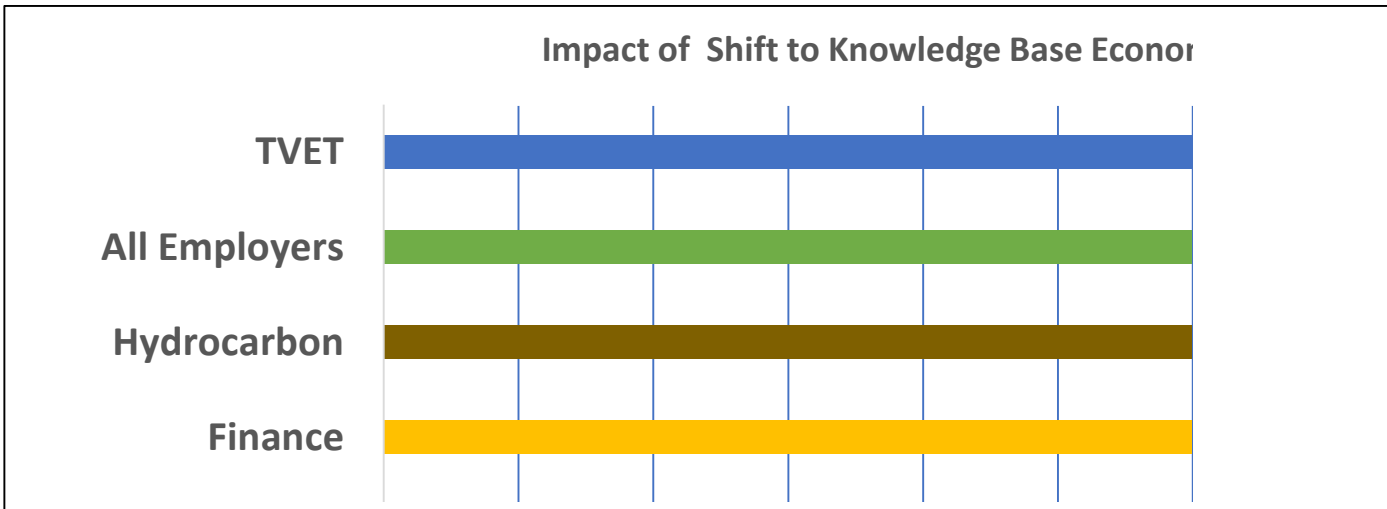

Figure 2. Perceptions of employers and TVET leaders on the impact of knowledge economy

How TVET programs are responding to this need of STEM Careers?

For industries like oil and gas which rely on a sustainable pipeline of STEM talent, finding ways to inspire, attract and retain young people's interests in these critical subjects is an increasingly important part of their work. Qatar's ambitious vision rests on four pillars of development: human, social, economic and environmental. Establishing private-public partnerships to develop an effective system for funding scientific research plays an important role in the country's strategies to support these pillars. The country encourages industry to benefit from the entrepreneurial academic expertise centres to fill the need for applied research.

Links between employers and TVET

As part of section -5 of the survey *"Training, Research and the Changing World of Work"* which consists of 24 questions, there were seven questions about the relationships between TVET institutions and industry, and among TVET institutions themselves. These questions are as follows.

- As part of workforce planning do you have any involvement with TVET/Applied Learning institutions and universities?
- Does your business Provide workplace for on-the–job training (industrial placements?
- Does your business Provide internship opportunities for students?
- Does your business Member or Chair of accreditation panels at TVET/Applied Learning institutions and universities?
- Does your business Engaged in content development of TVET/Applied Learning institutions and universities courses
- Does your business Allow site visits for students as part of their course?
- Does your business Provide TVET/Applied Learning institutions and universities Teachers with industry experience?

The responses are summarized in Figure-3 below.

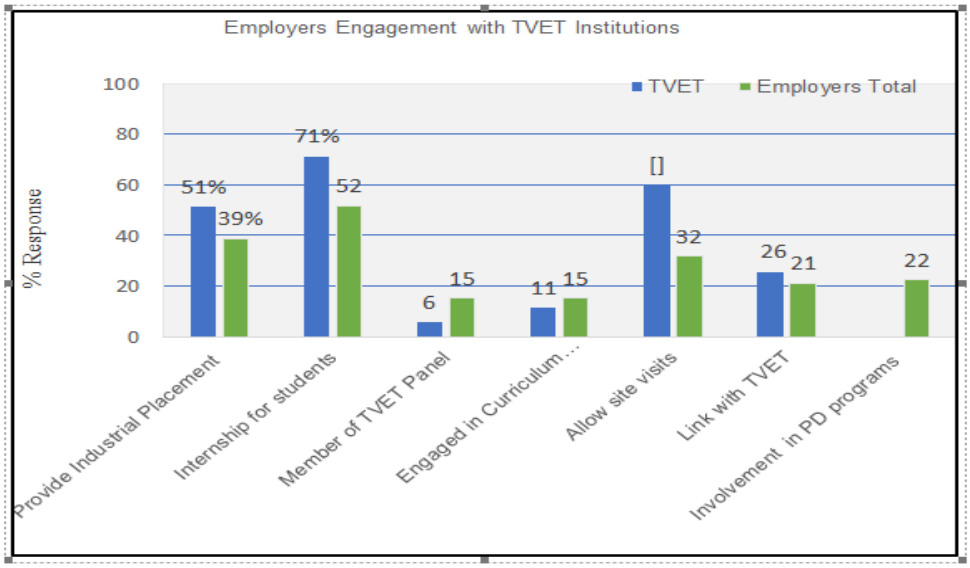

Figure 3. Links between TVET and Industry

TVET respondents also reported a low level of engagement and collaboration between the industry and their institutions as shown in figure-4 below. The below figure reflect the existence of clear weak links between employers and TVET institutions, which lead to a gap between TVET students' skills provided by education and training systems, and labour market. This means that TVET institutions are not communicating well on the skills' needs of labour market.

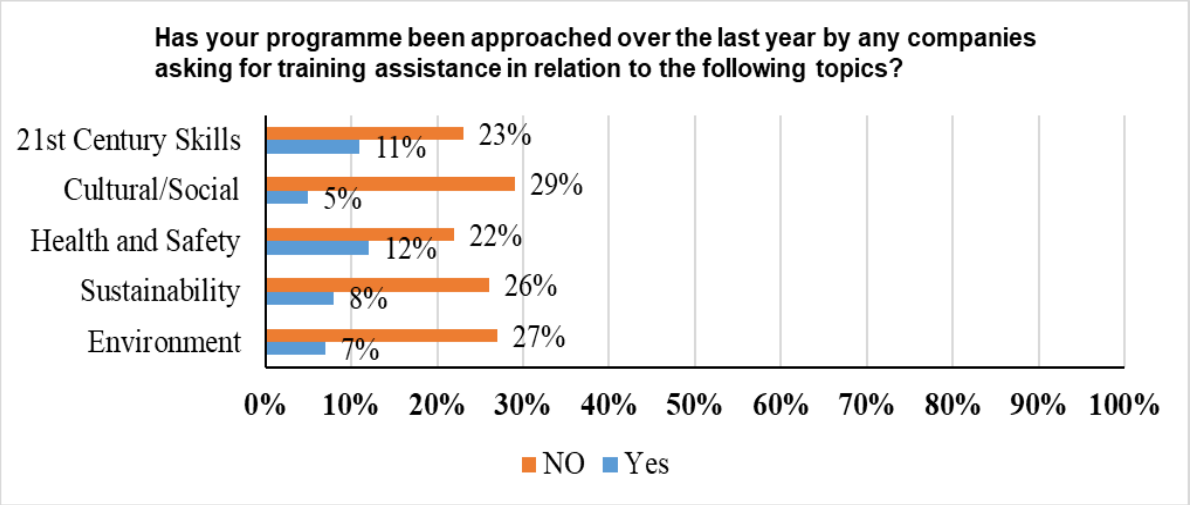

Figure 4. Involvement of employers in professional development programs offered by TVET institutions

Skills gap is defined as insufficient skill levels among employees to meet their job requirement. These gaps have the potential to harm the productivity level of individual organizations by increasing training expenditures and raising the average labour cost (McGuinness & Ortiz, 2016). To bridge this gap TVET institutions have a significant role to play in addressing the skills shortage in the industry. by providing a dynamic TVET curriculum that embraces labor market skills needs which should include skills and knowledge required for competencies such as critical thinking, problem solving, effective communication and collaboration, project–based learning with high technology skills. This can only be achieved by developing effective sustainable partnerships and networks with the industry stakeholders, government departments and policymakers, and with other TVET institutions. Part of this partnership should include participation of employers in TVET planning and processes including curriculum design, training and mentoring. This should allow integrating on-job training and lifelong learning into the TVET curriculum to ensure that graduates are job-ready and adaptable to changing skills requirement. Based on these needs, a robust STEM (Science, Engineering, Mathematics and Technology) curriculum is to be imbedded within TVET programs to prepare students to work and compete in the 21st century. TVET programs should develop balanced curricula that embrace both social and soft skills and technical discipline-based skills.

The need for strong link with industry is critical in evaluation and accreditation of TVET programs. An engineering program head wrote: "*We need to involve the industry, if we are talking about the 21st century skills, in my opinion, the accreditation of the programs will be different, because we need to involve industry for evaluating our programs, because we want to develop and, tailor our programs to address these skills, which are needed by industry. We also need for example, to consider placements for faculty members in industry, so they can go to industry, spend a couple of months there as well as for our students. Therefore, the internship components in the program are very important, so we need to give more opportunities to our students and faculty members to spend time with industry sector, this is very, very important*".

Table-1 and the above figures, indicate that these gaps are reflected from the difference in views on many required skills the TVET students need to acquire. Generally, employers view certain skills as important but they are not properly taught and / or, delivered within TVET curriculum. For example, employers require higher level of interpersonal skills such as self-awareness, perseverance, communication, collaboration and leadership skills, than what TVET providers perceive as important.

In parallel, diverse technologies are also emerging in education, information, nanotechnology, robotics, artificial intelligence. AI and IOT are some of the well-recognized emerging technologies in the world. However, change in education is normally slower than change in the industry sectors, therefore skills' gaps are mainly a consequence of the rapid advances in technologies; they are faster than education and training systems can respond. TVET program developers tend to plan some sustained programs for few years ahead.

The above table and figures suggest that new TVET curricula should consider integrating these STEM skills. This integration can be accomplished in several ways such as by enriching the curriculum with these skills across different technical and academic courses, and by engaging students in several classes with activities based on STEM knowledge and skills.

Conclusions

TVET is a key ingredient for social and economic development of a nation. In TVET, there are technical and vocational components and of the two, the technical component traditionally is more aligned with math and science. Rapid transformation of the economies in the last two decades through technological innovations, and globalization serve as drivers for tertiary TVET/STEM curriculum. Industry 4.0 professions are quickly emerging; they require technical, science and engineering skills combined with 21st century skills such as critical thinking, problem solving, analytical, and communication skills. World is moving from a labour society to an information and knowledge society. 21st century industry components include autonomous robots, simulation, system integration, internet of things, cybersecurity, cloud computing, additive manufacturing, big data, etc. Thus aim of project was to strengthen the vocational and technical high schools with STEM training and Industry 4.0 components. STEM education attempts to transform the typical teacher-centered classroom by encouraging a curriculum that is driven by problem-solving, discovery, exploratory learning, and require students to actively engage a situation in order to find its solution. TVET with STEM, results in development of 21-century skills (soft skills) and develop the aptitude and ability to continue learning and pursue lifelong education in a learning society.

Recommendations

There is no one model approach that fits all, because frameworks for the vocationalization of higher education will be different in different countries. However, based on results from this study some relevant practices could be considered a simplified road map towards integration of STEM into TVET.

1. Invest in teacher training and curriculum development
2. Combine academic and technical training to enhance preparation of students for a variety of post-graduation choices,
3. Identify technical high schools and institutions for promoting and giving recognition to TVET and STEM as critical education, and support them with proper regulatory mechanisms, established standards, and a well-developed framework,
4. Look at where there are national demands for TVET with STEM and identify programs accordingly (examples: health care, energy, finance, tourism, built environment, sports facilities development, transportation, IT infrastructure, manufacturing)
5. Caution against segregating and labeling STEM and TVET separately, creating a silo effect. STEM should be considered as a teaching methodology,
6. Establish a strategy to attract youth to STEM and TVET programs with a focus on attracting female students,
7. Using real world problems/issues/challenges as anchors to integrate STEM and other disciplines,
8. Co-developing feasible and flexible learning models/curricula with stakeholders through a systemic and systematic process,
9. Establishing some dual (academic –vocational) tracks schools that emphasize integration of 21st skills needs, into TVET programs where academic and vocational tracks interact and allow students to transfer between them.

Acknowledgements or Notes

This research is part of a research project on “Improving and Enriching the Human Capital of Qatar through the Identification and development of 21st Century Skills for Sustainability and Employability” award number NPRP 10-1212-160022. The author would like to thank the Qatar National Research Fund for the generous support of this research through the National Priority Research Program. Any opinions, findings and conclusions or recommendations expressed in this report are those of the PIs and do not necessarily reflect the views of the Qatar National Research Fund; QNRF has not approved or endorsed its content. We would also like to thank the TVET leaders and staff who made this study possible. We deeply appreciate their contributions and professionalism. In addition, we would like to acknowledge Dr. Rupert MacLean the previous LPI of this project.

Scientific Ethics Declaration

The author declares that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the author.

References

Ali, M. (2021). State of STEM education in Hong Kong: A policy review. *Academia Letters*, Article 3680. https://doi.org/10.20935/AL3680.

Chen, D.H.C and Dahlman, C. J (2006). *The knowledge economy, the Kam methodology and world bank operations. The International Bank for Reconstruction and Development*, the World Bank.,Washington, D.C.

Cohen, (1988). *Statistical power analysis for the behavioral sciences -, 2nd edition*, Lawerence Eribaum Associates publishers, USA.. . ISBN 0-8058-0283-5.

J. Fien, & J.R. Guevara,. (2013). Skills for a green economy: Practice, possibilities and prospects. In R. Maclean & S. Jagannathan (eds) *Skills for inclusive and sustainable growth in developing Asia – Pacific*. Dordrecht: Springer, Ch. 14.blisher, Year of Publication.

Fitzsimons, G. (2013). Doing mathematics in the workplace. A brief review of selected literature. *Adults Learning Mathematics: An International Journal, 8*(1), 7-19.

McGunness, S., & Ortiz, L. (2016). Skill gaps in the workplace: measurement, determinants and impacts. *Industrial Relation Journal, 47*(3) 253-278. Wiley Online https://doi.org/10.1111/irj.12136.

Ministry of Development Planning and Statistics. (2018). *Qatar second national development strategy 2018~2022*. Retrieved from https://www.mdps.gov.qa/en/knowledge/Documents/NDS2Final.pdf

Ministry of Education and Higher Education Education . *Strategy (2017-2022)*. MEHE Qatar 2018.

OECD (2019). *PISA 2018 results (Volume III): What school life means for students' lives, PISA*, OECD Publishing, Paris, https://doi.org/10.1787/acd78851-en

Qatar petroleum vocational programs https://qp.com.qa/en/Careers/Learninganddevelopment/Pages/VocationalLearning.aspx. Accessed November September 20, 2021.

Said, Z. (2016) Science education reform in Qatar: Progress and challenges. *Eurasia Journal of Mathematics, Science & Technology Education, 12*(8), 2253-2265.

Said, Z, Al-Emadi, A. H. L. Friesen, & E. Adam (2018). Assessing the science interest, attitude, and self-efficacy of Qatari students at the preparatory, secondary, and university levels. *EURASIA J. Math., Sci Tech. Ed 14*(12): em1618. DOI: https://doi.org/10.29333/ejmste/94733.

United Nations Development Program (UNDP) (2015). Human development report 2015: Work from human development. Accessed online from http://hdr.undp.org/en/2015-report

UNESCO (2016). *Education for people and planet: creating sustainable futures for all global education monitoring report, 2016*. https://unesdoc.unesco.org/ark:/48223/pf0000245752 Accessed September 21, 2021.

United Nations Educational Scientific & Cultural Organization (UNESCO) (2014). *Shaping the quality agenda: education for sustainable development as an integral element of quality education*. Paris: UNESCO.

Author Information

Ziad SAID
UNESCO Chair on TVET and Sustainable Development & College of the North Atlantic-Qatar
P.O. Box 24449 – Doha- State of Qatar
Contact e-mail: ziad.said@cna-qatar.edu.qa

To cite this article:

Said, Z. (2021). Integrating STEM in to TVET education programs in QATAR: Issues, concerns and prospects. *The Eurasia Proceedings of Educational and Social Sciences, 23,* 15-24.