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Application of Emotional Intelligence (EQ) among TVET Students to Face the Industrial Revolution 4.0 in the Light Engineering Sector of Bangladesh

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Abstract: 4IR readiness does not simply mean being equipped with technology. There are also social and psychological dimensions that are often overlooked in practical settings. Emotional Intelligence (EQ) is a key component of the social and psychological readiness of the 4IR workforce. Engineers need EQ in addition to IQ in the workplace. The light engineering sector is the fastest-growing commercial division in Bangladesh. TVET graduates represent the primary human resources for the light engineering sector. In the future, modern 4IR technology-enabled machines will be operated by engineers in this sector. Therefore, it is crucial to equip these resources with 4IR skills to enhance their productivity and minimize the need for on-the-job training. This study aims to explore the application of emotional intelligence among TVET students as they prepare to face the Industrial Revolution 4.0. It has been found that students are largely unaware of 4IR. The level of emotional intelligence among TVET students is notably low. Emotional intelligence shows significant correlations with 4IR readiness. The research findings indicate that a short orientation on EQ related to 4IR readiness yields significantly different results in TVET students compared to those who did not receive such orientation. Significant components of 4IR readiness have been identified in this study, which could assist TVET educators in incorporating the appropriate skill set.

Keywords: *Emotional Intelligence (EQ), Light Engineering (LE), 4IR, Technical Vocational Education & Training (TVET).*

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I. INTRODUCTION

The Industrial Revolution 4.0 (IR4.0) has created significant uncertainty, as automation and robotics pose a threat to replace the human workforce. Therefore, all Technical and Vocational Education and Training (TVET) students must cultivate both technical and soft skills to succeed in future work environments. Nonetheless, many students face challenges due to insufficient soft skills, which may impede their readiness for IR4.0. (Hashim, 2024).

Key elements that influence readiness for the Fourth Industrial Revolution include a strong technological infrastructure, a skilled and adaptable workforce, a supportive organizational culture, active leadership, expertise in data analytics, robust cybersecurity practices, favorable government policies, access to funding, variations across industry sectors, and employees' awareness of emerging technologies such as AI, IoT, and big data. Together, these factors determine a company's or nation's capacity to effectively adopt and utilize Fourth Industrial Revolution technologies (Prapti, Mashiat, Miah & Rafid, 2024).

The Fourth Industrial Revolution (4IR) marks the convergence of advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), automation, and blockchain, fundamentally altering the global economic and social paradigms. An increasing number of social scientists contend that we are on the verge of a technological revolution that will significantly change how we live, learn, and work. One term used to describe this social phenomenon is the "fourth industrial revolution." Other social scientists, particularly psychologists, have independently developed and discussed a concept of intelligence that is complementary to—and sometimes an alternative to—the traditional IQ tests, known as "emotional intelligence." In recent years, these two concepts have started to intersect and engage within scientific literature (Campa, 2020).

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The skills necessary for the Third Industrial Revolution (or 3IR, commonly referred to as the Digital Revolution) differ significantly from those required in the Fourth Industrial Revolution (4IR). While 3IR emphasizes basic digital literacy, 4IR demands a deeper understanding of emerging technologies, along with essential soft skills such as critical thinking and collaboration. The skills relevant to 4IR are more advanced, encompassing a broader range of competencies than those associated with 3IR. As the demand for soft skills increases, there is an urgent need to develop educational strategies that enhance interpersonal communication and critical thinking skills (Borrageiro & Mennega, 2023).

To be prepared for the Fourth Industrial Revolution (4IR), individuals need a combination of technical skills related to emerging technologies such as AI, data analysis, and automation, as well as soft skills, social skills, and methodological skills. These non-technical skills complement the hard skills required for the 4IR. (Borrageiro & Mennega, 2023).

In a recent study published in the journal Career Development International, researchers examined the effectiveness of engineers and its relationship to their IQ, personality, and emotional intelligence. Among these factors, only one was found to predict their success: emotional intelligence. This does not suggest that IQ or personality are unimportant; after all, engineers have strong math and science skills. The results emphasize the importance of emotional intelligence for achieving success in today's world.

➢ *Emotional Intelligence holds Significant Importance for Several Reasons.*

- Firstly, engineers create products intended for use by others. The capacity to grasp customer needs and empathize with end users is essential for developing successful, user-friendly, and valuable products and services.
- Secondly, as engineering increasingly shifts from individual work to teamwork, engineers with strong interpersonal skills will thrive in both communication and project delivery.
- Lastly, engineers with high emotional intelligence demonstrate additional qualities, such as the ability to navigate diverse cultural environments and appreciate cultural differences.

As reported by BBF Digital in 2024, there was a time when products from Jinjira and Dholaikhal were ridiculed. Today, these light engineering (LE) hubs in Dhaka, along with 34 LE clusters across 18 districts in Bangladesh, contribute nearly 3% to the nation's GDP. In FY22, the industry generated USD 796 million in export revenues. Annually, this sector alone produces around BDT 20,000 crore in revenue, with the market expanding at a rate of 10%.

The main challenge is the lack of skills and modern technology. This sector, primarily composed of informal SMEs, relies heavily on outdated technology and manual labor, which presents health risks. Reliance on outdated technologies requires more raw materials per unit, resulting in a waste of 30% to 40% of resources. Additionally, the extensive use of manual labor and obsolete technology significantly prolongs the overall process.

One day, engineers from Jinjira or Dholaikhal will utilize advanced machinery like CNC machines and 3D printers. This highlights the significant role of emotional intelligence in this industry.

In Bangladesh's light engineering sector, Dholaikhal and Jinjira emerge as the two main hubs, hosting nearly 7,500 factories, shops, and workshops. Approximately 60,000 individuals work here, producing motor parts, machinery, and various other components for a range of industries. Notably, workers in Dholaikhal have developed unique terminologies that may be unfamiliar to many professionally trained mechanical engineers.

Bangladesh exports light engineering goods worth less than half a billion USD annually on average. The light engineering sector in Bangladesh presents significant investment opportunities due to the increasing demand for machinery and components from the growing manufacturing sector, along with favorable economic policies and attractive incentives.

➢ *Key Points about the Light Engineering Industry:*

- 600,000 people employed by 40,000 light engineering companies
- 34 light engineering clusters across 18 districts of the country
- Significant growth potential in this segment, as local production meets only 50% of the total demand

The lack of skilled labor and advanced technology is putting Bangladesh's competitiveness in this sector at risk. The Bangladesh Institute of Development Studies (BIDS) reports a significant 33.6% skill gap in the LE sector. Furthermore, foreign direct investments (FDI) are increasing in the country. More FDI in manufacturing suggests that additional foreign firms may penetrate the Bangladeshi market through mergers and acquisitions (M&A) and/or joint ventures (JV). These companies are likely to set up their manufacturing facilities or production hubs, necessitating ongoing support for parts supply and repair services.

This requirement from manufacturers presents another obstacle within the industry. The second issue arises from the existing gap between VAT and TAX. Although manufacturers of light engineering products benefit from tax exemption, small repair services face a 15% VAT. Even though these repair services help manufacturers in other sectors save significantly on servicing costs, the VAT burden makes local repair services less appealing to them.

So, what needs to be done here? Four solutions can be explored to address these two problems. First, basic education in Bangladesh must be significantly improved. One of the

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primary reasons behind Vietnam's success in becoming a manufacturing miracle is its substantial investment in its demographic dividend through the promotion of basic education. Bangladesh can take inspiration from Vietnam by leveraging its own demographic dividend. Secondly, technical and vocational education and training (TVET) can play a crucial role in equipping Bangladesh's young population and preparing them to lead the country's light engineering industry. Thirdly, facilitating the use of modern technology can greatly empower this growing sector. Finally, reducing the VAT on service and repair shops can enhance the competitiveness of this vital part of the light engineering sector.

Many key players in this industry often lack formal education, typically completing only three to six months of training in specialized trades. Generally, those who finish short courses and diploma programs at TVET find employment in the light engineering sector. Incorporating emotional intelligence into graduation programs could enhance productivity and equip graduates with essential non-technical skills necessary for the Fourth Industrial Revolution (4IR).

➢ *Statement of the Problem*

It is globally accepted that soft skills and social skills are critically important for readiness in the Fourth Industrial Revolution (4IR). Engineers particularly need these non-technical skills. Soft skills encompass a wide array, including emotional intelligence, which requires greater attention in 4IR literature. Diploma engineers and TVET graduates predominantly enter the light engineering sector. As this sector grows, it necessitates more focus on preparing the workforce for 4IR. Readiness for 4IR includes various factors, among which sociological readiness is notably significant. The workforce in the light engineering sector will utilize updated technology in the future. It is also concerning that engineers and technicians must be well-prepared in emotional intelligence. This poses a substantial challenge. The study addresses this issue and seeks a way to overcome the problem.

➢ *The Rationale of the Study*

Exploring the social and psychological dimensions of readiness for the Fourth Industrial Revolution (4IR) within Bangladesh's light engineering sector is highly engaging. Developing personal and social skills is essential not only for achieving workplace success but also for fostering resilience and leading happy, healthy, and balanced lives (SDG 3: Ensure healthy lives and promote well-being for all at all ages).

As the Fourth Industrial Revolution approaches, bringing both promises and threats of automation for many jobs, emotional intelligence becomes increasingly important. Computers and robots are becoming more intelligent, and many tasks that once formed the backbone of engineering are now managed more quickly and affordably by software. Emotional intelligence and the ability to connect with others remain uniquely human traits, and it is expected that engineering and other professions will increasingly aim to cultivate these skills in future graduates.

II. LITERATURE REVIEW

➢ *Emotional Intelligence*

Globally, engineering education recognizes the necessity for students to develop additional learning skills and for graduates to enhance their capabilities for effective workplace functioning. Emotional intelligence (EQ) encompasses various abilities, such as self-awareness, self-regulation, motivation, empathy, and social skills. It significantly influences communication skills, particularly in an intercultural context, and also affects students' learning capacities. Nevertheless, EQ should not be viewed as a replacement for intellect; instead, it serves to augment work skills and improve employment prospects (Riemer, 2003).

Emotional intelligence, also known as EQ, was initially defined in 1990 by Salovey and Mayer. Since then, Goleman has significantly expanded on their work in 1995. He noted that EQ—a collection of skills unrelated to academic ability—is actually more crucial for success in life and work than IQ. Goleman outlined five key domains of emotional intelligence: self-awareness, self-regulation, motivation, empathy, and social skills. These components can be integrated into student education to better prepare them for their professional careers.

➢ *A follow-up Study Identified Seven Essential Skills, which Include:*

- Recognizing personal emotions and managing them effectively.
- Emotional resilience: maintaining performance under pressure. Motivation: the energy and drive to achieve goals.
- Considering the needs of others.
- Skills in influence and persuasion.
- Decisiveness: making clear decisions and following through.
- Conscientiousness: showing commitment to a plan and aligning actions with words.

This skill set can be categorized into two main areas within an emotional competence framework: personal competencies (how an individual manages themselves) and social competencies (how an individual navigates relationships). These categories also include various sub-competencies. A high level of emotional intelligence (EQ) signifies that a person can fully experience their feelings as they arise. A higher EQ equips an individual with qualities such as compassion, empathy, adaptability, and self-control. By enhancing their EQ, individuals become better at balancing their own needs with those of others.

➢ *Light Engineering Sector*

The light engineering industry (LEI) sector lacks a specific universal definition. However, various authors have characterized the LEI sector based on common traits such as being a small firm, engaging in engineering or technological

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production processes, creating metal-working or electromechanical components, and utilizing indigenous technical skills (Rabbani, 2005; Ahmed & Bakht, 2010; Quadir & Mahmud, 2009).

Rabbani (2005) described the light engineering industry (LEI) as one that incorporates local engineering elements in product design or manufacturing, showcasing contributions from native engineering knowledge or skills. Key processes include cutting, blending, machining, shaping, milling, hobbing, rolling, extruding, drawing, and sawing (Adhikary & McVay, 2006).

LEIs are small businesses specializing in the production of machinery, equipment, tools, metallic household appliances, sanitary ware, and various electrical, electronic, electromechanical, and mechatronic products, primarily using metals and employing engineering and technological processes (Uddin, 2009).

Talukder and Jahan (2016) describe the LEI sector as consisting of small firms that utilize engineering or technological processes to manufacture various products. These products include small machinery, tools, metallic household appliances, sanitary ware, and electrical, electronic, electromechanical, or mechatronic items, primarily made from metals. Furthermore, these firms produce spare parts for a wide range of industrial, agricultural, automotive, and small machinery, along with providing repair services.

There is no documented history of the LEI sector in Bangladesh. It is widely believed that the industry began by providing maintenance support to large-scale industrial units established in the 1950s in what was then known as East Pakistan. However, the sector has experienced significant growth since 1985 (Quadir & Mahamud, 2009). Before 1970, only a few industrial facilities in Bangladesh relied on imported machines and spare parts. Some skilled mechanics began manufacturing certain components (Talukder & Jahan, 2017). After Bangladesh gained independence, non-Bengali factory owners departed, prompting the government to nationalize their factories under large public sector organizations. The government subsequently established additional industrial units, creating substantial demand for spare parts and mechanical fittings that had previously been imported by private owners (Talukder & Jahan, 2016). Indigenous LEIs began to emerge in areas such as Dholaikhal, Jinjira, Mirpur, and Syedpur around 1980 (Talukder & Jahan, 2016). The sector experienced explosive growth during the 1980s, partly due to government support during that time (Talukder & Jahan, 2017). Today, the LEI sector plays a vital role in providing affordable spare parts, castings, molds and dies, fittings for oil and gas pipelines, light machinery, and repair services for the automobile, industrial, agricultural, and construction sectors (Talukder & Jahan, 2016). In 1984, the Dholaikhal area attracted government attention because of the commendable skills of the LEIs. It was recognized that they struggled to produce quality parts due to a lack of modern machinery, consistent demand, and formally trained staff. To address this, the Bangladesh Small and Cottage Industries Corporation (BSCIC) provided targeted low-interest loans to LEIs for purchasing machinery and working capital. To ensure continuous demand, the government issued a circular mandating that corporate entities in the sector procure local spare parts whenever possible. Additionally, BSCIC categorized the LEIs by product category, facilitating industrial buyers, including government sector corporations, in accessing local producers (Majumder & Dey, 2020).

- *4IR*

Circulation denotes a transition that influences developmental progress, frequently accompanied by the rise of new technologies. These technological changes create a foundation for future advancements. A country can achieve recognition when its technological innovations progress holistically. The term Industry 4.0 has recently emerged to signify the growing integration of information technology and automation across nearly all industrial sectors (Oesterreich & Teuteberg, 2016).

To understand the fourth industrial revolution, we must first grasp the preceding phases and their impacts. The first industrial revolution arose from the invention of the steam engine, which brought mechanization to the manufacturing sector. The second industrial revolution emerged with the use of electricity, leading to mass production. The third industrial revolution was driven by the advent of digital processes that enabled automation and the use of the internet (Petrillo et al., 2018; Oliver, 2018). The fourth phase of the industrial revolution is characterized by cyber-physical systems, resulting in increased automation, advanced communication, and the creation of smart machines capable of performing various tasks with minimal human intervention. Essentially, the fourth industrial revolution (4IR) pertains to the adoption of modern smart technology that decreases human involvement in manufacturing and industrial practices (Moore, 2018). This term was first introduced in a book of the same name in 2016 by Klaus Schwab, the founder of the World Economic Forum. It represents a fusion of, but is not limited to, various technologies including artificial intelligence, the Internet of Things, robotics, virtual reality, mobile devices, 3D printing, smart sensors, big data analytics, augmented reality (AR), data visualization, cognitive computing, location identification, customer profiling, blockchain, quantum computing, and cloud computing (Wigmore, 2020). Interestingly, the fifth industrial revolution is on the horizon, characterized by human-machine collaboration in the workplace. Since it has not yet occurred, its impacts remain unknown. The following table outlines the five phases of the industrial revolution, along with their timing, drivers, and outputs in brief (Rahman, 2022). Phases of the Industrial Revolution along with their timing, drivers, and outputs Phases.

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Table 1 4IR

Phases	**1st**	**2nd**	**3rd**	**4th**	**5th**
Timing	End of 18th century	Beginning of 20th century	Beginning of 21st century	2013	2020+
Drivers	Water and Steam Power	Electricity	Digital processes	Cyber physical system	Co-working of human and machines
Outputs	Mechanization of manufacturing	Mass Production	Automation processes and use of the internet	Automation, advanced communication, production of smart machines	As it has not occurred yet, the impact will be seen in future

Source: (Rahman, 2022)

➢ *Research Gap*

Emotional intelligence plays a crucial role in preparing university graduates for the Fourth Industrial Revolution (4IR). Engineers must possess emotional intelligence to adapt to the evolving work environment of 4IR. The social and psychological aspects of 4IR readiness in the light engineering sector in Bangladesh remain largely unexplored, despite the country exporting light engineering goods valued at an average of half a billion dollars annually. Approximately 600,000 individuals are employed by 40,000 light engineering companies. In the future, the light engineering sector will utilize advanced machinery such as CNC machines and 3D printers. This highlights the potential significance of emotional intelligence within this industry.

➢ *Research Newness*

This study centers on exploring the social and psychological dimensions of readiness for the Fourth Industrial Revolution (4IR) in Bangladesh's light engineering sector. Developing these personal and social skills is vital not just for achieving success at work but also for building resilience and nurturing fulfilling, healthy lives, which aligns with Sustainable Development Goal 3: Ensure healthy lives and promote well-being for everyone, regardless of age.

➢ *Research Questions & Hypotheses*

- *Research Questions*
- *The Central Question*

✓ Does Emotional Intelligence (EQ) significantly impact the 4IR readiness of TVET students for the Light Engineering Sector in Bangladesh?

- *Sub Questions*

✓ What constitutes Emotional Intelligence (EQ)?
✓ What is the current Emotional Intelligence (EQ) level among TVET students?
✓ Are TVET students ready to face the 4IR?
✓ What are the dominant factors responsible for 4IR readiness at most?
✓ Does a short orientation of EQ change TVET student's attitude towards 4IR readiness?

- *Research Hypotheses*

✓ H0: There is no relationship between Emotional Intelligence (EQ) and the 4IR readiness
✓ H1: There is a relationship between Emotional Intelligence (EQ) and the 4IR readiness

✓ H0: There is no difference between before and after a short orientation of EQ towards 4IR readiness
✓ H1: There is a difference between before and after a short orientation of EQ towards 4IR readiness

➢ *Research Objectives*

- Exploring the essential social psychological factors that constitute Emotional Intelligence (EQ) for 4IR readiness in the light engineering sector of Bangladesh
- Investigating the impact of Emotional Intelligence (EQ) among TVET students to Face the Industrial Revolution 4.0 in Bangladesh
- Experiment on TVET students with a short orientation of Emotional Intelligence (EQ) towards 4IR readiness

➢ *Conceptual Framework*

- *Research Design*

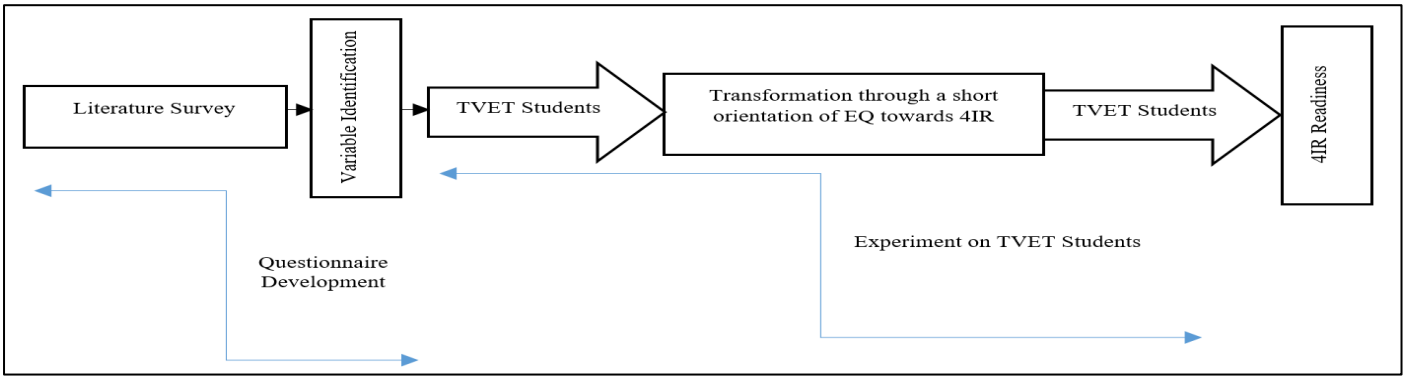

Fig 1 Conceptual Framework of the Study

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III. RESEARCH METHOD

➢ *The Research Methodology is as follows:*

The approach of the study	: Qualitative & Quantitative Approach
Design of the study	: Conceptual Framework Based
Area of the study	: Dhaka City
Population	: UCEP Bangladesh
Sample	: 28 TVET Students
Sampling technique	: Purposive (Theoretical Sample)
Data collection techniques	: Interview and Survey
Data collection tools	: Online Survey for Questionnaire
Data analysis	: SPSS (Version 25)

Objectives	Specific Methodology
Exploring the essential social psychological factors that constitute Emotional Intelligence (EQ) for 4IR readiness in the light engineering sector of Bangladesh	Literature Survey
Investigating the impact of Emotional Intelligence (EQ) among TVET students to Face the Industrial Revolution 4.0 in Bangladesh	Statistical Investigations (Correlations, Hypotheses Testing) Using SPSS
Experiment on TVET students with a short orientation of Emotional Intelligence (EQ) towards 4IR readiness	Statistical Investigations (Paired Sample Test, Factor Analysis & Clustering) Using SPSS

➢ *Significant Contribution of the Research*

This study will act as a comprehensive guideline presented as a course module for the industry.

- Bangladesh Investment Development Authority (BIDA)
- Bangladesh Industrial Technical Assistance Center (BITAC)
- Bangladesh Small and Cottage Industries Corporation (BSCIC)
- TVET Institutions
- Polytechnics

➢ *Target Groups & Industry*

- Experiment on TVET & Polytechnic students
- Light Engineering Sector

IV. DATA ANALYSIS

➢ *Data Collection*

The study collects data from two sources. Firstly, by reviewing the literature on emotional intelligence, the five constructs and relevant concepts have been identified, as described in Annexure 01. The survey questionnaires were developed based on the secondary data. To obtain the primary data from the survey method, a sample of 28 TVET students from UCEP Bangladesh was selected. The same survey questionnaire was administered before and after a brief orientation on EQ concerning 4IR readiness. The analysis of the results is presented in the following section.

V. RESULT ANALYSIS

➢ *Aim 01: Finding the level of EQ that TVET Students Possess*

Table 2 Level of EQ of TVET Students

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Self_Awareness_Before	28	1.40	5.00	3.6476	.77254
Self_Management_Before	28	1.60	5.00	3.6429	.90653
Self_Motivation_Before	28	1.00	5.00	3.8000	.93808
Empathy_Before	28	1.80	5.00	3.5286	1.04876
Social_Skills_Before	27	1.60	4.80	3.4722	.97629
Four_IR_Readiness_Before	27	1.13	5.00	3.6442	.85873
Valid N (listwise)	27				

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➢ *Result 01: The level of EQ of TVET Students are very Low.*

➢ *Aim 02: Testing the following Hypotheses*

- H0: There is no relationship between Emotional Intelligence (EQ) and the 4IR readiness
- H1: There is a relationship between Emotional Intelligence (EQ) and the 4IR readiness

Table 3 Correlations between EQ & 4IR Readiness

Correlations							
		Self_Awareness_Before	**Self_Management_Before**	**Self_Motivation_Before**	**Empathy_Before**	**Social_Skills_Before**	**Four_IR_Readiness_Before**
Self_Awareness_Before	Pearson Correlation	1	.677**	.682**	.400*	.448*	.610**
	Sig. (2-tailed)		.000	.000	.035	.019	.001
	N	28	28	28	28	27	27
Self_Management_Before	Pearson Correlation	.677**	1	.700**	.167	.404*	.452*
	Sig. (2-tailed)	.000		.000	.396	.037	.018
	N	28	28	28	28	27	27
Self_Motivation_Before	Pearson Correlation	.682**	.700**	1	.446*	.638**	.730**
	Sig. (2-tailed)	.000	.000		.017	.000	.000
	N	28	28	28	28	27	27
Empathy_Before	Pearson Correlation	.400*	.167	.446*	1	.526**	.470*
	Sig. (2-tailed)	.035	.396	.017		.005	.013
	N	28	28	28	28	27	27
Social_Skills_Before	Pearson Correlation	.448*	.404*	.638**	.526**	1	.682**
	Sig. (2-tailed)	.019	.037	.000	.005		.000
	N	27	27	27	27	27	27
Four_IR_Readiness_Before	Pearson Correlation	.610**	.452*	.730**	.470*	.682**	1
	Sig. (2-tailed)	.001	.018	.000	.013	.000	
	N	27	27	27	27	27	27
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

➢ *Result 02: The Null Hypothesis has been Rejected. EQ has Strong Correlations with 4IR Readiness*

➢ *Aim 03: Testing the following Hypotheses*

- H0: There is no difference between before and after a short orientation of EQ towards 4IR readiness
- H1: There is a difference between before and after a short orientation of EQ towards 4IR readiness

Table 4 Paired Sample Statistics

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Self_Awareness_Before	3.6476	28	.77254	.14600
	Self_Awareness_After	4.0411	28	.73775	.13942
Pair 2	Self_Management_Before	3.6429	28	.90653	.17132
	Self_Management_After	4.0714	28	.68034	.12857
Pair 3	Self_Motivation_Before	3.8000	28	.93808	.17728
	Self_Motivation_After	4.1714	28	.71949	.13597
Pair 4	Empathy_Before	3.5286	28	1.04876	.19820
	Empathy_After	3.8857	28	1.03913	.19638
Pair 5	Social_Skills_Before	3.4722	27	.97629	.18789
	Social_Skills_After	4.0519	27	.76176	.14660

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Pair 6	Four_IR_Readiness_Before	3.6442	27	.85873	.16526
	Four_IR_Readiness_After	4.2731	27	.75958	.14618

Table 5 Paired sample correlations

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	Self_Awareness_Before & Self_Awareness_After	28	.330	.087
Pair 2	Self_Management_Before & Self_Management_After	28	.449	.017
Pair 3	Self_Motivation_Before & Self_Motivation_After	28	.301	.120
Pair 4	Empathy_Before & Empathy_After	28	.686	.000
Pair 5	Social_Skills_Before & Social_Skills_After	27	.452	.018
Pair 6	Four_IR_Readiness_Before & Four_IR_Readiness_After	27	.412	.033

Table 6 Paired Sample Test

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Self_Awareness_Before - Self_Awareness_After	-.39345	.87487	.16533	-.73269	-.05421	-2.380	27	.025
Pair 2	Self_Management_Before - Self_Management_After	-.42857	.85499	.16158	-.76010	-.09704	-2.652	27	.013
Pair 3	Self_Motivation_Before - Self_Motivation_After	-.37143	.99586	.18820	-.75758	.01473	-1.974	27	.059
Pair 4	Empathy_Before - Empathy_After	-.35714	.82795	.15647	-.67819	-.03610	-2.283	27	.031
Pair 5	Social_Skills_Before - Social_Skills_After	-.57963	.92760	.17852	-.94657	-.21268	-3.247	26	.003
Pair 6	Four_IR_Readiness_Before - Four_IR_Readiness_After	-.62897	.88139	.16962	-.97763	-.28030	-3.708	26	.001

- *Result 03: The null hypothesis has been rejected. The short orientation of EQ towards 4IR readiness has significant impact*
- *Aim 04: Factor analysis before orientation*

Table 7 Total Variance Explained

Total Variance Explained						
	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.239	34.059	34.059	4.792	14.521	14.521
2	3.970	12.031	46.090	4.517	13.689	28.210
3	3.099	9.391	55.481	3.428	10.387	38.597
4	2.556	7.746	63.227	2.903	8.797	47.394
5	2.080	6.304	69.531	2.855	8.652	56.045
6	1.527	4.628	74.159	2.774	8.406	64.452
7	1.438	4.359	78.517	2.544	7.709	72.161
8	1.125	3.410	81.927	2.325	7.046	79.207
9	1.065	3.226	85.153	1.962	5.946	85.153
10	.960	2.910	88.063			
11	.715	2.168	90.230			
12	.549	1.665	91.895			
13	.546	1.654	93.548			
14	.461	1.397	94.946			
15	.335	1.016	95.962			

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16	.310	.940	96.902			
17	.236	.715	97.617			
18	.177	.538	98.155			
19	.166	.504	98.659			
20	.129	.392	99.050			
21	.103	.313	99.363			
22	.066	.199	99.562			
23	.059	.177	99.740			
24	.040	.123	99.862			
25	.029	.089	99.951			
26	.011	.033	99.985			
27	.005	.015	100.000			
28	4.979E-16	1.509E-15	100.000			
29	2.899E-16	8.785E-16	100.000			
30	1.764E-16	5.347E-16	100.000			
31	-1.146E-16	-3.473E-16	100.000			
32	-1.767E-16	-5.355E-16	100.000			
33	-4.696E-16	-1.423E-15	100.000			
Extraction Method: Principal Component Analysis.						

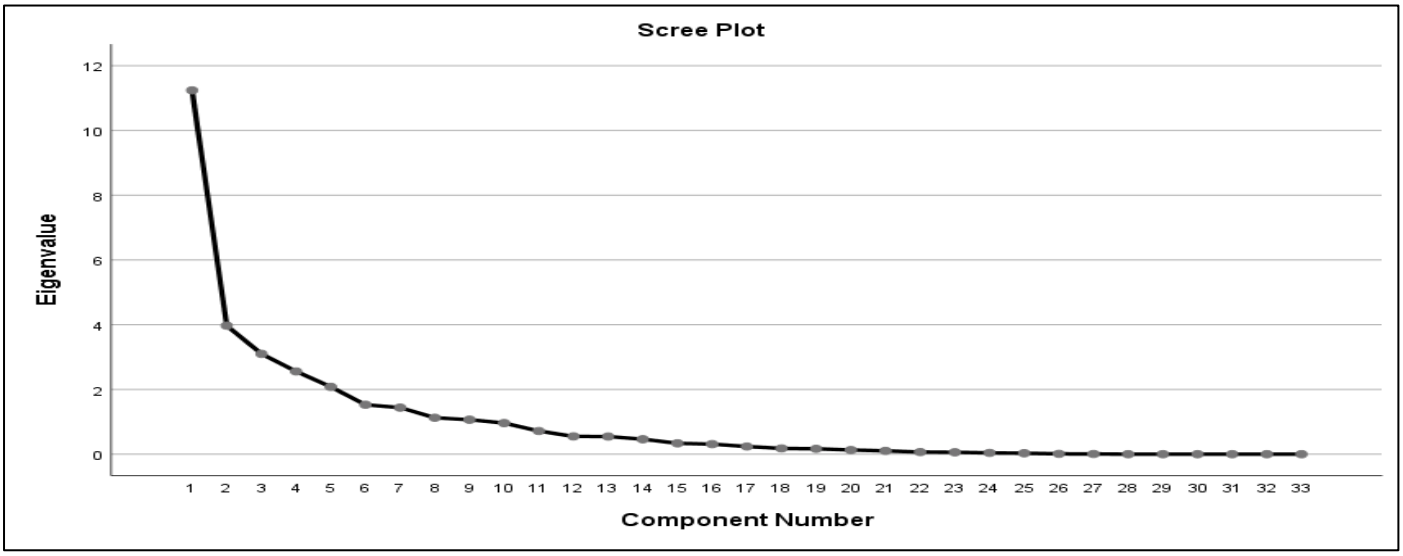

Fig 2 Scree Plot before Orientation

Table 8 Rotated Component Matrix

Rotated Component Matrix[a]									
	Component								
	1	2	3	4	5	6	7	8	9
aB	.252	-.232	-.010	.681	.249	.329	.245	.330	.107
bB	-.009	.674	.351	-.039	.138	.253	.167	.277	.259
cB	.531	.163	-.148	.075	-.281	-.040	.569	.166	.005
dB	.156	.129	.189	.062	.207	.792	.301	-.043	.003
eB	.154	.352	-.058	.011	-.101	.811	.100	.039	.095
fB	-.122	.165	.301	.013	.119	.383	.780	.011	-.027
gB	.028	.749	-.042	.170	.244	-.065	.455	-.139	.095
hB	.173	.686	-.051	.025	-.047	.322	.151	.164	-.155
iB	.217	.260	-.128	-.038	-.080	.180	.806	.022	-.186
jB	.132	.499	.256	.380	.289	.079	.241	-.146	.523
kB	.355	.765	.140	.136	.261	.204	-.038	.108	.004
lB	-.115	.301	-.250	.361	-.066	.470	.375	.161	-.138
mB	.120	.822	.141	.125	.177	.126	.160	.160	-.098
nB	.554	.219	.468	.059	-.031	.421	.041	-.187	.137
oB	.509	.513	.219	.383	.321	.119	-.071	-.021	-.098
pB	.108	.081	.790	-.054	.320	-.109	-.047	-.115	.317

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qB	.387	-.146	.605	.044	.235	.273	-.170	-.183	.271
rB	.584	.208	.274	.407	.179	.399	-.133	-.088	.000
sB	.142	-.067	.255	.066	-.192	.001	-.200	.055	.808
tB	.189	-.067	.492	.341	.094	.314	-.135	.406	.433
uB	.018	.252	.889	.123	.003	.040	.089	.131	-.021
vB	.777	.157	.362	.172	.066	-.084	.241	.176	-.145
wB	.248	.307	.186	.814	-.031	-.080	.020	.168	-.004
xB	.265	.357	.424	.297	.386	-.105	.093	.345	-.383
yB	.085	.120	.225	.402	.258	-.131	-.135	.744	.034
zB	-.005	.233	-.164	.090	.181	.086	.176	.873	.001
aaB	-.007	.218	.134	.065	.794	-.103	-.141	.312	-.112
abB	.500	.162	.201	.049	.602	.104	.158	.074	.056
acB	.215	.374	.192	.272	.689	.242	.048	.159	-.130
adB	.681	.068	-.099	.364	.018	.183	.086	.224	.303
aeB	.847	.008	.015	-.132	.276	-.032	.030	-.058	.302
afB	.879	.197	.044	.196	.023	.175	-.015	-.012	-.073
agB	.128	.296	-.074	.642	.487	.113	-.150	.170	.265
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.									
a. Rotation converged in 14 iterations.									

➢ *Result 04: 9 Dominant Factors have been Identified which are Described in below*

Component Number	Variables
Competent 1	afB- I am ready to apply technical skills to the tasks required for IR4.0. aeB- I am ready to attend training provided by the institute to thrive in IR4.0 vB- I can be comfortable with all types of people young and old, rich and poor
Competent 2	mB- I have passions for work kB - I committed to my goals gB - I manage stress easily
Competent 3	uB - I love to socialize pB - Being together with a sad person, I feel sad too
Competent 4	wB - I usually take the initiative to introduce myself to strangers
Competent 5	aaB- I am ready to adapt to changes during IR4.0.
Competent 6	eB- I am open to feedback and willing to make changes dB- I can accurately assess my abilities and performance
Competent 7	iB- I am good at decision making fB- I manage time wisely
Competent 8	zB- I know about the Industrial Revolution 4.0 (IR4.0). yB- When I am with a group of friends, I am often the spokes-person for the group
Competent 9	sB- Among worried people, I become anxious

➢ *Aim 05: Factor Analysis after Orientation*

Table 9 Total Variance Explained

Total Variance Explained						
	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.820	35.818	35.818	7.772	23.550	23.550
2	4.809	14.572	50.390	5.799	17.574	41.124
3	3.380	10.244	60.634	3.584	10.862	51.986
4	2.087	6.325	66.958	2.534	7.679	59.665
5	1.777	5.385	72.344	2.522	7.643	67.308
6	1.496	4.533	76.877	2.063	6.252	73.560
7	1.232	3.734	80.611	1.814	5.496	79.056
8	1.189	3.604	84.215	1.703	5.159	84.215

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9	.918	2.782	86.997			
10	.788	2.387	89.384			
11	.623	1.887	91.271			
12	.488	1.480	92.751			
13	.456	1.380	94.131			
14	.391	1.183	95.315			
15	.340	1.030	96.345			
16	.320	.969	97.314			
17	.240	.726	98.040			
18	.191	.578	98.618			
19	.129	.391	99.010			
20	.099	.301	99.310			
21	.087	.263	99.574			
22	.055	.168	99.741			
23	.029	.089	99.830			
24	.024	.074	99.904			
25	.019	.058	99.962			
26	.008	.023	99.985			
27	.005	.015	100.000			
28	1.277E-15	3.868E-15	100.000			
29	5.190E-16	1.573E-15	100.000			
30	3.044E-16	9.223E-16	100.000			
31	-9.660E-17	-2.927E-16	100.000			
32	-2.501E-16	-7.578E-16	100.000			
33	-5.419E-16	-1.642E-15	100.000			
Extraction Method: Principal Component Analysis.						

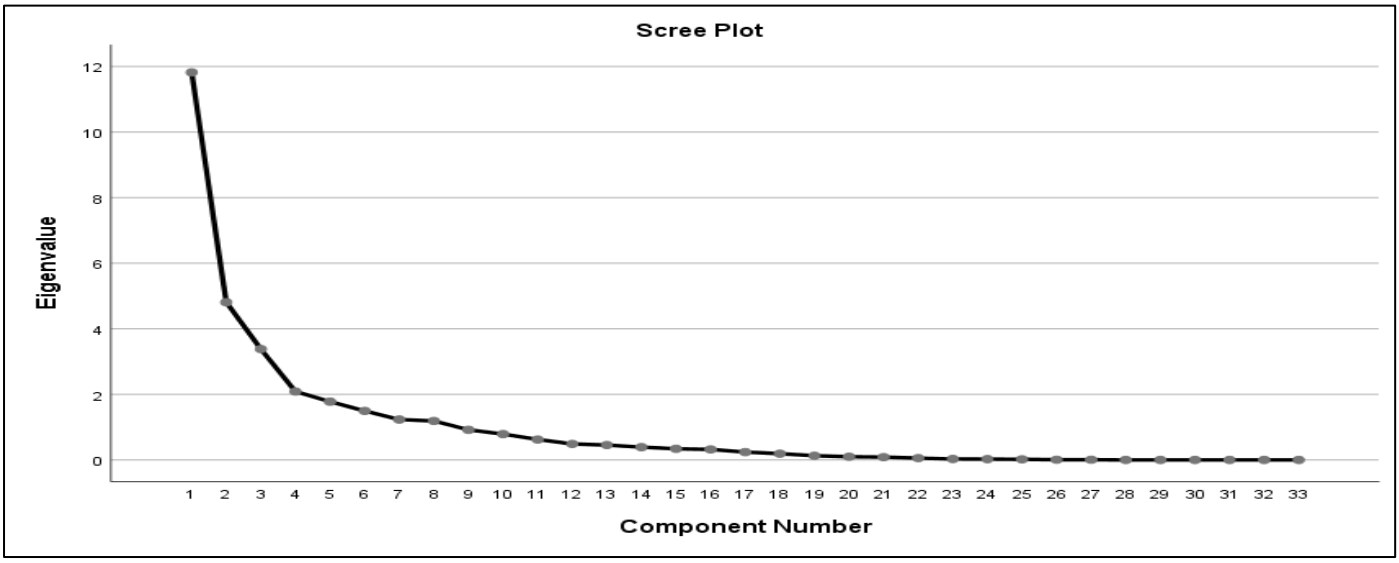

Fig 3 Scree Plot after Orientation

Table 10 Rotated Component Matrix

Rotated Component Matrix[a]								
	Component							
	1	2	3	4	5	6	7	8
ahA	.458	.721	.048	.013	-.048	.054	-.196	-.039
aiA	-.032	.445	.694	.171	.002	-.178	-.232	.335
ajA	.327	.725	-.005	.166	-.186	-.257	-.178	-.008
akA	-.101	.480	.127	-.021	.621	.206	-.265	-.019
alA	.798	.390	.095	-.050	.119	.003	-.136	.006
amA	-.062	.525	.054	.339	.598	.238	-.023	.176
anA	.593	.050	.133	.571	.201	.053	.122	.286
aoA	.093	.040	.206	.877	.181	.035	.046	.228

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apA	.476	.152	-.294	.558	.225	.140	.092	-.201
aqA	.128	-.138	.438	.318	.703	-.209	-.022	-.070
arA	.667	.091	.086	.503	-.181	.240	.067	.185
asA	.158	.220	.108	.253	.113	.121	-.015	.753
atA	.715	.225	-.116	.477	.080	.223	-.010	.065
auA	.498	.767	-.001	-.008	.239	.037	.146	-.003
avA	.088	.117	.768	.078	.189	.182	.369	-.071
awA	-.177	.647	.598	.014	.074	.164	.211	-.004
axA	.330	.785	.067	.041	-.064	.238	.251	-.080
ayA	-.107	.724	.521	.100	.161	.007	.088	.020
azA	.069	.768	-.153	.034	.186	.155	.111	.418
baA	.196	.666	.062	.118	.079	-.015	.607	.126
bbA	.067	.590	.229	-.063	.074	.510	-.097	.186
bcA	.524	.296	.193	.294	-.125	.519	.145	-.327
bdA	.126	.109	.283	.175	.168	.846	.159	.108
beA	.163	.016	.843	.050	.178	.253	-.036	-.024
bfA	.446	.031	.066	.070	-.160	.166	.727	-.032
bgA	.727	-.134	-.055	.161	-.064	-.123	.244	.475
bhA	.566	-.013	.299	-.081	.592	.318	-.143	.189
biA	.846	.143	.131	.089	.065	.096	.078	.006
bjA	.495	-.104	.588	-.108	.201	.225	-.196	.245
bkA	.851	.113	.136	.102	-.035	.066	.062	.003
blA	.325	.044	.251	.270	.603	.074	.337	.300
bmA	.905	.127	-.135	.016	.098	.045	.221	.067
bnA	.889	.149	.099	.089	.094	-.083	.198	-.010
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.								
a. Rotation converged in 16 iterations.								

➢ *Result 05: 8 Dominant Factors have been Identified which are Described in below*

Component Number	Variables
Competent 1	bmA - I am ready to apply technical skills to the tasks required for IR4.0 bnA - I am ready to apply soft skills in the tasks required for IR4.0. bkA - I am ready to change my working style for IR4.0 biA - I am ready to learn new knowledge provide by the institution regarding IR4.0 alA - I am open to feedback and willing to make changes bgA - I know about the Industrial Revolution 4.0 (IR4.0). atA - I have passions for work
Competent 2	axA - Somebody else's happiness makes me feel happy too azA - Among worried people, I become anxious auA - I am positive ajA - I understand how others perceive me ayA - I understand people's feelings from their behavior ahA - I understand my emotions and how they influence my behavior
Competent 3	beA - I can easily adjust to being in just about any social situation avA - I like changes and newness aiA - I am aware of my strengths and weaknesses
Competent 4	aoA - I am adaptable
Competent 5	aqA - I am dedicated to personal development
Competent 6	bdA - I usually take the initiative to introduce myself to strangers
Competent 7	bfA - When I am with a group of friends, I am often the spokes-person for the group
Competent 8	asA - I am an initiator

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➢ *Aim 06: Cluster analysis before Orientation*

Table 11 Case Processing Summary

Case Processing Summary[a,b]					
Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
27	29.3	65	70.7	92	100.0
a. Squared Euclidean Distance used					
b. Average Linkage (Between Groups)					

Table 12 Agglomeration Schedule

Agglomeration Schedule						
Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	17	21	.650	0	0	7
2	12	24	.711	0	0	8
3	3	9	.918	0	0	14
4	1	28	.982	0	0	12
5	2	19	1.096	0	0	8
6	5	14	1.102	0	0	15
7	8	17	1.222	0	1	16
8	2	12	1.344	5	2	16
9	7	26	1.442	0	0	14
10	16	22	1.616	0	0	18
11	4	10	1.643	0	0	13
12	1	15	1.866	4	0	13
13	1	4	2.239	12	11	17
14	3	7	2.285	3	9	18
15	5	27	2.286	6	0	22
16	2	8	2.429	8	7	17
17	1	2	3.678	13	16	19
18	3	16	4.102	14	10	20
19	1	13	4.872	17	0	21
20	3	11	5.318	18	0	25
21	1	25	6.323	19	0	22
22	1	5	6.906	21	15	24
23	20	23	7.259	0	0	26
24	1	18	8.532	22	0	25
25	1	3	11.264	24	20	26
26	1	20	25.139	25	23	0

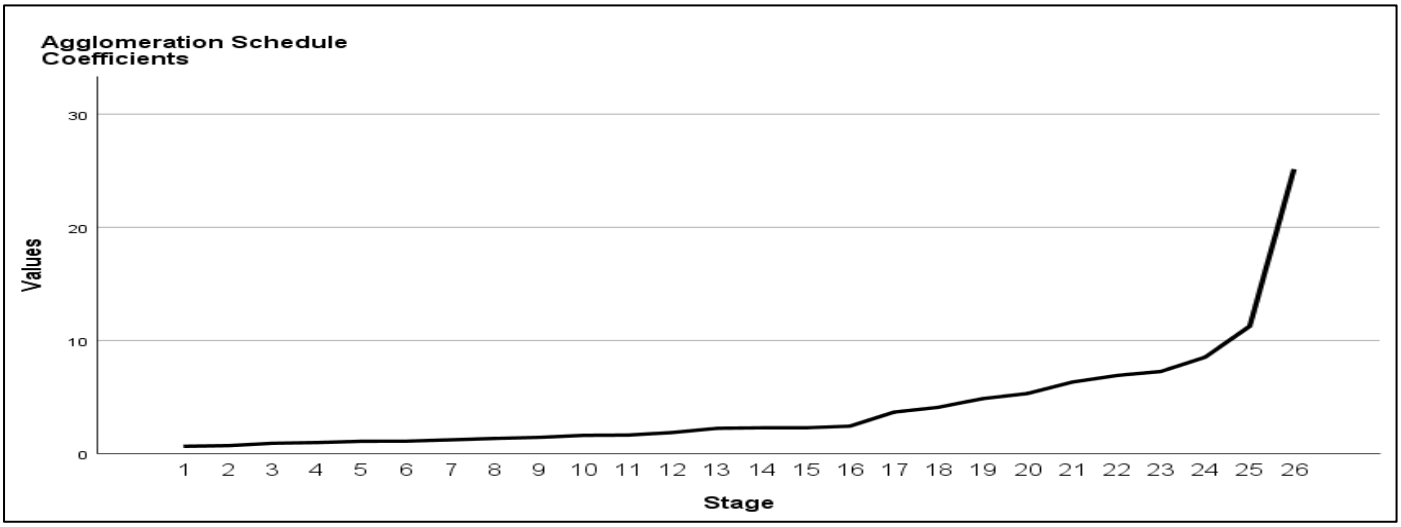

Fig 4 Agglomeration Schedule Coefficients

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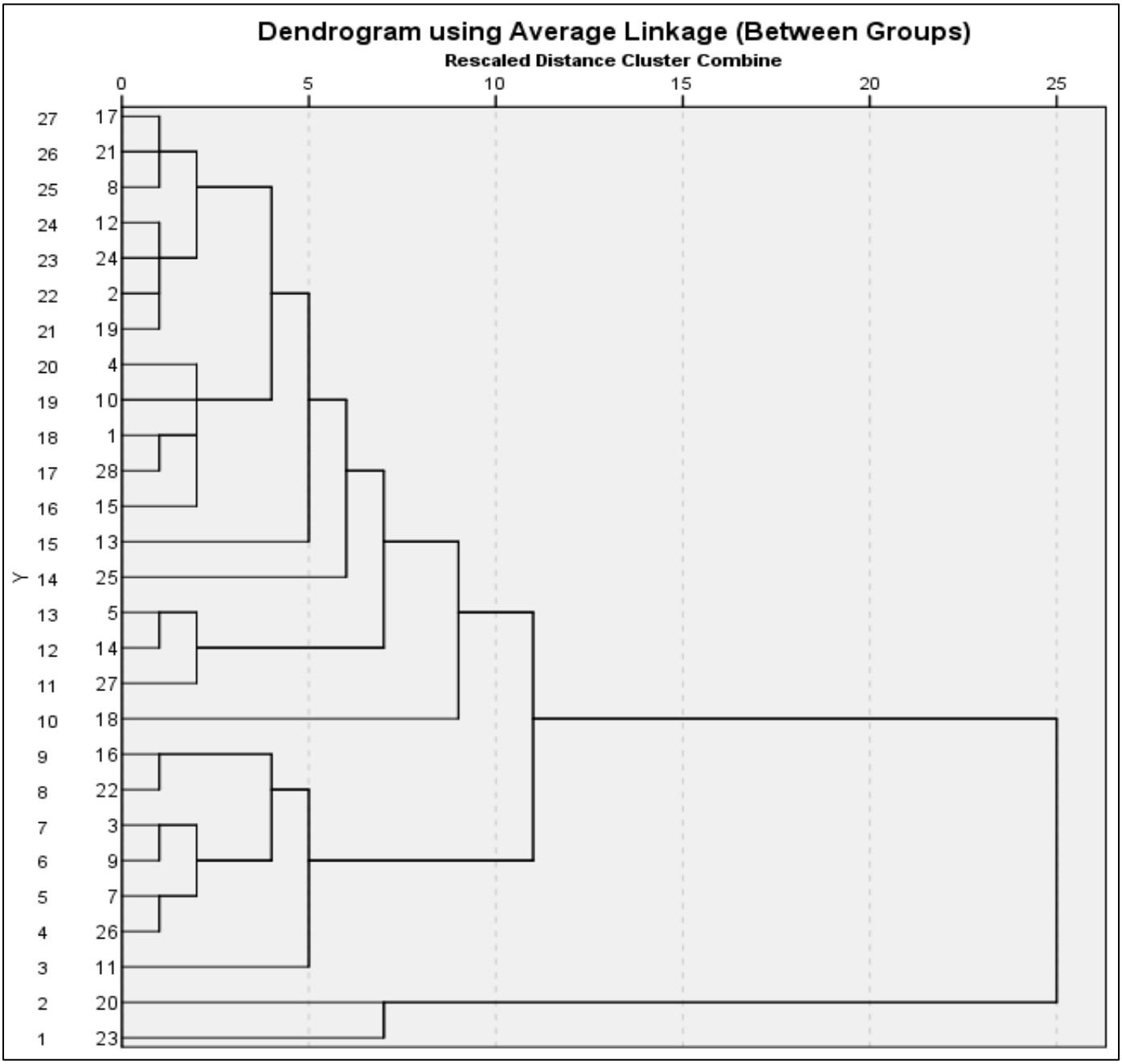

Fig 5 Dendrogram before orientation

- *Result 06: No. of cluster has been identified as 11*

No. of cluster = No. of classes – No. of stage (Step of Elbow) = 27 -16 = 11

- *Aim 07: Cluster analysis after orientation*

Table 13 Case Processing Summary

Case Processing Summary[a,b]					
Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
28	30.4	64	69.6	92	100.0
a. Squared Euclidean Distance used					
b. Average Linkage (Between Groups)					

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Table 14 Agglomeration Schedule

Agglomeration Schedule						
	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
1	14	24	.120	0	0	2
2	2	14	.300	0	1	11
3	19	25	.421	0	0	6
4	4	5	.440	0	0	9
5	6	17	.530	0	0	11
6	19	21	.610	3	0	10
7	10	23	.703	0	0	19
8	13	28	.791	0	0	10
9	1	4	.796	0	4	12
10	13	19	.897	8	6	13
11	2	6	.996	2	5	14
12	1	12	1.223	9	0	15
13	7	13	1.241	0	10	14
14	2	7	1.452	11	13	20
15	1	16	1.587	12	0	20
16	3	9	1.631	0	0	22
17	20	22	1.991	0	0	21
18	8	15	2.256	0	0	21
19	10	11	2.281	7	0	24
20	1	2	2.409	15	14	23
21	8	20	3.342	18	17	25
22	3	26	4.218	16	0	26
23	1	27	4.223	20	0	24
24	1	10	5.170	23	19	25
25	1	8	5.676	24	21	27
26	3	18	15.555	22	0	27
27	1	3	18.134	25	26	0

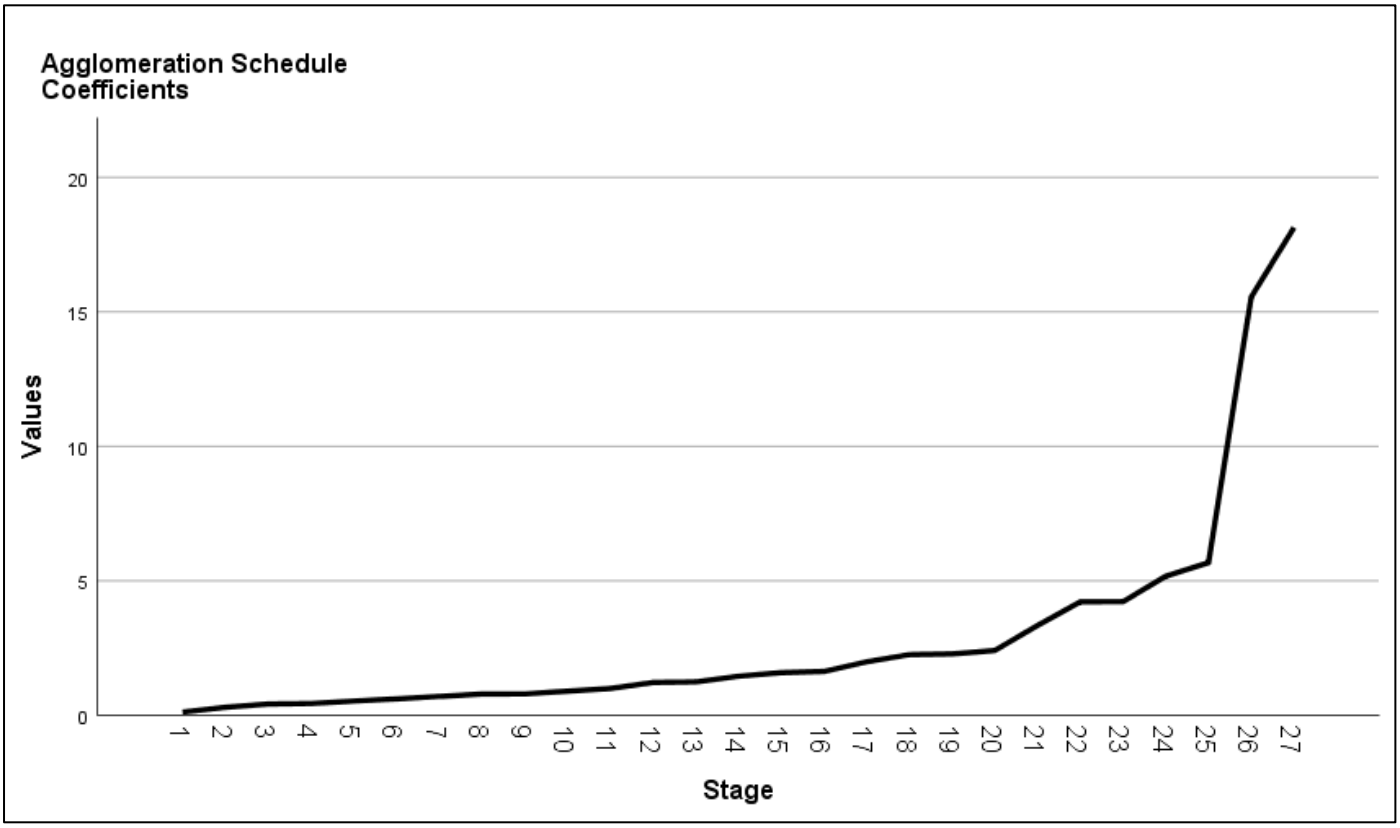

Fig 6 Agglomeration Schedule Coefficients

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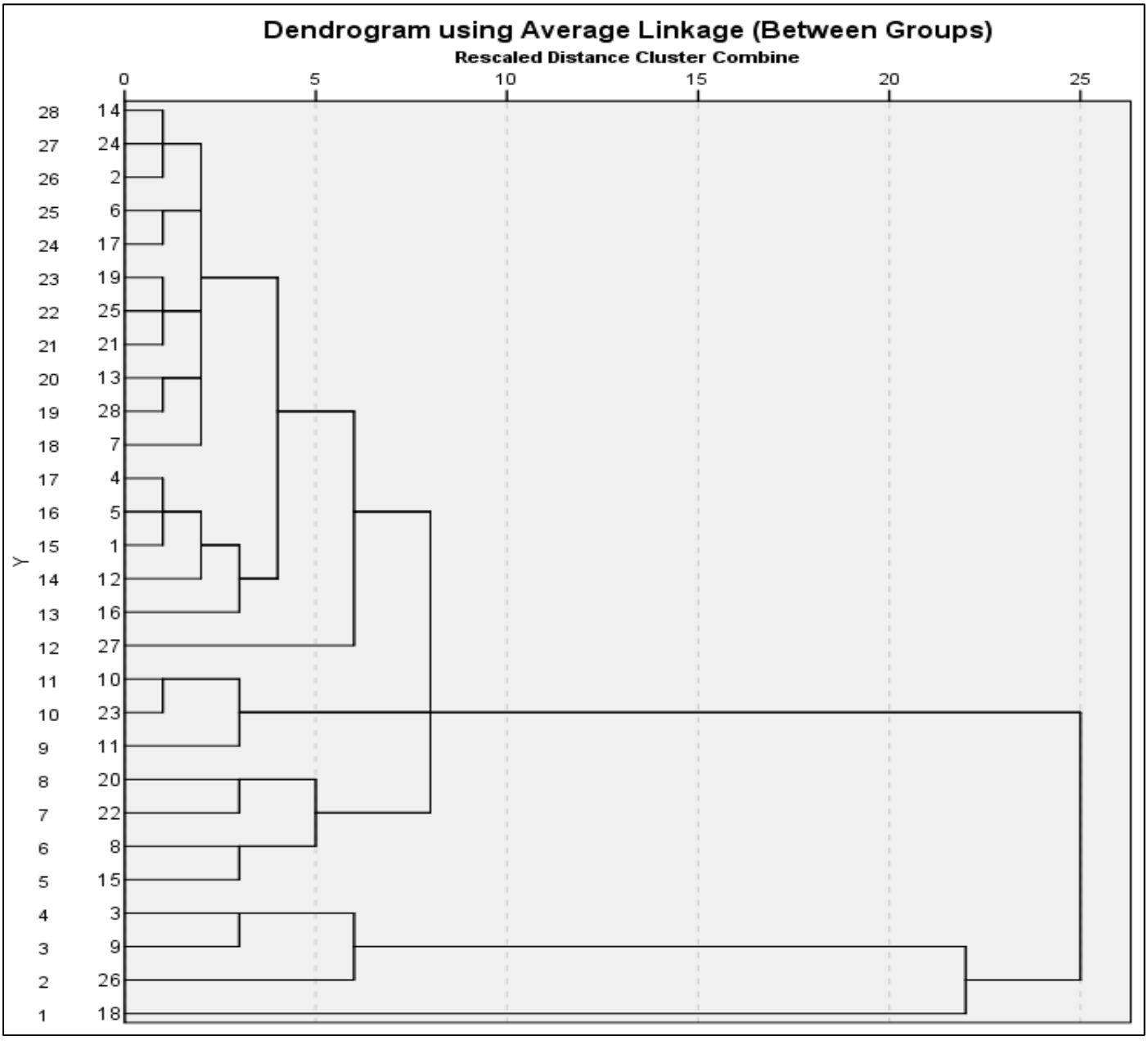

Fig 7 Dendrogram after Orientation

- *Result 06: No. of Cluster has been Identified as 8*

No. of cluster = No. of classes – No. of stage (Step of Elbow) = 28 -20 = 8

VI. DISCUSSION

Research Questions	Answers Based on Study Findings
Does Emotional Intelligence (EQ) significantly impact the 4IR readiness of TVET students for the Light Engineering Sector in Bangladesh?	Yes, it has a significant impact.
What constitutes Emotional Intelligence (EQ)?	Self-awareness, self-management, self-motivation, empathy, and social skills make up EQ. These are the key components, and the variables under these components are described in Annexure 01.
What is the current Emotional Intelligence (EQ) level among TVET students?	The present level of Emotional Intelligence (EQ) is quite low.
Are TVET students ready to face the 4IR?	No, they are not prepared from the social and psychological perspective.

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What are the dominant factors responsible for 4IR readiness at most?	Eight dominant factors have been identified and are shown in Result 5.
Does a short orientation of EQ change TVET student's attitude towards 4IR readiness?	Yes, according to the paired test results, the short orientation on EQ changed TVET students' attitudes toward 4IR readiness. The number of clusters also decreased after the orientation. At the same time, the number of dominant factors is decreasing after the orientation.

VII. IMPLICATIONS OF THE FINDINGS

The study can capture the interest of policymakers from both industry and educational institutions. Based on the findings, the TVET curriculum can be revised. Social and psychological skills training can be offered to TVET students. The training duration could be extended to better prepare students for the Fourth Industrial Revolution. By the time they graduate, TVET students can build a foundation in emotional intelligence.

VIII. LIMITATIONS OF THE STUDY

➢ *The Study has the Following Limitations:*

- Focuses solely on TVET diploma engineering students
- Sample size consists of 28
- Conducted within Dhaka city
- Survey questionnaires are based on existing literature
- In-depth expert interviews were not conducted
- Due to time constraints, a brief orientation on EQ was provided

IX. RECOMMENDATIONS

➢ *The Recommendations are as Follows*

- Provide training on emotional intelligence (EQ) to TVET students at graduation time.
- Offer EQ training to technicians in the light engineering sector.

X. CONCLUSION

The readiness of TVET graduates for the Fourth Industrial Revolution (4IR) is largely governed by Emotional Intelligence (EQ). The effective use of advanced technology in the light engineering sector depends on the engineers' EQ. TVET students are the future leaders of this sector, making it crucial to equip them with the right skill sets. While TVET graduates excel in technical skills, they have limited opportunities to train with 4IR technology-enabled machines. Emotional Intelligence (EQ) does not require modern machinery, but rather a trainer with a structured module, along with sufficient time for course duration. If we instill EQ in TVET students before they enter the job market, it will be highly beneficial because technical skills can be taught anytime and anywhere, whereas EQ requires a consistent process of development over time.

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ANNEXURE 01: MEASURES OF EMOTIONAL INTELLIGENCE

➢ *Self Awareness*

- I understand my emotions and how they influence my behavior
- I am aware of my strengths and weaknesses
- I understand how others perceive me
- I can accurately assess my abilities and performance
- I am open to feedback and willing to make changes

➢ *Self Management*

- I manage time wisely
- I manage stress easily
- I am adaptable
- I am good at decision making
- I am dedicated to personal development

➢ *Self_Motivation*

- I committed to my goals
- I am an initiator
- I have passions for work
- I am positive
- I like changes and newness

➢ *Empathy*

- Being together with a sad person, I feel sad too
- Somebody else's happiness makes me feel happy too
- I understand people's feelings from their behavior
- Among worried people, I become anxious
- Seeing a person is made surprised, I feel excited too

➢ *Social Skills*

- I love to socialize
- I can be comfortable with all types of people young and old, rich and poor
- I usually take the initiative to introduce myself to strangers
- I can easily adjust to being in just about any social situation
- When I am with a group of friends, I am often the spokes-person for the group

➢ *4IR_Readiness*

- I know about the Industrial Revolution 4.0 (IR4.0).
- I am ready to adapt to changes during IR4.0.
- I am ready to learn new knowledge provide by the institution regarding IR4.0.
- I am ready to do my tasks in an innovative way to face IR4.0.
- I am ready to change my working style for IR4.0.
- I am ready to attend training provided by the institute to thrive in IR4.0.
- I am ready to apply technical skills to the tasks required for IR4.0.
- I am ready to apply soft skills in the tasks required for IR4.0.