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# TVET Skills Gap Analysis in Electrical and Electronic Industry: Perspectives from Academicians and Industry Players

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**Abstract:** Skills mismatch or skill gap is a long-standing issue whereby the levels and types of the existing skills do not meet the needs of the job market. With no exception, this issue also become one of the challenges that facing by Technical and Vocational Education and Training (TVET). If this issue prolongs, it will lead to graduate unemployment, specifically in TVET. Therefore, this study aims to identify the occupational skills (including both soft and hard skills) that are perceived as important by those in public Higher Education Institutions (HEI) and the electrical and electronic (E&E) industry which represent the manufacturing industry. A total of 58 academicians from public HEI and 55 industry players from the E&E industry in Malaysia were chosen purposively. These academicians and industry players were selected as they are having experience in occupational skill and training in their respective institutions and industries. Questionnaires were distributed online to these targeted respondents. The results revealed that there are skills gaps in terms of both soft and hard skills, which all skills are skills related to the career in E&E industry. The outcomes of this study should enable the Ministry of Higher Education, mainly in TVET to devise strategies to improve graduate employability. They might also serve as additional evidence for the occurrence of skills mismatch.

**Keywords:** TVET skills mismatch, electrical and electronic industry, higher education, occupational skills

## 1. Introduction

Higher Education Institutions in Malaysia produce a huge number of graduates every year. Based on Higher Education Institution statistics, a total of 128,418 students gained admission to public universities in 2019. The number of total admissions increased from the total of the previous year, 2018, which was 119,345. These high numbers may lead to unemployment among graduates. This can be demonstrated by the 5.5 percent rise in the number of unemployed graduates, which increased from 161,000 in 2018 to 170,300 in 2019. One of the reasons why graduates are still unemployed is due to skills mismatch (Kadir, Naghavi, Subramanian & Abdul Halim, 2020). This unresolved issue of skills mismatches then leads to a worse issue of unemployment among graduates (Halim, 2018). To reduce unemployment among graduates, the government has suggested that Higher Education Institutions and industry should provide occupational skills (including soft skills and hard skills) and training for students. In fact, one of the initiatives taken by the government through empowering Technical and Vocational Education and Training (TVET) in Malaysia. TVET is a programme aims to produce skilled graduates to meet industrial needs. This initiative is consistent with the

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aspiration of UNESCO (2011), in producing future manpower who possess with highly skilled, having practical work skills and equip with technical knowledge. Further, TVET plays a role in alleviate unemployment by retraining new vocational skills for unemployed graduates (Ramlee, 2017). However, TVET programme is reported yet far to reach the target of 900,000 TVET graduates which only managed to produce 474,672 TVET graduates from 2016 to 2020 (Bernama, 2021). Among the challenges that undermine this target were TVET effectiveness was questionable, enrolment of TVET students showing a declining trend and soft skills of TVET graduates (Bernama, 2021; Bassah 2022).

Skills mismatch has been a persistent issue in Malaysia, whereby the expertise of jobseekers, especially fresh graduates, does not meet industry requirements (Musa, 2020). Skills mismatch has occurred due to the supply-demand skills gap between what skills Higher Education Institutions produce and what industry expects from graduates (D'Silva, 2020). The skills mismatch also was found as one of the issues that related to TVET (Ramlee, 2017). In fact, skills mismatch is also due to the emergence of Industry 4.0. The changes associated with Industry 4.0 in terms of the workforce setting have driven the need to obtain new skills that are aligned with the advancement of high technology (Mohd Kamaruzaman, Hamid, Mutalib & Rasul, 2020). Therefore, to prepare Malaysia to address the challenges of Industry 4.0, graduates need to be exposed to the appropriate skills that relate to these technological advancements. Not only that, Industry 4.0 also provides challenges for those in the working world, who also need to be prepared to face the emergence of Industry 4.0.

In addition, employees are the group most affected by the changes due to Industry 4.0. Many industries today are seeking both hard and soft skills in potential graduate candidates (Tan, Chew, & Kalavally, 2017). A report by the World Economic Forum (WEF, 2017) stated that most individuals relied on a single set of skills or a narrow range of expertise. Hence, they were likely to be unable to maintain a long-term career in the economy of the future because of the rapidly evolving job market. Jobs created in the future will differ from those of the past. This implies that a person with better skills will be more valued in the current industrial market even though they do not have higher qualifications or an excellent academic record (Hidayat & Yunus, 2019). Thus, industries should identify qualified candidates who are suitable for the company in the future (Ahmad et al., 2019). They also should provide the skills specifically needed in their organizations to prepare their employees for the future era of globalization. In doing so, a collaborative network between higher education institutions and industries is deemed crucial, so that Malaysia's aspiration to prepare future employees with occupational related skills can be fulfilled. Such initiatives aim to reduce the skills gap between both stakeholders (Yusof, Munap, Said, Ali & Mat, 2017).

Changing in the work landscape today requires efforts from stakeholders in overcoming the challenges on how future works will look alike. Specifically, the future work requires workers with skills related to their job, so that it can enhance the productivity. Unfortunately, skills mismatch related to TVET is still prolonged, which deemed attention for this paper to identify set of skills that graduates require, as perceived by academicians in public Higher Education Institutions (HEI) and industry players in the electrical and electronic (E&E) industry. Here, electrical, and electronic industry including works that related to electrical and electronic technician and maintenance, and electrical wiring and installation. Meanwhile, majority of academicians were among those from Malaysian Technical University Network (MTUN). The set of skills however will be specifically focusing on soft skills and hard skills as general, but still closely related to the TVET program and Industry 4.0. After identifying the set of skills, this paper aims to investigate skills gap between both stakeholders. The following section further explains these skills, based on the perceptions of both Higher Education Institutions and electrical and electronic industry players. This section also examines the skills gap research conducted by previous studies.

## 2. Literature Review

Based on the literature review, both stakeholders hold different perceptions of the skills required among graduates. Skills can be classified as soft skills and hard skills (Yaakob, Radzi & Sudan, 2018). The soft skills can be defined as a combination of knowledge, skills and personal characteristics that individuals need to possess in their daily lives (Ticle & Louise, 2013). Meanwhile, hard skills can be explained as the understanding and efficiency of an individual when undertaking a particular activity. In addition, hard skills include skills that need to be mastered through methods, processes, procedures and techniques (Yaakob et al., 2018). This section includes four subsections namely academicians' perceptions of soft skills and hard skills in Section 2.1, followed by industry players' perceptions of soft skills and hard skills in Section 2.2. Next, in Section 2.3 was explained on the skills gap between academicians and industry players in terms of soft skills and hard skills. Lastly, Section 2.4 discussed on the skills gap between TVET institutions and industries.

### 2.1 Academicians' Perceptions of Soft Skills and Hard Skills

There are few studies conducted by previous research related to academicians' perceptions on soft skills and hard skills. For instance, a study by Amiruddin et al. (2016) outlined five types of soft skills as follows: communication skills, leadership skills, teamwork skills, the ability to solve problems, as well as ethical and moral work-related skills. It would be more valuable to implement these skills through undergraduate teaching and learning programs to enable graduates to gain the competencies required by industry. However, Salleh et al. (2017) undertook a study on soft skills, which are communication skills, collaboration or teamwork skills and entrepreneurship skills, and suggested integrating soft skills pedagogical approaches. A quantitative study by Ahmad, Segaran, Ng, Md Sapry and Omar (2019) showed how it is important to make students ready for Industry 4.0 by introducing soft skills, for instance, skills in solving problems, leadership skills and communication skills.

In addition, in his mixed-methods study, Egcas (2019) revealed that soft skills would become more critical in the future compared to hard skills. This is because hard skills would be glaringly impractical because technology changes in short spans of time. The participants included in his study (education managers, technology managers, and technical and engineering professors) listed the prior skillset in comparison to the skillset outlined at the World Economic Forum 2020. These skills were listed as the abilities to think critically, solve complex problems, be creative, people management, be cognitively flexible, coordinate activities with others, decision making and judgement, be emotionally intelligent, be service-oriented, be a good negotiator and be adaptable. Furthermore, a study by Jima'ain et al. (2020) found that problem-solving skills, networking skills, communication skills, teamwork skills and time management skills will be required in Industry 4.0, based on students' perspectives. They conducted a qualitative study with a sample of 35 students from four different universities in Malaysia, chosen based on purposive sampling. They also stated that hard skills, such as ICT skills, are needed by students.

Ahmad, Segaran, Ng, Md Sapry and Omar (2019) undertook a quantitative study, finding that hard skills (that is, digital skills) are important for students' readiness for Industry 4.0. Even today, digital skills are needed for employment. Thus, it is essential to address the need to develop digital skills for countries and regions to achieve sustainable economic and social development (Ahmad et al., 2019). Support for this was provided by Motyl et al. (2017), when they proposed revising and extending the questionnaire survey by distributing it to teachers and instructors. The aim was to determine whether digital skills were being effectively applied in university classes. These skills referred more to signal processing, complex troubleshooting, repairing network faults, knowing how to read and interpret operational data, as well as resolving issues with mechanical components and sensor technology (Ismail & Razali, 2019).

The review study by Rivera et al. (2020) found that troubleshooting skills are the element of innovation skills in the engineering education field which is most closely based on the industry 4.0 and Sustainable Development Goals (SDG) contexts. However, a study by Tetep et al. (2019) found that media skills are essential for students because the latter are the future generation of the nation. The researchers also found that possessing technical skills, communication skills and critical thinking skills will be advantageous for students in gaining the media skills that shape their personal strengths.

## 2.2 Industry Players' Perceptions of Soft Skills and Hard Skills

Numerous researchers had conducted the soft skills and hard skills from the industry players' perspective. For example, the findings of a study by Hanapi et al. (2018) showed that communication skills, teamwork skills, leadership skills, information management skills, creative and critical thinking skills, ethical and moral professional skills, and entrepreneurship skills need to be mastered by graduates to be employed. However, Adebakin et al. (2015), in their findings, stated that there was no difference in the skills required of graduates aiming to work in the manufacturing sector, banking and finance, education or telecommunication sectors. For instance, Cicek et al. (2019), in their findings, outlined the skills needed by the future workforce in the maritime industry. These skills include teamwork and communication. This has been supported by Jaaffar et al. (2016), who examined the perceptions that employers from the manufacturing industry had of the student workforce engaged in industry training and the skills required by the future workforce, such as teamwork and communication.

Industries simultaneously demand that each student equips themselves with global 21st-century skills, for instance, the abilities to communicate, collaborate, be creative, and critically thinking, as well as additional skills required for Industry 4.0 (Ismail & Razali, 2019). A qualitative study by (Azmi et al., 2018) found that communication skills, presentation skills, critical thinking skills, language skills, entrepreneurship skills and teamwork skills are the abilities that will be required in Industry 4.0. Industrial training can improve the skills of graduates.

In a theoretical analysis, the researcher Fomunyam (2020) suggested the need for the incorporation of various courses into curricula. These would include topics such as leading and managing, thinking critically, managing change, communicating, and managing crises. Such skills would be useful, given that future activities in engineering education were likely to become automated. Research by Wagiran et al. (2019) demonstrated how the era of Industry 4.0 would likely demand soft skills like being honest, disciplined, responsible and healthy. Employees would also need to collaborate, communicate, be creative and innovative and solve problems. Their findings were based on a mixed-methods study of what was expected by industry employers in terms of the skills of vocational school graduates. As Wagiran, Pardjono and Sofyan (2020) stated, when vocational school graduates entered various industries, their greatest deficiencies were in soft skills like the ability to communicate and think critically, while they tended not to be self-confident, ethical and disciplined.

Digital skills are the dexterous abilities to understand and use digital content, devices and systems to perform activities (Flores et al., 2020). According to Yaakob et al. (2018), perceptions of employers regarding the hard skills of Politeknik Ungku Omar graduates recorded high mean scores. A qualitative study (Azmi et al., 2018) found that computer and language skills are the skills that will be required in Industry 4.0. Moreover, Wagiran et al. (2019) undertook a study that showed how the era of Industry 4.0 will demand certain hard skills, such as extensive technical abilities, competence in foreign languages and skills in IT. Their findings were based on a mixed-methods study of what was expected by industrial employers in terms of the skills of vocational school graduates. Furthermore, coding and programming skill is one of the hard skills that will be needed in the future. This was explained by Benitez et al. (2020), who found that coding and programming skill is required for Programmable Logic Controllers (PLC) and also relates to the manufacturing industry. This skill must be provided by Higher Education Institutions for the future workforce. However, Maisiri et al. (2019) stated that coding and programming skill included using algorithm and statistical programming language to analyze real-time data. The skill also included the process of handling, analyzing, and interpreting complex digital data. Therefore, this skill will be required in the future.

## 2.3 Skills Gaps Between Academicians and Industry Players in Terms of Soft Skills and Hard Skills

According to Anuar, Mansor and Din (2016), a skills gap emerges when Higher Education Institutions, on the supply side, produce a future workforce that does not meet the skill demands of the industry. CEDEFOP (2010) mentioned that a skills gap involves a situation in which some skills do not match the requirements of a job. For instance, the study conducted by Tan et al. (2017) found that there is a gap between the expectations of Higher Education Institutions and industry in relation to soft skills.

The study by Tan et al. (2017) adopted a qualitative inquiry to explore the expectations of industry experts and academicians in terms of fresh graduates' skills. The findings listed the leading five soft skills that graduates must have for them to be employed. Various soft skills were expected by the Higher Education Institutions, for instance, the abilities to solve problems, think critically, communicatee, be independent and work in a team, as well as a capacity for lifelong learning. However, lifelong learning was not one of the expectations of the industry experts. They mentioned analytical skill, rather than lifelong learning as a skill that graduates must possess.

Several studies have identified the skills gap between graduates and industry. For example, Nadarajah (2021) conducted a study to identify the skills gap among graduates and the skills needed in the job market. She found that the majority of her 300 graduates, who were the survey respondents, possessed various skills, namely ICT skills, teamwork, good time management and leadership. However, the skills required in the job market skills meant that graduates had to improve their communication, problem-solving and analytical skills.

Another study conducted by Hanapi, Kamis, Tee and Hanapi (2018) found a soft skills gap between Community College graduates in the electrical field and employers in the industry. A total of 103 industry players and 162 graduates in the electrical field from Community Colleges participated in the survey. The findings revealed a significant gap in terms of soft skills, namely communication, information management, self-management, ethics and professionalism, leadership, and teamwork. Each soft skill mentioned was proposed by the industry players as necessary to implement in the process of teaching and learning.

Moreover, Patacsil and Tablatin (2017) stated that there was a gap between the perceptions of industry players and IT graduates regarding soft and hard skills. The survey was conducted purposively among IT students who had enrolled in an internship program, as well as supervisors working in industry. The results of the study indicated that industry players preferred soft skills such as teamwork, communication skills, leadership and good management. This was because the industry players suggested that graduates needed to possess these skills to become future managers. Nevertheless, when IT students were surveyed, their responses tended to favour interpersonal skills, presentation skills, addressing difficult personalities, and facilitation skills. The respondents believed that such abilities would be necessary in their professional capacity since they would need to provide effective customer service.

Furthermore, Mohd Kamaruzaman, Hamid, Mutalib and Rasul (2019) developed a study related to the skills gap. The study aimed to identify the skills missing among graduates. Therefore, they conducted a survey of the satisfaction and expectations of academicians related to the skills listed by industry. The findings revealed that communication skills (including written and verbal), punctuality, good management, leadership, problem-solving skills, professionalism, creativity, lifelong learning and flexibility need to be possessed by graduates. It was suggested that the academicians prepare their graduates for the real scenario of the world of work by teaching them appropriate and relevant skills. As a result, graduates would be ready to face challenges and be more responsible for themselves and their country.

On the other hand, industry focused more on design skill, data analytics, organizational capabilities, and coding and programming skill. According to Aqlan and Nwokeji (2018), data analytics skill is an essential requirement for industries that need engineers. Hence, it was suggested that Higher Education Institutions integrate data analytics into their curricula. However, Nadarajah (2021) stated that graduates are more competent in ICT skills. An assessment of the job market skills required by industry recorded the lowest percentage for ICT skills, 17.6 percent. She defined ICT skills as including the use of email, mobile phone services, PowerPoint, preparing reports and using the Internet for collecting data.

Furthermore, Patacsil and Tablatin (2017) stated that IT students and industry ranked ICT skills the same way. These skills include, for example, a knowledge of standard software applications, computer hardware and networking. Moreover, the study showed that the largest gap in mean skills between students of IT and industry demands was evident in hard skills, for instance, the ability to design or the programming skills associated with programming languages. Thus, industrial players appeared to focus more on skills in processing documents, operating hardware and maintaining equipment. These operations are fundamental to offices prioritizing customer service and form the basis of all transactions involving the public. Despite the increasing attention to the skills gap, studies on the skills change caused by Industry 4.0 are still scarce. Pinzone et al. (2017) agreed with this, stating how greater focus is being devoted to the alterations to jobs and skills which Industry 4.0 will require, but these studies are still emerging. The next subsection explained generally on the skills gaps in TVET.

## 2.4 Skills Gaps Between TVET Institution and Industries

According to the Ministry of Education Malaysia (MOE), Technical and Vocational Education and Training (TVET) is related to the education and training techniques for individual with specialized talents which will be used in the future. According to the Oviawe et al. (2017), the demand on the Industry 4.0 workplace for skilled workforce can be achieved if the TVET institution have the collaboration with the industry to bridge the gaps. In Malaysia, there are various ways of collaboration between the TVET institution and industries which allowed students to be attached in the industry (Bassah, 2020). One of the ways is by the job training which this be a part of the pre-employment skills development process. In the study by Abdullah (2019), Malaysia Higher Education Institution are competing for students, educators of the TVET professionalism, credentials, and general abilities are an issue in the country's educator training. It is suggested for every educator to master the teaching skills.

In a study conducted by Islam (2018), he aims to identifying the existing gaps of skills required at industry and skills provided by the TVET institute. The skills required by the industry can be categorized into three skills sets namely crucial skills, urgent skills, and reasonable skills. The crucial category included four skills set namely, conceptual understanding, good communication skills, technical problem-solving skills, and hands on experience. These skills are seemed like importance because without these skills, graduates are not able to enter the job market of in the future. However, Bassah (2020) found that, TVET graduates have only a good technical skill. This due to graduates in TVET are found to have several issues with the soft skills such as lack of good communication skills, especially when they deal with the customers. Therefore, TVET institution need to implement the skills in the teaching and learning process such as develop different activities for students to integrated with these skills.

In the urgent skills type, there are six skills set included which are leadership, willingness to learn, analyze and solve complex problem, ICT, teamwork and multitasking (Islam, 2018). All the skills listed are considered as urgent skills set due to the graduates as future workforce will facing difficulties when they are entering the world of work. According to Bassah (2020), graduates are suggested to work within the team as it is essential for the industry to achieve the goals. One of the reasons is in industry have different departments and units that interconnected each other. Therefore, it is suggested for the TVET graduates to be able to communicate or work as a group.

The last category is reasonable skills. The skills set included in the reasonable skills are language, secretarial skill, influencing skill, accounting skill and time management. According to Islam (2018), all the reasonable skills set give the TVET graduates an added advantages in the workplace to fulfil the responsibilities given in the industry. Furthermore, he concluded that there is a gap remains between industrial skills and skills provided by the TVET institutions. He also stated that industries have not put much effort to collaborate with TVET institution to produce a competitive skilled workforce for job market of Industry 4.0 era. One of the reasons is most of the TVET institution do not consult with the industry during their curriculum development to improve the current skills training. Next, Islam (2018) add that TVET institution do not have any collaboration with the industries to immediately provide employments to the graduates. However, the study conducted by Islam (2018) was conducted at the Bangladesh country. Therefore, this study aims to reduce and bridge the loopholes of the skills gap between both stakeholders especially in the TVET institutions in Malaysia. The following section explains the current study's methodology.

## 3. Methodology

The study was conducted specifically to identify skills, based on the perceptions of public Higher Education Institutions (HEI) and Electrical and Electronic (E&E) industry players, as well as the skill gap between both stakeholders. Prior to survey, Systematic Literature Reviews (SLR) were conducted to identify the skills commonly cited as critical for graduates in electrical and electronic industry. A total number of research papers included in the SLR were 69 research papers, whereby 39 research papers were related to the perceptions from academicians in public Higher Education Institution, while another 30 research papers were the perceptions from electrical and electronic industry players. Systematic Literature Review (SLR) conducted to helps researcher to identify the present soft skills and hard skills based on academicians and industry players perspectives. In performing the systematic literature review (SLR), preferred reporting items for systematics reviews and meta-analyses (PRISMA) by Liao et al. (2017) was being adapted in this study. The PRISMA included the information flow throughout the following four phases including, identification, screening, eligibility and inclusion, and present the number of the research papers that included and excluded for the study. Figure 1 presenting a PRISMA from academicians in public Higher Education Institution, while Figure 2 portrayed a PRISMA from Electrical and Electronic industry players.

In the identification phase, the potentially relevant research papers would be identified. This study uses three databased including Scopus, Emerald, and Springer. The study only limited to the journal source type and article document type. Others publication such as reports, and book chapters were excluded. In identifying the potential research papers that will be used, the research questions of the study were list out to create the keywords. Then, the research papers collected were screened and filtered based on the exclusion and inclusion formulated criteria. Next, the research papers were reviewed in the eligibility phase and lastly all the research papers induced in the systematic literature review were in the included phase.

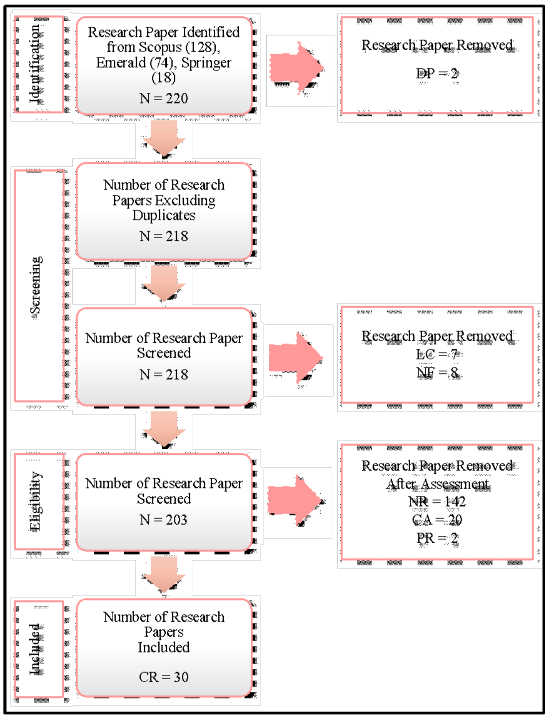


**Fig. 1 - PRISMA from academicians in public higher education institution perception**

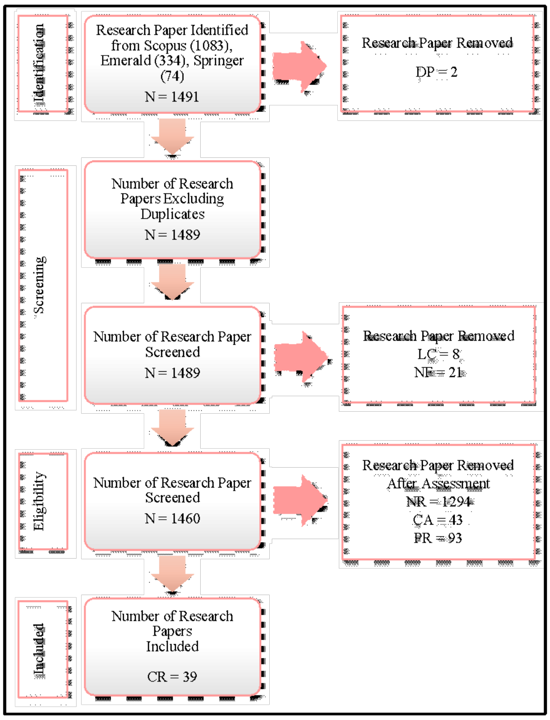


**Fig. 2 - Prisma from electrical and electronic industry player perception**

## 3.1 Identification Phase

This study aims to identify the future workforce skills from academicians in public Higher Education Institution (HEI) and Electrical and Electronic (E&E) industry player. To start the research paper search, possible keywords have been identified. The keywords were generated as tabulated in Table 1 for academicians while Table 2 was for industry players. The study used three databases namely Scopus, Emerald and Springer. For the academicians, the research papers obtained were 220 research papers, while industry players contributed 1491 research papers from the three databases. Scopus recorded the highest number of research papers which is 128 and 1083 research papers respectively. When checking the duplication (DP) in the identification phase, both recorded two research papers with the same criteria appears repeatedly. This required only 218 research papers based on perception from academicians and 1489 research papers related to perception from industry players for the next phase.

**Table 1 - Search strategy for public higher education institution**

| Search Term | Alternative Search Words |
|---|---|
| Skill | "skill*" OR "employability skill*" OR "soft skill*" OR "generic skill*" OR "non-technical skill*" OR "hard skill*" OR "technical skill*" OR "future skill*" |
| Industry 4.0 | "Industry 4.0" OR "Fourth Industrial Revolution" OR "4th Industrial Revolution" OR "IR4.0" OR "Industrial Revolution 4.0" |
| Higher Education Institution | "Public higher education institution*" OR "public institution* of higher education" OR "public universit*" |

**Table 2 - Search strategy for electrical and electronic industry**

| Search Term | Alternative Search Words |
|---|---|
| Skill | "skill*" OR "employability skill*" OR "soft skill*" OR "generic skill*" OR "non-technical skill*" OR "hard skill*" OR "technical skill*" OR "future skill*" |
| Industry 4.0 | "Industry 4.0" OR "Fourth Industrial Revolution" OR "4th Industrial Revolution" OR "IR4.0" OR "Industrial Revolution 4.0" |
| Electrical and Electronic Industry | "electric* and electronic* industr*" OR "electric* and electronic* sector*" OR "electric* industr*" OR "electronic* industr*" OR "electric* sector*" OR "electronic* sector*" OR "electric* and electronic*" OR "E&E" |

## 3.2 Screening Phase

In the PRISMA's, out of 218 research papers on academicians' perception seven research papers were removed due to language compatibility (LC) while another eight research papers were removed due to the research papers not in full article (NF). While for industry player perception, out of 1489 research paper, eight research papers were removed due to LC and 21 research papers were removed due to NF. The explanation of all the criteria has been explained in the Table 3 and Table 4 respectively. Therefore, the next phase exhibited 203 research papers from academicians' perceptions and 1460 research papers from industry players perceptions.

**Table 3 - Exclusion and inclusion criteria for public Higher Education Institution (HEI)**

| Exclusion / Inclusion | Phase | Criteria | Description |
|---|---|---|---|
| Exclusion | Identification | Duplication (DP) | The research paper with the same criteria appears repeatedly |
| | Screening | Language Compatibility (LC) | The full context of the research papers is not in English exclude title, abstract and any key terms |
| | | No Full text (NF) | The research paper is not accessible for the full text or not available at the Google search |
| | Eligibility | Non-related (NR) | The research paper not related to skill in Industry 4.0 |
| | | Casually Applies (CA) | The research paper used the terms 'Industry 4.0' and 'skills' loosely include with the synonyms terms |
| | | Partially Related (PR) | The Industry 4.0 and skills in general been focused in research paper, but not specifically in public Higher Education Institution (HEI) |
| Inclusion | Included | Closely Related (CR) | The research paper explicitly discussed on skill and Industry 4.0 in the perception of public Higher Education Institution (HEI) |

**Table 4 - Exclusion and inclusion criteria for electrical and electronic industry**

| Exclusion / Inclusion | Phase | Criteria | Description |
|---|---|---|---|
| Exclusion | Identification | Duplication (DP) | The research paper with the same criteria appears repeatedly |
| | Screening | Language Compatibility (LC) | The full context of the research papers in not in English exclude title, abstract and any key terms |
| | | No Full-text (NF) | The research paper is not accessible for the full text or not available at the Google search |
| | Eligibility | Non-related (NR) | The research paper not related to skill in Industry 4.0 |
| | | Casually Applies (CA) | The research paper used the terms 'Industry 4.0' and 'skills' loosely include with the synonyms terms |
| | | Partially Related (PR) | The Industry 4.0 and skills in general been focused in research paper, but not specifically in electrical and electronic industry |
| Inclusion | Included | Closely Related (CR) | The research paper explicitly discussed on skill and Industry 4.0 in the perception of electrical and electronic industry |

## 3.3 Eligibility Phase

In the eligibility phases, this phase begins with 203 research papers from academicians' perceptions and 1460 research papers from industry players perceptions. Based on exclusion criteria from Table 3 and Table 4, the research papers that is not fulfil were removed due to non-related research papers (NR), casually applied (CA) and partially related (PR). In the PRISMA from academicians' perceptions, the NR recorded 142 research papers, followed by CA with 20 research papers and PR with two research papers. However, different numbers of research papers recorded by industry players perceptions which is NR contributed 1294 research papers, CA recorded 43 research papers, while PR recorded 93 research papers. After the research papers have been removed which do not meet the criteria listed, the research papers included in the next phase were 30 research papers and 39 research papers respectively.

## 3.4 Included Phase

The last included phase start with 30 research papers for academicians' perceptions, while 39 research papers were used based on the industry players perceptions. The inclusion criteria included in this phase are closely related (CR) which has been tabulated in Table 3 and Table 4 respectively. The result of the SLR then were used to develop the questionnaire for this study in identifying the future workforce skills in Electrical and Electronic industry. In conclusion, the SLR included the total of 69 research papers based on both perspectives. The result of the SLR were used to develop the questions for the survey.

## 3.5 Questionnaire

To achieve these objectives, a quantitative research design was used. A questionnaire as the main research instrument, was developed by researchers through a SLR. The questionnaire was divided into three sections, A, B and C. Sections A and B comprised lists of soft skills and hard skills, respectively. Section C included questions pertaining to the demographic profile of each respondent. A total of 70 questionnaires were distributed to the employers and academicians. The response rate for the employers was 78.6%, while the academicians' response rate was slightly higher (82.9%). Data analysis was conducted by utilizing the Statistical Package for the Social Sciences version 26 (SPSS 26.0). Data for the respondents' demographic profiles was analysed using descriptive statistics, including frequency and percentage.

During data analysis, Average Weighted Mean (AWM) was utilized to ascertain how important soft and hard skills were. A 10-point scale ranging between 'Least Important' (1) and 'Most Important' (10) was employed to register these skills. This rating scale of 10 response categories is generally preferred (Preston & Coleman, 2000) as it provides the respondents with the freedom to rate the importance of different skills. A useful description of the 10-point scale is provided in table 5.

**Table 5 - Describing the importance of soft skills and hard skills**

| Class Interval | Description |
|---|---|
| 1.00 – 2.00 | Least Important |
| 2.01 – 4.00 | Less Important |
| 4.01 – 6.00 | Somewhat Important |
| 6.01 – 8.00 | Important |
| 8.01 – 10.00 | Most Important |

After examining the descriptions of soft skills and hard skills, then the highest mean value was considered as the most important perceived skill, which would be ranked as one (1). Furthermore, a skills gap analysis was performed by measuring any mean average differences between the perceptions of the academicians in public Higher Education Institution and electrical and electronic industry players (Patacsil & Tablatin, 2017). The skills gap analysis was measured using the following formula:

$$\text{Skills Gap} = \sum_{i-1}^{n} = [(\text{academician perception} - \text{industry player perception}) / n]$$

where,

i = $i$th respondents
n = total number of respondents

A higher mean gap score indicated more discrepancies between the academicians and industry players in terms of their perceptions of soft and hard skills. In addition, a positive result for a mean gap score indicated the skill was more important for academicians, while industry players perceived a skill as being of greater important when the result exhibited a negative mean gap score. Furthermore, an independent sample t-test was also performed to analyse the mean differences between these two stakeholders.

## 4. Results and Discussion

### 4.1 Academicians' Demographic Profiles

This section discusses on the academicians' demographic profiles. The profiles related to gender, age, race, discipline, grade, work experience and experience in developing academic programs at undergraduate level. Out of 58 respondents, more than half were male. Most respondents (46.6%) were between 31 and 40 years, while only three of them were between 25 and 30 (5.2%). Almost all the respondents were Malay. In regard to discipline, the percentages of respondents in Science and Technology and in Social Science were almost the same. Respondents who were under grade DS51 / DS52 dominated the sample (62.1%). Lastly, nearly three-quarters of the respondents claimed that they were experienced in developing academic programs at undergraduate level. Based on the results (shown below), most academicians have experienced in developing academic programs as they would produce the workforce of the future. This was due to Yaakob et al (2018), who stated that some societies and industries have questioned the quality of education in Malaysia. Therefore, it is necessary for academicians to improve the teaching and learning system in Higher Education Institutions to produce high-quality graduates.

### 4.2 Industry Players' Demographic Profiles

The industry players' demographic profiles, pertaining to their gender, age, race, department, work experience and the size of the electrical and electronic company. Like the academicians' demographic profiles, male (63.6%) and Malay (85.5%) respondents dominated the sample. Almost half of the respondents were aged between 25 and 30 years. The percentages of respondents working in the administration department (36.4%) and the technical department (38.2%) were nearly the same. The industries are an integral part of TVET which required the hands-on skills. The remaining respondents were working in the production and operations department. Approximately, half of respondents had less than five years of work experience. Meanwhile, 80% of the respondents were working in large electrical and electronic companies, in which the number of employees was 201 and above. The results indicate that the electrical and electronic industry includes different departments which require different skills. According to Saleh (2019), the skills required by the manufacturing industry must be aligned with business needs. Therefore, the electrical and electronic industry as one of the subsectors for manufacturing industry is required to provide training for the workforce to improve their skills.

### 4.3 Academicians' Perceptions of Soft Skills

This section reports the academicians' perceptions regarding the importance of soft skills in the electrical and electronic industry, as shown in Table 6. Based on the results in Table 6, the respondents, on average, perceived that the top five soft skills considered most important were (1) discipline, (2) responsibility, (3) problem solving/complex problem solving, (4) cognitive skills/thinking skills and (5) teamwork. Out of 28 soft skills, all were considered the most important skills for the future workforce in the electrical and electronic industry, except for entrepreneurial skill ($\mu$=7.59, $\sigma$=1.50) and language proficiency ($\mu$=7.79, $\sigma$=1.32), both of which were considered important (class interval range between 6.01 – 8.00). The results of this study indicated that the academicians were more focused on discipline than other skills. This was because academicians are not only educators but also individuals who are building students' personalities, including their discipline (Abdul Wahab, Muhammad and Ismail, 2019). Nevertheless, the academicians favoured responsibility, followed by problem solving or complex problem solving, cognitive skills or thinking skills and, lastly, teamwork. However, these outcomes are different from those of the study conducted by Amiruddin et al. (2016), which stated that communication skills were most important for the student. This was supported by Salleh et al. (2017), who argued that communication skills need to be implemented in pedagogical approaches.

### 4.4 Industry Players' Perceptions of Soft Skills

Table 7 exhibits the results of the industry players' perceptions regarding the importance of soft skills for the future workforce in the electrical and electronic industry. All the skills were given a more than average mean score of 8.01 and above, except for entrepreneurial skill ($\mu$=7.96, $\sigma$=1.77). However, entrepreneurial skill was still perceived as important by the industry players. In order, the industry players agreed that the top five most important soft skills were (1) teamwork, (2) discipline, (3) responsibility, (4) analytical thinking and problem solving/complex problem solving and, lastly, (5) critical thinking. The study found that the industry players perceived teamwork skills as more important. This aligns with the research by Hanapi et al. (2018), who determined that skill in teamwork is needed by various industries. Graduates need to master this skill to gain employment. Moreover, teamwork has been deemed the skill that will be required in Industry 4.0 (Azmi et al., 2018). However, these skills can be improved by the graduates by attending the industrial training provided by Higher Education Institutions in collaboration with the industry. Therefore, the industry is recommended to provide training to improve the skills of the workforce.

**Table 6 - Academicians' perceptions of the importance of soft skills in the electrical and electronic industry**

| No. | Soft Skills | Mean | SD | Description | Rank According to Importance |
|---|---|---|---|---|---|
| 1 | Adaptability skills | 8.76 | 0.96 | Most Important | 12 |
| 2 | Analytical thinking | 9.09 | 0.92 | Most Important | 7 |
| 3 | Autonomous leadership | 8.33 | 1.23 | Most Important | 18 |
| 4 | Cognitive skill/Thinking skills | 9.14 | 1.02 | Most Important | 4 |
| 5 | Communication skills | 9.10 | 0.93 | Most Important | 6 |
| 6 | Coordinating with others/coordination | 8.57 | 1.05 | Most Important | 16 |
| 7 | Creative thinking | 8.90 | 1.39 | Most Important | 9 |
| 8 | Critical thinking | 9.09 | 0.94 | Most Important | 7 |
| 9 | Decision making | 8.93 | 1.18 | Most Important | 8 |
| 10 | Discipline | 9.33 | 0.74 | Most Important | **1** |
| 11 | Driving and managing change | 8.38 | 1.27 | Most Important | 17 |
| 12 | Emotional intelligence | 8.57 | 1.35 | Most Important | 16 |
| 13 | Entrepreneurial skill | 7.59 | 1.50 | Important | 23 |
| 14 | Ethics and moral professionalism | 9.09 | 0.98 | Most Important | 7 |
| 15 | Flexibility | 8.69 | 1.11 | Most Important | 14 |
| 16 | Innovative thinking | 8.83 | 1.23 | Most Important | 11 |
| 17 | Intercultural skills | 8.09 | 1.30 | Most Important | 21 |
| 18 | Language proficiency | 7.79 | 1.32 | Important | 22 |
| 19 | Lifelong learning | 8.71 | 1.31 | Most Important | 13 |
| 20 | Negotiation | 8.31 | 1.29 | Most Important | 19 |
| 21 | Networking skills | 8.29 | 1.43 | Most Important | 20 |
| 22 | Proactivity | 8.60 | 1.28 | Most Important | 15 |
| 23 | Problem solving/Complex problem solving | 9.16 | 0.97 | Most Important | 3 |
| 24 | Responsibility | 9.19 | 1.00 | Most Important | 2 |
| 25 | Self-development | 8.83 | 1.11 | Most Important | 11 |
| 26 | Self-management | 8.90 | 1.05 | Most Important | 9 |
| 27 | Stress management | 8.88 | 1.04 | Most Important | 10 |
| 28 | Teamwork | 9.12 | 1.03 | Most Important | 5 |

## 4.5 Gap Analysis on Soft Skills

In achieving the objective of this study, a soft skills gap analysis was conducted to examine the mean difference of soft skills as perceived by the two stakeholders, the academicians and industry players. Table 8 reveals that the mean difference of the importance of soft skills ranged from -0.44 to 0.51. Flexibility skill exhibited the highest skill gap of 0.51, while teamwork skill exhibited the lowest skill gap of 0.01. This result indicates a discrepancy in the perceptions these two stakeholders had of the importance of flexibility as a skill. However, both stakeholders were in almost total agreement regarding teamwork skill. Meanwhile, an independent sample t-test analysis showed that there was no significant difference between the academicians and industry players regarding the importance of soft skills. However, there was a significant difference between these two stakeholders in terms of flexibility skill ($t=2.03$, $p<0.05$). The academicians ranked this skill higher than the industry players did.

**Table 7 - Industry players' perceptions of the importance of soft skills in the electrical and electronic industry**

| No. | Soft Skills | Mean | SD | Description | Rank According to Importance |
|---|---|---|---|---|---|
| 1 | Adaptability skills | 8.69 | 1.37 | Most Important | 10 |
| 2 | Analytical thinking | 8.85 | 1.39 | Most Important | 4 |
| 3 | Autonomous leadership | 8.36 | 1.57 | Most Important | 22 |
| 4 | Cognitive skill / Thinking skills | 8.78 | 1.60 | Most Important | 6 |
| 5 | Communication skills | 8.76 | 1.29 | Most Important | 7 |
| 6 | Coordinating with others/coordination | 8.65 | 1.61 | Most Important | 11 |
| 7 | Creative thinking | 8.47 | 1.51 | Most Important | 17 |
| 8 | Critical thinking | 8.80 | 1.53 | Most Important | 5 |
| 9 | Decision making | 8.62 | 1.53 | Most Important | 13 |
| 10 | Discipline | 9.09 | 1.25 | Most Important | 2 |
| 11 | Driving and managing change | 8.55 | 1.51 | Most Important | 15 |
| 12 | Emotional intelligence | 8.42 | 1.60 | Most Important | 20 |
| 13 | Entrepreneurial skill | 7.96 | 1.77 | Important | 25 |
| 14 | Ethics and moral professionalism | 8.71 | 1.34 | Most Important | 9 |
| 15 | Flexibility | 8.18 | 1.53 | Most Important | 23 |
| 16 | Innovative thinking | 8.40 | 1.55 | Most Important | 21 |
| 17 | Intercultural skills | 8.44 | 1.41 | Most Important | 19 |
| 18 | Language proficiency | 8.07 | 1.70 | Most Important | 24 |
| 19 | Lifelong learning | 8.45 | 1.46 | Most Important | 18 |
| 20 | Negotiation | 8.40 | 1.52 | Most Important | 21 |
| 21 | Networking skills | 8.73 | 1.24 | Most Important | 8 |
| 22 | Proactivity | 8.55 | 1.56 | Most Important | 15 |
| 23 | Problem solving/Complex problem solving | 8.85 | 1.52 | Most Important | 4 |
| 24 | Responsibility | 9.00 | 1.28 | Most Important | 3 |
| 25 | Self-development | 8.49 | 1.36 | Most Important | 16 |
| 26 | Self-management | 8.64 | 1.48 | Most Important | 12 |
| 27 | Stress management | 8.60 | 1.44 | Most Important | 14 |
| 28 | Teamwork | 9.11 | 1.13 | Most Important | **1** |

Furthermore, a positive mean difference implied that the academicians tended to regard a skill more highly than the industry players. Based on the results shown in Table 8, there was a trend whereby the academicians rated 20 soft skills higher than the industry players: the results show a positive mean difference or gap. The remaining soft skills obtained higher rankings by the industry players; these are networking skill, entrepreneurial skill, intercultural skill, language proficiency, driving and managing change, negotiation, coordinating with others/coordination and, lastly, autonomous leadership. Nevertheless, overall, they agreed that these 28 soft skills are important for the future workforce, mainly in the electrical and electronic industry.

The findings of this study found that there was a gap in the perceptions of soft skills between the academicians and industry players. The most important skill recorded by the academicians is responsibility. This was followed by responsibility, problem solving or complex problem solving, cognitive skills or thinking skills and, lastly, teamwork skills. However, different perceptions were demonstrated by the industry players, as teamwork skill recorded the highest mean. Not only that, but the skill also recorded in second place is discipline, followed by responsibility, analytical thinking, problem solving or complex problem solving and, lastly, critical thinking. However, the findings of this study are not the same as those of the study by Tan et al. (2017). They found that soft skills, from the perception of those in Higher Education Institutions, involve solving problems, thinking critically, communicating and being independent, as well as showing the capacity for lifelong learning However, lifelong learning is not an expectation according to the industry experts. They stated that analytical skill, rather than lifelong learning, is a skill that graduates must possess. Moreover, the study by Nadarajah (2021) stated that most graduates possessed skills such as teamwork, good time management and leadership. However, to be employed, the job market required them to improve their communication, problem-solving and analytical skills. Therefore, Higher Education Institutions and industry should collaborate to produce and improve the skills of graduates, as they are the future workforce.

**Table 8 - Gap analysis of soft skills**

| No. | Soft Skills | Mean | | Mean difference (Gap) | t | Sig. |
|---|---|---|---|---|---|---|
| | | Academicians | Industry Players | | | |
| 1 | Adaptability skills | 8.76 | 8.69 | 0.07 | 0.31 | .761 |
| 2 | Analytical thinking | 9.09 | 8.85 | 0.24 | 1.05 | .297 |
| 3 | Autonomous leadership | 8.33 | 8.36 | -0.03 | -0.14 | .892 |
| 4 | Cognitive skill / Thinking skills | 9.14 | 8.78 | 0.36 | 1.42 | .158 |
| 5 | Communication skills | 9.10 | 8.76 | 0.34 | 1.61 | .110 |
| 6 | Coordinating with others/coordination | 8.57 | 8.65 | -0.08 | -0.34 | .737 |
| 7 | Creative thinking | 8.90 | 8.47 | 0.43 | 1.55 | .123 |
| 8 | Critical thinking | 9.09 | 8.80 | 0.29 | 1.20 | .232 |
| 9 | Decision making | 8.93 | 8.62 | 0.31 | 1.22 | .226 |
| 10 | Discipline | 9.33 | 9.09 | 0.24 | 1.23 | .220 |
| 11 | Driving and managing change | 8.38 | 8.55 | -0.17 | -0.63 | .527 |
| 12 | Emotional intelligence | 8.57 | 8.42 | 0.15 | 0.54 | .590 |
| 13 | Entrepreneurial skill | 7.59 | 7.96 | -0.37 | -1.22 | .224 |
| 14 | Ethics and moral professionalism | 9.09 | 8.71 | 0.38 | 1.71 | .090 |
| 15 | Flexibility | 8.69 | 8.18 | 0.51 | 2.03 | .045* |
| 16 | Innovative thinking | 8.83 | 8.40 | 0.43 | 1.63 | .106 |
| 17 | Intercultural skills | 8.09 | 8.44 | -0.35 | -1.37 | .173 |
| 18 | Language proficiency | 7.79 | 8.07 | -0.28 | -0.98 | .329 |
| 19 | Lifelong learning | 8.71 | 8.45 | 0.26 | 0.97 | .336 |
| 20 | Negotiation | 8.31 | 8.40 | -0.09 | -0.34 | .736 |
| 21 | Networking skills | 8.29 | 8.73 | -0.44 | -1.72 | .088 |
| 22 | Proactivity | 8.60 | 8.55 | 0.05 | 0.22 | .829 |
| 23 | Problem solving / Complex problem solving | 9.16 | 8.85 | 0.31 | 1.26 | .210 |
| 24 | Responsibility | 9.19 | 9.00 | 0.19 | 0.88 | .380 |
| 25 | Self-development | 8.83 | 8.49 | 0.34 | 1.45 | .151 |
| 26 | Self-management | 8.90 | 8.64 | 0.26 | 1.08 | .283 |
| 27 | Stress management | 8.88 | 8.60 | 0.28 | 1.19 | .238 |
| 28 | Teamwork | 9.12 | 9.11 | 0.01 | 0.06 | .955 |

** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed)

Apart from the mean difference, this study also analysed the results based on rankings of the importance of soft skills, as presented in Table 9. As expected, the results displayed disparities between the academicians and industry players about the importance of the soft skills needed by the future workforce in the electrical and electronic industry. Interestingly, three soft skills were perceived as ranking the same by both stakeholders. These were proactivity (rank 15), language proficiency and entrepreneurial skill (the two skills ranked last). The academicians favoured discipline, responsibility, problem solving/complex problem solving, cognitive skill/thinking skills and teamwork. On the other hand, the soft skills favoured by the industry players were teamwork, discipline, responsibility, analytical thinking, problem solving/complex problem solving and critical thinking. From this gap analysis, it has been proven that there is still a skills mismatch between academicians and industry players in terms of identifying the best set of soft skills needed by the future workforce in the electrical and electronic industry.

**Table 9 - Soft skills based on rank according to importance between academicians and industry players**

| Academicians | Rank | Industry Players |
|---|---|---|
| Discipline | 1 | Teamwork |
| Responsibility | 2 | Discipline |
| Problem solving/Complex problem solving | 3 | Responsibility |
| Cognitive skill / Thinking skills | 4 | ● Analytical thinking<br>● Problem solving/Complex problem solving |
| Teamwork | 5 | Critical thinking |
| Communication skills | 6 | Cognitive skill / Thinking skills |
| ● Analytical thinking<br>● Critical thinking<br>● Ethics and moral professionalism | 7 | Communication skills |
| Decision making | 8 | Networking skills |
| ● Creative thinking<br>● Self-management | 9 | Ethics and moral professionalism |
| Stress management | 10 | Adaptability skills |
| ● Innovative thinking<br>● Self-development | 11 | Coordinating with others/coordination |
| Adaptability skills | 12 | Self-management |
| Lifelong learning | 13 | Decision making |
| Flexibility | 14 | Stress management |
| Proactivity | 15 | ● Driving and managing change<br>● Proactivity |
| ● Coordinating with others/coordination<br>● Emotional intelligence | 16 | Self-development |
| Driving and managing change | 17 | Creative thinking |
| Autonomous leadership | 18 | Lifelong learning |
| Negotiation | 19 | Intercultural skills |
| Networking skills | 20 | Emotional intelligence |
| Intercultural skills | 21 | ● Innovative thinking<br>● Negotiation |
| Language proficiency | 22 | Autonomous leadership |
| Entrepreneurial skill | 23 | Flexibility |
| | 24 | Language proficiency |
| | 25 | Entrepreneurial skill |

**Table 10 - Academicians' perceptions of the importance of hard skills in the electrical and electronic industry**

| No. | Hard Skills | Mean | SD | Description | Rank According to Importance |
|---|---|---|---|---|---|
| 1 | Coding and programming skills *(debugging, program authoring, designing, program comprehension)* | 7.37 | 1.67 | Important | 10 |
| 2 | Data analytics *(business, statistic, machine learning, analysis & communication of findings)* | 8.53 | 1.06 | Most Important | 3 |
| 3 | Design skills *(analysis and design of analogue and digital electronic circuits, designing embedded system)* | 8.45 | 1.03 | Most Important | 5 |
| 4 | Digital skills *(using devices, finding and evaluating information, managing and storing information)* | 8.64 | 1.09 | Most Important | 2 |
| 5 | ICT literacy *(communicating tools, accessing networking, integration, evaluation)* | 8.81 | 1.12 | Most Important | **1** |
| 6 | New media literacy *(content development)* | 8.19 | 1.26 | Most Important | 8 |
| 7 | Organizational capabilities *(understanding, product development, motivation)* | 8.47 | 1.16 | Most Important | 4 |
| 8 | Research skills *(collecting, reviewing & deciding the information)* | 8.22 | 1.55 | Most Important | 7 |
| 9 | Technology use *(generating technology in E&E)* | 8.12 | 1.44 | Most Important | 9 |
| 10 | Troubleshooting *(maintenance, installation)* | 8.31 | 1.14 | Most Important | 6 |

## 4.7 Industry Players' Perception on Hard Skills

As for industry players' perceptions of hard skills, the results in Table 11 show that they tend to perceive all eight hard skills as the most important skills that the future workforce in the electrical and electronic industry needs to be equipped with. Surprisingly, organizational capabilities obtained the highest mean score ($\mu$=8.62, $\sigma$=1.46), which ranked it as the most important skill out of these 10 hard skills. This indicates that the industry players believed that the future workforce would be able to understand outstanding customer service and possess excellent product development capabilities by offering innovative products and services to customers. The next most important hard skills were digital skills and ICT literacy ($\mu$=8.62, $\sigma$=1.46). Nevertheless, new media literacy and coding and programming skills were only rated as important by the industry players. The mean scores for the former and latter skills were $\mu$=7.84 and $\mu$=7.16, respectively.

Based on this study, the results indicate that the industry players perceived organizational capabilities as more important. This was followed by digital skills and ICT skills, which ranked the same. Next, data analytics ranked third and troubleshooting was fourth. Lastly, research skills were ranked fifth. However, the results of this study were different from those of a previous study conducted by Flores et al. (2020), who stated that digital skills were more important. Moreover, Wagiran et al. (2019) found that employers expected graduates to have hard skills. This was because Industry 4.0 requirements involve aspects of hard skills such as ICT skills. Therefore, the industry players should adopt the role of providing training to improve and develop the hard skills of the workforce.

**Table 11 - Industry players' perceptions of the importance of hard skill in the electrical and electronic industry**

| No. | Hard Skills | Mean | SD | Description | Rank According to Importance |
|---|---|---|---|---|---|
| 1 | Coding and programming skills *(debugging, program authoring, designing, program comprehension)* | 7.16 | 2.23 | Important | 9 |
| 2 | Data analytics *(Business, statistic, machine learning, analysis & communication of findings)* | 8.36 | 1.34 | Most Important | 3 |
| 3 | Design skills *(Analysis and design of analogue and digital electronic circuits, designing embedded system)* | 8.02 | 1.63 | Most Important | 7 |
| 4 | Digital skills *(Using devices, finding and evaluating information, managing, and storing information)* | 8.51 | 1.63 | Most Important | 2 |
| 5 | ICT literacy *(Communicating tools, accessing networking, integration, evaluation)* | 8.51 | 1.59 | Most Important | 2 |
| 6 | New media literacy *(content development)* | 7.84 | 1.56 | Important | 8 |
| 7 | Organizational capabilities *(understanding, product development, motivation)* | 8.62 | 1.46 | Most Important | **1** |
| 8 | Research skills *(Collecting, reviewing & deciding the information)* | 8.20 | 1.60 | Most Important | 5 |
| 9 | Technology use *(Generating technology in E&E)* | 8.09 | 1.91 | Most Important | 6 |
| 10 | Troubleshooting *(maintenance, installation)* | 8.24 | 1.66 | Most Important | 4 |

## 4.8 Hard Skills Gap Analysis

A hard skills gap analysis was measured by examining the mean difference between the perceptions of academicians and industry players related to the importance of these skills for the future workforce in the electrical and electronic industry. The higher the mean difference score, the higher the gap or mismatch in the said skills, based on these two stakeholders' perceptions. Table 12 reports that design skills obtained the highest mean difference. Meanwhile, the lowest mean difference was demonstrated by research skills. It is noteworthy that the academicians perceived a higher mean average score than the industry players for all hard skills, except for organizational capabilities (the results show a negative mean difference). Further analysis using an independent sample t-test revealed no significant difference in any of the hard skills.

This study found a hard skills gap, based on the academicians' and industry players' perceptions. The academicians perceived ICT skills, digital skills, data analytics, organizational capabilities, and design skills as more important. However, industry players perceived all these skills as important, except design skills. Furthermore, the industry players also perceived troubleshooting skills and research skills as more important. According to Nadarajah (2021), graduates are more competent in ICT skills. However, these skills can be divided into two categories, basic and advanced ICT skills. Basic ICT skills include the use of email, mobile phone services, PowerPoint and using the Internet for data collection. Meanwhile, advanced ICT skills include tools like participating in forums or chats and operating software. Therefore, both stakeholders are required to provide complete infrastructures to improve hard skills.

**Table 12 - Gap analysis of hard skills**

| No. | Hard Skills | Mean | | Mean difference (Gap) | t | Sig. |
|---|---|---|---|---|---|---|
| | | Academicians | Industry Players | | | |
| 1 | Coding and programming skills *(debugging, program authoring, designing, program comprehension)* | 7.37 | 7.16 | 0.21 | 0.56 | .576 |
| 2 | Data analytics *(business, statistic, machine learning, analysis & communication of findings)* | 8.53 | 8.36 | 0.17 | 0.75 | .453 |
| 3 | Design skills *(analysis and design of analogue and digital electronic circuits, designing embedded system)* | 8.45 | 8.02 | 0.43 | 1.69 | .094 |
| 4 | Digital skills *(using devices, finding and evaluating information, managing and storing information)* | 8.64 | 8.51 | 0.13 | 0.50 | .621 |
| 5 | ICT literacy *(communicating tools, accessing networking, integration, evaluation)* | 8.81 | 8.51 | 0.30 | 1.17 | .243 |
| 6 | New media literacy *(content development)* | 8.19 | 7.84 | 0.35 | 1.33 | .188 |
| 7 | Organizational capabilities *(understanding, product development, motivation)* | 8.47 | 8.62 | -0.15 | -0.62 | .538 |
| 8 | Research skills *(collecting, reviewing & deciding the information)* | 8.22 | 8.20 | 0.02 | 0.08 | .935 |
| 9 | Technology use *(generating technology in E&E)* | 8.12 | 8.09 | 0.03 | 0.09 | .925 |
| 10 | Troubleshooting *(maintenance, installation)* | 8.31 | 8.24 | 0.07 | 0.28 | .782 |

** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed)

In terms of rank, the results in table 13 indicate there was still a hard skills mismatch or gap, based on the perceptions of the academicians and industry players. It was clear that the perceptions of both stakeholders were not the same. In rank 1, ICT literacy was preferred by the academicians, but the industry players viewed organizational capabilities as the most important hard skill for the future workforce in the electrical and electronic industry. However, four hard skills were ranked the same, showing the stakeholders had similar perceptions of these according to their importance for future employees. These hard skills were digital skills, data analytics, new media literacy and, lastly, coding and programming skill.

**Table 13 - Hard skills based on rank according to importance between academicians and industry players**

| Academicians | Rank | Industry Players |
|---|---|---|
| ICT literacy | 1 | Organizational capabilities |
| Digital skills | 2 | • Digital skills<br>• ICT literacy |
| Data analytics | 3 | Data analytics |
| Organizational capabilities | 4 | Troubleshooting |
| Design skills | 5 | Research skills |
| Troubleshooting | 6 | Technology use |
| Research skills | 7 | Design skills |
| New media literacy | 8 | New media literacy |
| Technology use | 9 | Coding and programming skills |
| Coding and programming skills | 10 | |

## 5. Conclusion and Recommendation

The findings of the research revealed that the top five soft skills that favoured by academicians are discipline (as the highest mean) followed by responsibility; problem solving or complex problem solving; cognitive skills or thinking skills and, lastly, teamwork skills. However, the industry players' perspectives showed teamwork as the most important skill, followed by discipline; responsibility; analytical thinking; problem solving or complex problem solving and, lastly, critical thinking. This shows that the skills were different according to the stakeholders, which is a difference that becomes the skills gap. Therefore, it is suggested that academicians develop the teaching and learning process in Higher Education Institutions, while industry players are recommended to provide training to improve the skills of the future workforce.

This study also found that there were hard skills gaps, based on both perspectives. For the academicians, the top five hard skills were ICT literacy (as the highest mean), followed by digital skills, data analytics, organizational capabilities and, lastly, design skills. However, the industry players recorded the highest mean skill as organizational capabilities, followed by digital skills and ICT literacy; data analytics; troubleshooting and, lastly, research skills. This demonstrates that there is a mismatch between the academicians' and industry players' perspectives. According to Nadarajah (2021), most graduates are unemployed because of the skills gap. To reduce the gap related to soft and hard skills, ongoing effort is required from both higher education institutions and industry. Further study is required to identify the future skills required by various industry. Future studies could use different methods of identifying the skills demanded, such as quantitative methods, qualitative methods or mixed methods.

The findings of this study provide the insight to the stakeholders especially the policymakers and curriculum developers on the appropriate interventions that need to be taken to ensure that graduates from Malaysia especially TVET graduates are well equipped with the soft skills and hard skills that needed in the future. Furthermore, the academicians need to further improve their skills in all aspects such as teaching, planning a various activity as well as understanding the current and future skills demanded by the industries. Even there are gaps in present skills and future skills based on both perceptions, the industries should have a partnership with the institution to reduce the gaps by providing on job training for the TVET students to learn and experience the real work placement.

## Co-Author Contribution

On behalf of every author, the corresponding author confirms that no conflict of interest affected this paper. The first author conducted the fieldwork, wrote the literature review, and supervised the writing-up of the overall article. The second author produced the research methodology and undertook the data entry. The third author conducted the statistical analysis and interpreted the results. The fourth author wrote up the discussion and suggestions for future research sections, in addition to checking the grammar of the article.

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