MASTER OF SCIENCE IN TECHNICAL EDUCATION
(MECHANICAL ENGINEERING SPECIALIZATION**)**

DEVELOPING A PEDAGOGICAL MODEL FOR BRIDGING THE SKILLS GAP BETWEEN TVET INSTITUTIONS AND INDUSTRIES IN BANGLADESH

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Thesis submitted in partial fulfillment of the requirements for the degree of **Master of Science in Technical Education** with specialization in **Mechanical Engineering**

DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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DHAKA, BANGLADESH

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RECOMMENDATION OF THE BOARD OF EXAMINERS

The Thesis title is **"Developing a pedagogical model for bridging the skills gap between TVET institutions and industries in Bangladesh"** Submitted by **Muhammad Shams-Uz-Zaman, Master of Science in Technical Education** with specialization in **Mechanical Engineering, Student ID: 191031105** of the Academic Year 2021-2022 has been found Satisfactory and Accepted as partial fulfillment of the requirement of the degree of **Master of Science in Technical Education (M.Sc. TE)** in May 2022.

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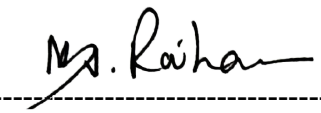

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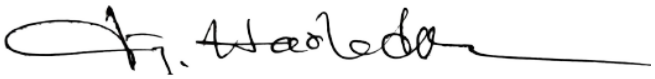

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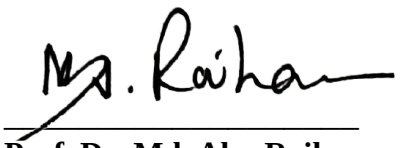
DECLARATION

This project work is authentic, and it is an outcome of the investigation carried out by **Muhammad Shams-Uz-Zaman** under the supervision of **Prof. Dr. Md. Abu Raihan,** in the Department of Technical and Vocational Education (TVE), Islamic University of Technology (IUT), Organization of Islamic Cooperation (OIC), Gazipur, Bangladesh. It is hereby declared that this thesis or any part of it has never been submitted elsewhere for the award of any Degree or Diploma. All literatures and contributions cited are fully acknowledged.



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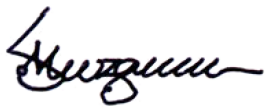

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DEDICATED

This thesis is dedicated to my family for all their continued love and support. First and foremost to my beloved Mother ,spouse and child, **Mrs. Nurun Naher Begum Sheuly , Dr. Mahmuda Khanam Tania, and Affan Abraur** for all of their support and encouragement. You peoples have successfully made me the person I am becoming.

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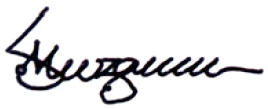

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ABSTRACT

The employability of TVET (polytechnic) graduates is a big challenge because of the skills (soft skills and hard skills) gap. In order for TVET graduates to be successful in today's digital world, they must receive adequate soft skills and hard skills from TVET institutions. In this regard, industry experts are the primary agents and bridging the industry institutions collaborate through which TVET graduates' skills can be instilled with the willingness to embrace, adapt, and utilize such technologies in the pursuit of their professional goals and the unemployment problem. Industry-institute bridging focused on the ultimate development of TVET graduates in their career. Whereas TVET institutions facilitated the institution's environment to develop the soft skills and hard skills for TVET students and industry will be achieved skillful TVET graduates so that their products will be increased and they used the institutions for their research center for new product development. TVET institutions must collaborate with the industry towards bridging the skill gap. This paper examine the areas of skills gap and bridging the skills gap of industries and TVET institutions for enhanced employability. In this regards it is considering 210 nos of industries and institute experts from Bangladeshi TVET polytechnic institutes and industries. The researcher examined the three objectives for developing the skills of TVET graduates, First objectives found the areas of soft skills and hard skills gap of TVET graduates, Second objective was found a model of curriculum development to cope up the skills requirements of industries in Bangladesh and third objective found a teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh. Based on the findings of the study, it was recommended that industries, government and institutions should establish a partnership which execute from institutions known as a bridging hub that will help to enhance the skills and chances of employment of TVET graduates in Bangladesh.

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CHAPTER 1 - INTRODUCTION

1.1 Introduction

The skills gap of TVET graduates is a big challenge for enhancing employability. The skills basically declared soft skills and hard skills. One thing is certain though as TVET students need to develop hard skills in addition to soft skills then that will navigate easily tomorrow's job market. Lack of the bridging strategy and modality of TVET institutions and industries create an unemployment rate of TVET graduates. Employability depends on the knowledge, skills, and attitudes, it is the capacity to present the skills and abilities to the employers. Employability Skills can be defined as the transferable skills needed by an individual to make them employable. Only skills development to enhance the Employability and the skills are Analytical thinking and innovation, Complex problem-solving, Critical thinking and analysis, Active learning and learning strategies, Creativity, originality & initiative, Attention to detail, trustworthiness, Emotional intelligence, Reasoning, problem-solving & ideation, Leadership & social influence, and Coordination & time management. Employability skills are the essential skills, personal qualities, and values that enable you to flourish in any workplace.

The employability of TVET graduates is a big challenge because of the skills gap and a skills gap is a gap between the skills a TVET graduate has and the skills TVET graduates actually need to perform a job well. Skills empower the TVET graduate to enter the job market but there is a difference between the skills and the employer's requirements of Skills (Soft & Hard Skills). Only the proper teaching & learning as per industries demand can create a bridge of skills gap to employability. So the teaching & learning methodology means Pedagogical approaches for theatrical and practical sessions concerned with what the teacher does to influence learning & teaching for students. Pedagogy is a method, and practice, of teaching on Teaching styles, Teaching theory, and Feedback and assessment. Whereas the development of skills ensured for TVET graduates and industries will get the skills employer.

Technical and Vocational Education & Training is a present controversy to reduced unemployment of youth in Bangladesh for ensuring economic growth of Bangladesh. TVET involves both the

formal and informal or non-formal education system. It could be described as an organized program of instruction offered in the school system and out of school to inculcate in the learners' knowledge, skills, attitude, and appreciation of the worth and dignity of labor both in the public and organized private sector. The reality is that need assessment by interested groups continue to reveal skill gap among graduates in correlation with the industry demands. Bridging between TVET institutions and industries would lead to the provision of relevant skills for industrialization. This study aimed at establishing the extent of Bridging between TVET Institution and industry to meet the present demand of required skills of the industry to enhance employability. TVET refers to a deliberate intervention to bring about learning which would make people more relevant and productive in designated areas of economic and technological activities. In order to meet the demand of the 21st century workplace for skilled manpower and also to produce individuals that will be equipped with marketable skills for employment and independent. New technological engagement required in preparing graduates to fit in today's digital world. In this regard, industries are the origin of new technologies for a developing country like Bangladesh. The research should be an updated investigation about the present industrial skills requirement before considering the TVET system as a key for skill development.

The study make a bridge between TVET Institutions and Industries for meet the demand of industrial or professional skills which integration with labor market and those skills development provided by TVET Institutions.

1.2 Statement of the Problem

Each and every year a huge quantity of diploma engineers completed their courses and try to enter the job market. But lack of soft skills and psychomotor skills they did not get any job, especially in their relevant field. And the causes of this skills gap created by lack of communication of industry-institute, updated curriculum, and need based teaching-learning and training. These demand driven skills (soft and hard) are called employability skills which empower the TVET graduate in job market. These employability skills assist peoples to adjust themselves towards different changes and to increase working abilities based on working environmental needs. Employability skills focuses on the need for individuals to obtain identifications, knowledge and

skills status. The concept of employability skills is demand-driven independent and dependent on related elements. Employability skills does not simply depend on whether one is able to accomplish the necessities of exact jobs, but also on how one stands comparative to others within a pyramid of job hunters. TVET Institutions have to be by its mandate and composition is sited to support skills development and give rise to employability and productivity (Dr. Edet, 2019).

Bridging the skills gap is a crucial concern for enhance employability of TVET graduate. The issue has been raised by different stakeholders regarding outdated curricula, backdated technology, poor management, low quality instructors, and low job placement in TVET institutions. Industry-institution cooperation platform can connection the technological gap. Both the Skills (soft and hard) are vital for insufficiency reduction, economic recovery and sustainable development. So it is definitely believable Skill is the ability to accomplish expertly, facility in performance, dexterity and tact. Hands-on training and soft skills development is required for every TVET students if they are really anticipated to graduate with competent skills (hard and soft) for employability. Employability skills are basic skills needed for individual to get a job and to take-out responsibilities well. Employability skills are set of vital skills taught in everyone in order to produce dynamic workforce. Employability skill is fundamental in all occupation (Dr. Edet, 2019).

The appropriate knowledge and skill require to handling the recent technologies all around the world. Present industries are furnished with refined technologies those are mostly most of the time unaware by the TVET students in Bangladesh. To set up the Industry-institution relationship criteria is important for the nation. This study emphasis the controversy are: to forecast on industry skill (soft & hard) shortages and the supply of and demand for human resources; to develop curriculum model for updating curriculum and course materials; to design a teaching-learning strategic framework for minimizing the skills gap; to inspection & monitor the delivery of TVET for quality assurance; to make arrangements for how skill assessments to establish a skill assessment body from the industry; and to distribute TVET information to industries sectors.

1.3 General Objective of the study

The general objective of this study is to identifying the skills gap of the TVET graduate in light of skills required in industries in Bangladesh to enhance employability.

1.4 Specific Objectives of the study

The Specific objective are:

- To find out the areas of Skills gap of the Polytechnic graduate in the field of Mechanical Engineering considering industry demand
- To recommend a model of curriculum development to cope up the skills requirements of industries in Bangladesh
- To design a teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh

1.5 Research Question

1. What are the areas of skills gap of the Polytechnic graduate in the field of Mechanical Engineering considering industry demand?
2. How recommend a model of curriculum development cope up the skills requirements of industries in Bangladesh?
3. How teaching-learning strategic framework minimizing the skills gap with TVET institute and Industries in Bangladesh?

1.6 Significance of the Study

The study will represent the TVET graduate's skills (soft and hard) gap in the different areas based on industries' demand and bridging those areas of skills gap recommend a model of curriculum development with designing a teaching-learning strategic framework for minimizing the employability skills as well as some solution for industry-institute collaboration. Researcher thought this study is very important for polytechnic students to developed their soft skills and hard skills development to enhance employability. The study attentive on the present demand of soft skills and hard skills for mechanical graduates of polytechnic institute. And the demand ultimately required by the employer. Because technology regularly changed whereas curriculum is not up-to-date. But if there is available a recommended model of curriculum development then this model cope up the skills requirements of industries. Besides it is needed to designing a teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in

Bangladesh. This study will open the path for future researchers to designing a bridging model of TVET institutions and industries.

1.7 Limitation

Bridging the skills gap of TVET institutions and industries ensured the quality education and training because of the labor market based teaching-learning education and training. The industries skills demand effect on the institutions pedagogic model, strategic teaching-learning framework, curriculum model development, technological development. As a result the TVET graduate attain a skills (soft skills and hard skills) manpower for the present and future labor market.

The researcher has some limitation for finding the result. The research limitations are: The researcher considered only govt. polytechnic institution and 20 nos of Govt. Polytechnic institute though there is a privet polytechnic institute and more Govt. polytechnic institute. The researcher only considered Mechanical Engineering department though there is a huge number of others department. The researcher concise the sample size because of the limitation and the opinions of the sample may not adequately represent the opinions of the entire populations. The researcher also have the limitation of investigation tools.

1.8 Definition of the Terms

TVET: TVET means Technical and Vocational Education and Training. Technical and vocational education and training (TVET) states to all features of the learning process that contain, in accumulation to common learning, the study of technologies and related sciences, as well as the achievement of hands-on skills, attitudes, understanding, and knowledge related to livelihoods in several sectors of the economy and humanity.

Employability Skills: Employability Skills are the 'transferable skills' that an individual requires in order to be 'employable.' Employers typically specify a set of abilities that they expect from an employee in addition to outstanding technical expertise and topic knowledge. Those are the skills they believe will best prepare the employee to accomplish their job to their full potential.

Soft Skills: Soft skills refer to abilities that have to do with how you work and connect with others. Communication, teamwork, and other interpersonal abilities are all popular soft talents. Soft skills

are difficult to teach and are critical for long-term success, therefore employers search for them in candidates.

Hard Skills: Hard skills are specific qualities or capabilities that a person can have and exhibit in a controlled manner. A hard talent denotes an individual's competence and expertise in doing a single activity or series of tasks to fulfill a job.

Pedagogy: The process and practice of teaching, notably as an academic discipline or theoretical conception, is referred to as pedagogy. Simply said, pedagogy is the approach and practice of teaching. It includes:

- Teaching styles
- Teaching theory
- Evaluation and feedback

When individuals talk about teaching pedagogy, they're talking to how teachers convey curricular content to their students.

When an instructor is forecasting a lesson, they will consider about numerous ways to transfer the topic. This selection will be based on their personal teaching preferences, prior teaching experience, and the situation in which they teach.

Curriculum Model: Curriculum development model discusses to the technique of exhausting a set of ideas to achieve both quantity and quality education through a succession of guided learning capabilities. When designing subject and teaching guides, a curricular model is utilized as a guideline. Learn the fundamentals of what makes up a curriculum model, as well as the widely used product and process models.

CHAPTER 2 - REVIEW OF LITERATURE

2.1 Introduction

Bridging the Skills Gap between TVET Institutions and Industries in Bangladesh to Enhance Employability which basically possible to focus on developing a pedagogic model to considering industries need. The skills development pedagogic model depending on a model of curriculum development, development of a teaching learning strategic framework of institutions, uses strategies of modernized technologies with the bridging between TVET Institutions and industries. As per researcher analysis of difference research paper, article, report and best of my experience the researcher has developed a conceptual TIAIB Model for Bridging the Skills Gap for enhance the employability. In this conceptual TIAIB model the researcher has integrated 3 nos of input those are: (i) Role of institutions (ii) Role of Industries & (iii) Bridging strategy of skills development & employment. And the output of conceptual TIAIB model meet the Soft skills and Hard Skills development for enhancing employability**.** The results of the conceptual TIAIB (TVET Institutions and Industries Bridging) Model will be used to;

- Design a model of curriculum development, and
- Design a teaching-learning strategic framework.

The role of Institutions emphasize the role, strategy, & policy of institution for Individual Strategy, Student Enrolment, Curriculum Development, Teaching, Learning and demonstrating Methodology, Laboratories & workshop development, Pedagogic development, Academic Based Employability Committee , Research and Innovation. In role of industries emphasize on Individual Strategy, TVET graduate Recruitments Policy, Knowledge & skills shearing strategies, Workplace Based Academic Development Committee, Research and Innovation.

This two input work together and developed another bridging input considering strategy of skills development & employment. In this bridging strategy makes a Common Strategy with curriculum Development Model, Teaching-Learning Strategic framework, Workshop or laboratories development strategies, Instructor's development strategy, Assessment process of students, Research and Innovation (Involvement of Industries Expert , TVET Institute & Specialist). The

TVET institute finding & bridging the gap using common strategy of bridging strategy and in same way the industries finding & bridging the gap using common strategy of bridging strategy.

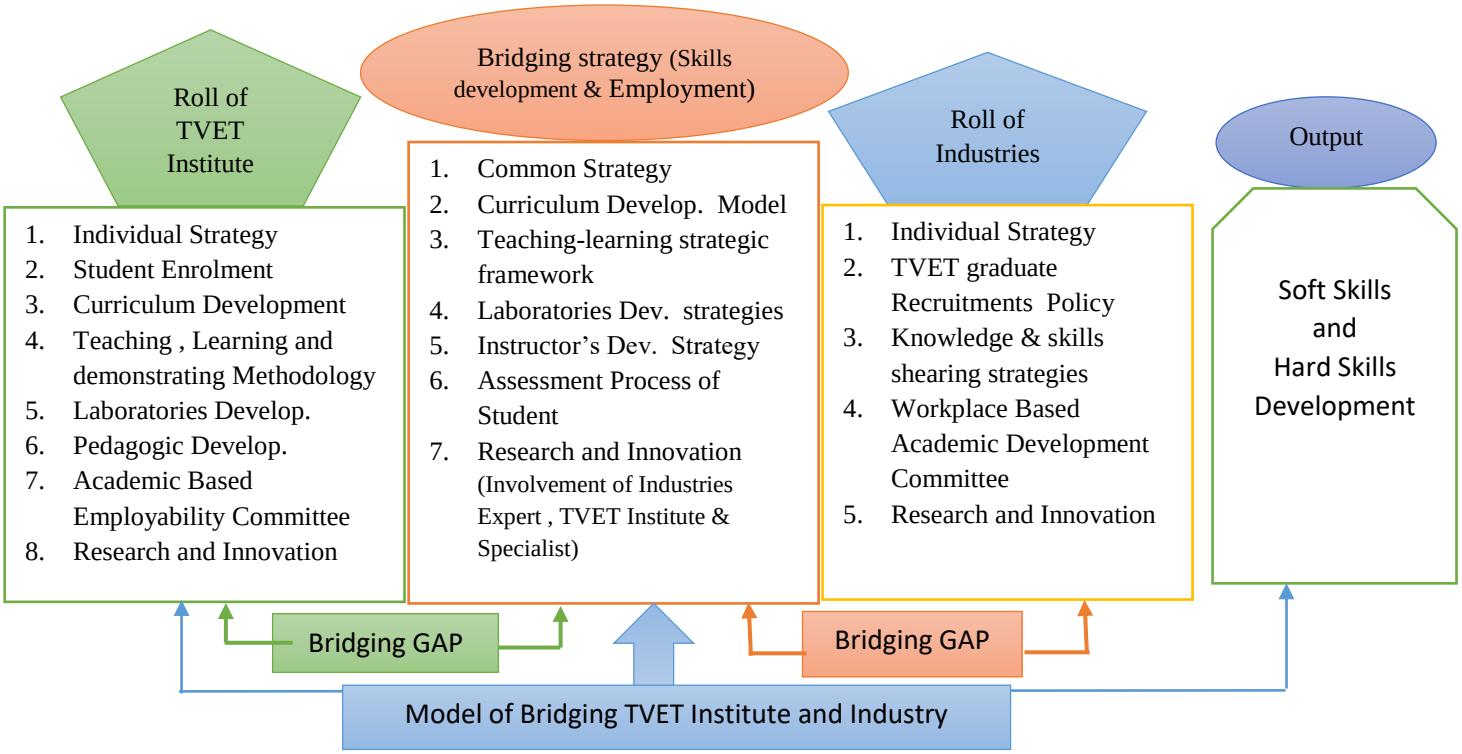


Figure 1: Conceptual TIAIB model

Then the Skills Gap between TVET Institutions and Industries recommended the skills gap of students which ensured by the collaboration of TVET institutions and industries. The list of soft skills and hard skills of Mechanical Engineering programme outcomes in polytechnic institutions are to be considered for finding the skills gap for enhance employability. The skills are: soft skills (Communication Skills, Critical Thinking Skills, Creativity & Innovation Skills, Problem-Solving Attitude Skills, Time management & Coordination Skills, Decision-making Skills, Teamwork Skills, Interpersonal Skills, Adaptability Skills, Self-Motivation Skills, Work Ethic Skills, etc) and hard skills (Machine Operation and Maintenance Skills, CNC Machine Programming and Operation skills, Mechanical Maintenance skills, Drawing & Designing [Auto CAD , Solid Works, CAM] skills, Welding and Testing skills, Mechanical Cost Estimation and Manufacturing skills, Production Planning and Control skills, Mechanical Measurement & Quality Control skills,

Hydraulics Machineries & Accessories Maintenance skills, Heat Engine and Heat Exchanger, Casting and Heat Treatment skills, etc).

This Literature review focused on 3 different contexts to meet the 3 objectives of the research;

2.2 Bridging the areas of skills gap between TVET Institutions and Industries

Skills gap of TVET graduates as per industry is only possible to make a bridge between TVET institutions and industries. Bangladesh is grappling with a widening skills gap that endangers the country's long-term economic viability. To seal an ever-increasing quantity of high-skill jobs, the workforce just does not have sufficient workers and skilled applicants. Because having a great workforce is the most important factor in achieving professional success, issues associated with attracting the greatest people have a direct impact on an organization's competitiveness today and in the future. Employers require a world-class, highly skilled workforce to meet the skills gap. This will necessitate recruiting from atypical labor pools, employee training, collaboration with educational institutions to boost graduate employability, and international competition for top talent. So the skills gap' is a term used to characterize the disparity between the abilities that employers seek, as evidenced by job adverts, and the talents that are available from job seekers. During Bangladesh's economic change, skill shortages and surpluses have surfaced as a critical issue for transfer and reorganization. Newly developed employment as a result of technology advancements necessitated a variety of advanced talents, and the demand for new skills is growing faster than the education and training system can respond to widespread skill shortages. The initiative for industry-institution collaboration can help close the technology gap. However many educational research has been carried out to identify the employability skills gap and its influence to the different aspects of skills development. To handle modern technology all across the world, you'll need the right knowledge and skills. Most of the time, technologies are unfamiliar to the majority of people (Raihan, 2014). There is a skills gap in the body of knowledge, and this section explains how it can be filled. A "skills gap" is the disparity between the position criteria and the skills currently possessed by the person in that position. A more robust approach is needed to identify, measure, and manage the skills gap between roles and persons; this is especially important in system and organizational design because increasing levels of system autonomy have changed

the way positions are defined (Martin J. McKenney, 2019). Some of the education researcher emphasize the psychomotor skills development and suggested to develop the hand-on-skills as per technological changes.

Skills shortages are a source of concern for businesses. The global skills gap is so acute that even countries with significant youth and adult unemployment are considering loosening immigration policies to allow imported skilled labor to fill positions that domestic unemployed could have occupied if they had the proper skills (Aring, 2012). A consistent classification system for skills and articulation to education curriculum, as well as a standard for what "employability skills" means, are all vital for future development. Increased public-private investments to finance a continuous stakeholder dialogue on skills; a shift in employers' attitudes so that education and training systems in countries where they operate are seen as a part of their value chains; and a shift in employers' attitudes so that education and training systems in countries where they operate are seen as a part of their value chains (Aring, 2012).

In order to correctly assess the graduates, TVET institutions should engage with industry. They should make sure that each graduate has a last-year internship program. Overall, the institutions must form a partnership that creates immediate jobs and produces qualified skilled workers for the global labor market. Before preparing for employment, TVET graduates should acquire the skills needed by industry (Islam, 2018). Industries should inform TVET universities about their current skill requirements so that TVET institutions may quickly identify the capabilities that need to be developed for their graduates. Internship programs should be organized by the industry to offer TVET students with practical experience. Industry should send workers (TVET graduates) overseas for field training to equip them with up-to-date capabilities. Bangladesh's companies should collaborate with TVET institutions to examine their students' knowledge of emerging technology (Islam, 2018). Bridging the gap includes cultivating relationships with external stakeholders while collecting data that may be utilized to improve the educational process' quality. Using stakeholder theory as a guide, educational institutions must form connections with their stakeholders in order to involve them in developing the skills needed to meet employer demands. As a result, the answers to the three study questions will look into how this might be done in STEM educational institutions (Doreen McGunagle, 2020).

Industries-institute partnerships are demand-driven, allowing the industry to engage in the development and management of TVET to eliminate skilled labor mismatches, and are backed by a regulatory and methodical framework. Curriculum development, internships or apprenticeships, guest lecturers, teacher/student training, joint research, entrepreneurship, teaching factories, and student exchange were among the other areas where collaborations were formed (Towipa, 2021). TVET-industry collaboration, opinions of the importance of TVET-industry collaboration in the development of employability skills by polytechnic graduates, and a number of obstacles that both TVET institutions and enterprises confront in implementing effective TVET-industry collaboration (Getachew Mitiku, 2021). The bulk of our partner's industry managers/supervisors are unaware of the importance of collaborative work; they do not see it as a mutual advantage, but rather as a burden to their industry. Even if trainees are accepted for cooperative training, the chances of them being assigned to the expected appropriate employment are slight (Getachew Mitiku, 2021). To make a good cooperation work, both TVET providers and industry stakeholders must believe that there are mutual benefits; more crucially, the industry must believe that partnering with TVET delivery would result in considerable benefits. The training providers do not have a good understanding of the industries' work environments, and they are not committed to improving the cooperation in the face of all the problems (Getachew Mitiku, 2021). In order to assist and encourage enterprises to cooperate with TVET institutions, the government should develop policy-based incentive methods that allow businesses to benefit from duty-free imports and tax reductions in exchange for their commitment to work with TVET colleges. Then, industry-wide competency requirements must be created (Getachew Mitiku, 2021).

Institute supervisors who are familiar with the industry might be thought of as the "bridge" between the industry and the institute. The supervisor is in a position to find a balance between the requirements of the degree award and industry needs, ensuring that the candidate is not split between the two (Raihan, 2014). Students believe that industrial training gives them with "real-world experience" that they can connect to the academic information they learned in polytechnics (Raihan, 2014). According to research, these industry trainings boost students' soft skills as expected. Industries, governments, and TVET schools should form partnerships to improve the competency of TVET students through initiatives such as workplace partnerships, resource sharing, and staff training, joint curriculum reviews, SIWES (Students' Industrial Work Experience Scheme), and joint certification of TVET students (Aniedi Daniel Usoro, 2018). TVET institutions

place a strong emphasis on hard skills while forgetting soft skills such as job search and interview skills, which are essential for finding work (Diop, 2020). Insufficient information flow between TVET institutions and industry, obsolete training curricula, poor leadership, and insufficient language literacy all played a role in TVET graduates' employability (Diop, 2020).Without a link to industry, TVET graduates will not be able to maintain professional capabilities, and industrial output will not be able to increase with only low-level people resources. For talent development, generation, innovation, and technology transfer, collaboration between TVET and industry is essential (Dr. Balkeshwar Singh, 2019)

TVET institutions must expand their ties with industry in order to improve networking between a cademics and industry, allowing them to better understand each other's requirements and determi ne how they might be satisfied through industry programs. The importance placed on trainee job preparation is one of the most noticeable characteristics of this relationship (Dr. Balkeshwar Singh, 2019). The acquisition of occupational skills is widely seen as a critical driver of economic and technological progress. The critical significance of Technical Vocational Education and Training (TVET) in promoting skills development for countries' socioeconomic and technical development explains why TVET is becoming increasingly important. TVET is a sort of education that teaches people the skills, knowledge, and attitudes they need to succeed in a certain job (Jane Itohan Oviawe, 2017). Workplace training has long been regarded as the most effective way to improve one's skills. Workplace training and learning refers to education or training that takes place in the workplace, frequently on the job and under normal operating conditions. Workplace training is defined as a type of training that takes place in the workplace and is based on the principle of learning by doing. It includes demonstrations by a more experienced employee, performance under supervision, and coaching, as well as job rotation and participation in specific projects (Jane Itohan Oviawe, 2017). Through the platform of institutes-industries collaboration, which offers TVET students the unique opportunity of developing the required manpower to meet the ever-changing world of work, collaboration will provide the key to the production of manpower that will be able to utilize the abundant human and material resources. After examining the difficulties in the twenty-first century workplace, institutes and industries collaborate to fill the identified skill gaps. This collaboration could be extremely beneficial to students' practical training and, as a result, to their effective skill acquisition (Jane Itohan Oviawe, 2017).

Students who complete long semester vacation placement training in relevant industries in their field of endeavor should be encouraged and given credit points by TVET institutions in order to strengthen and boost the student working experience for a smooth transfer of learning to work (Jane Itohan Oviawe, 2017).In every facet of human endeavor and task execution, skills are required. Skills helps to develop new problem-solving and thinking skills, increase self-awareness, make decisions and understand skills in a particular choices. TVET institutions main goal is to help people learn new skills. The concept of Technical Vocational Education and Training (TVET) was further defined as: Involves muscular dexterity, must lend itself to activity coordination, and requires that the quantity of labor to be done be completed competently. Implies that the performance should be characterized by a strong sense of direction, pressure, and a great lot of relaxation, as well as some intellectual content. Accuracy is emphasized as a key attribute. Although abilities vary by industry, there is a general belief that every company strives to recruit individuals with desired abilities. Every industry looks for desirable skills such as a desire to learn about one's chosen industry, focus, and the ability to listen, assimilate knowledge, and then apply it, a clear communicator, technical knowledge and creative problem solving skills, coaching ability, teamwork, strong work ethic, strong communication skills, and independent initiative, as well as ambition, politeness, empathy, and reliability (Dr. Edet, 2019). TVET institution have the mandate to prepare for the world of work considering industry. Obviously it is a deep fact the institution usually trains hard skills and very important and fewer important soft skills (Dr. Edet, 2019).

Skills will most certainly change in the next decade as a result of technological advancements. Industries experts should engage closely with TVET institutions to take advantage of the chance to inject the skills that they require into the academic system, and institutes should alter their academic programs accordingly. What is going on right now Students Industrial Work Experience Scheme (SIWES) should be introduced after they have completed all other academic activities and have written their final test, so that it can serve as a bridge between institutions and the real world (Dr. Edet, 2019).

Bridging the skills gap the approach should be like that; Laboratory, workshop, and personnel resources are all shared, Program for staff exchange/training and development between industry-institute, Curriculum development/review by a group of people between industry-institute,

Students' skills are jointly assessed by industries and TVET institutions, and students are jointly certified by industries and TVET institutions (Ayonmike C.S., 2016).

Most of the education researcher carried out to identify the bridging approaches the skills gap between TVET institutions and industries to minimize the skills gap and focused the areas of soft skills gap and sometimes focused on technological skills gap. But no research has been conducted to identify the soft skills gap and hard skills gap for the mechanical engineering students of polytechnic institutions. So the researcher explore the issues of bridging the skills gap of TVET graduates of polytechnic institutions more closely.

2.3 Model of Curriculum Development

Curriculum development is the methodical design of what is taught and learnt in schools, as represented in school courses and programs. Provincial and territorial departments of education make these curricula necessary by enshrining them in official papers (usually curriculum "guides" for instructors).The TVET program must not only meet the education and training goals and objectives, but it must also be implemented effectively. In the past, a number of models were used, and as a result, curriculum development was either subjective or objective. Trainers and educationalists, on the other hand, have recently developed competency-based curricula that may be used in conjunction with new multi-media educational tools. The open entry/open exit notion of Curriculum implementation can be adopted as a result of this method, allowing trainees to learn at their own speed and in the most flexible way feasible. The best curriculum model is one that is centered on the learners' individual or class needs, as well as the available learning environment, resources, and time. All needs should be determined at the first level, and then a target should be created based on the learner, environment, subject matter requirements, and time restrictions. In order to be easily implemented, a curriculum should be entertaining, motivating, adaptive, and practical (Tariq Mehmood Bhuttah, 2019).

Hilda Taba was an architect, curriculum thinker, curriculum reformer, and teacher educator who lived from December 7, 1902 to July 6, 1967. Taba contributed to the theoretical and pedagogical foundations of concept development and critical thinking in the social studies curriculum, as well as helping to lay the groundwork for education. She also developed a multipurpose teaching

paradigm that incorporates a variety of processes, such as listing, grouping, re-grouping, labeling, and synthesizing (Gulzar, 2021). Taba outlined the following seven crucial steps:

- Diagnosis of needs: Before constructing a curriculum, it is necessary to first determine the learners' needs.
- Formulation of objectives: Once goals have been identified, the teachers must work to achieve them.
- Content selection: Contents and objectives should not only be consistent with one another, but also be valid and significant.
- Content organization: Content should be organized according to the children's interests, taking into account their maturity, understanding, and enthusiasm.
- Learning experiences should be chosen in such a way that the learners are engaged with the information.
- Learning activities should be categorized, in addition to the sequenced and organized materials, so that learners can connect the activities to the contents and remember what they've learned.
- Curriculum planners must also assess whether the objectives have been met. In the evaluation process, both the teacher and the student are involved.

Another popular method for curriculum development is DACUM. DACUM has been effectively utilized to determine a person's talents and knowledge required to complete a task. It has been widely used in the Technical and Vocational Education and Training (TVET) sector around the world to develop technical courses. DACUM stands for Developing Curriculum and is the most important step of the curriculum development process (Sanyog Bhattarai, 2022).

In broad overviews of significant linked sources to examine in the curriculum development process, the stages of curriculum conceptualization and design, classroom-level teacher curriculum design, and class/room-level teacher professional development are all covered. As previously said, curriculum development is a planned, rigorous, and systematic process for introducing positive changes to the educational system. Every time the world changes or develops, it affects school curricula. To suit the needs of society, they must be updated. It is tied to our rich cultural legacy, basic value systems, contemporary social concerns, and society's future needs from the past (Mohanasundaram, 2018). Curriculum goals focused on employability are being developed. More

thought should be given to incorporating core competencies into teaching objectives, teaching activities, and teaching evaluation processes during the curriculum development process, as it is critical for learners to develop core competencies (Tien-Chi Huang, 2010). There are two types of core competency indicators that can be used to determine the curricular objectives. The first is Discipline Specific Skills, also known as hard skills, which are comprised of three evaluation indicators: technical competence, knowledge, and qualifications—all of which are frequently used to determine whether stated goals correspond to key competency indicators in professional domains. The second category is soft skills. These indicators are most commonly used in the workplace to describe non-technical skills (Tien-Chi Huang, 2010).To keep up with the continuously changing needs and demands of the labor market, the TVET curriculum should be examined and revised. As a result, the skill gap between the necessity for training through internship and cooperative training approaches on the part of TVET institutions and the real-world work condition in the sectors would be narrowed. Furthermore, industry participation in the process of curriculum review and updating is an added benefit in making TVET training more responsive to industry needs; such approaches also help to eliminate the issue of mismatch between TVET institution requirements for internship, cooperative training, and industry operation standards (Getachew Mitiku, 2021).

Most of the circumstances it is found hard skills learnt in TVET institutions can become out-of-date which effect in backdated curriculum (Dr. Edet, 2019). It's also important to keep in mind that soft skills development and hard skills development that are required by industries, of course. Due to industry's adaptation, many jobs, particularly those that are technology-based, will become outdated *(Dr. Edet, 2019).* TVET institutions' curricula should place a greater emphasis on developing work environment habits in students in order to keep them up to date on current trends in the workplace (Jane Itohan Oviawe, 2017). The curriculum in education is relatively constant. A 3-year-old TVET curriculum may be teaching the history of technology rather than the skills needed by industry today. Curricula are required to be established with the goal of developing proficient and employable people who can quickly adapt to the sector without additional training (Dr. Balkeshwar Singh, 2019).

Most of the education researcher carried out to identify to established the curriculum model for soft skills development and hard skills development that are required by industries focused on

teaching-learning, feedback, technological needs etc. But no research carried to design a bridging hub between industries and institutes for model of curriculum development, also no research found to develop a model of curriculum development for mechanical engineering students of polytechnic institutions to cope up the skills requirements of industries in Bangladesh.

2.4 Teaching-learning strategic for minimize the skills gap

The Pedagogical Model explains how effective teachers engage students in intellectually challenging tasks in their classes. The five domains of teaching in the learning cycle: Engage, Explore, Explain, Elaborate, and Evaluate. Pedagogical design, a new phrase in the world of instruction, teaching, learning, and learning support, refers to the deliberate selection and application of procedures, methods, prescriptions, and instruments to achieve effective, efficient, and productive learning. Any systematic pedagogical design activity produces a plan or scenario that specifies the environments format, content, and organization, as well as distribution systems and implication strategies (Lowyck, 2002).

Teach new subject to students who have no prior knowledge or experience with design thinking and design based learning methodologies as they pertain to newer and/or developing sectors more effectively and efficiently. It is critical to consider how the teaching-learning methods improve. Learners will be expected to go deeper into strategic and reflective thinking processes as they meet difficult topics like unexpected futures design, dynamic public policies, and social transformations in a variety of settings (Peter Scupelli, 2019). We know that well-facilitated creative thinking and problem-solving experiences have a significant impact on the learning and results based on learning sciences. Students are being prepared to engage, analyze, and retain information. New content is discovered through hands-on experiences, which leads to new opportunities. Thought about how you're considering and keep trying to figure out what you're really thinking (Peter Scupelli, 2019).It is serious need by TVET institutions to adopt a well-adjusted method in the teaching-learning of skills where both hard and soft skills are taught in institutions. TVET institutions to implement a balanced methodology in the teaching-learning of both skills that means hard skills and soft skills *(Dr. Edet, 2019).*

Instructors should concentrate less on teaching knowledge, particularly in theory, and more on teaching-learning problem-solving skills that can be applied to different contexts and difficulties, with an emphasis on the importance of including intercultural experiences *(Dr. Edet, 2019).* It is important to building the instructors competence in teaching-learning these 21st century skills. Effective learning includes: ensuring that individuals have access to theoretical and experimental knowledge; providing opportunities for individuals to engage in authentic tasks and interactions with others; providing opportunities for individuals to develop critical and intellectual capacities through the application of concept and theory in practice; and providing opportunities for individuals to have their thinking and understanding enhanced through the guidance and teaching of others (Jane Itohan Oviawe, 2017). Some of the primary components of TVET institution mission include providing quality teaching-learning and training to develop competent graduates in Knowledge, Skill, and Work Ethics, as well as being demand-driven and market-oriented (Dr. Balkeshwar Singh, 2019)

It is founded that individual researcher carried out to identify to designed a teaching-learning framework skills development of learners. That are needed skills, knowledge, and attitude development. Which are demand-driven and market-oriented. But no research carried to design a bridging center concerning with industries and institutes for teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh. So researcher design a teaching-learning strategic framework for bridging the skills gap of TVET institutes and industries more clearly.

CHAPTER 3 – METHODOLOGY

3.1 Research design

The study aimed to identify the skills gap between industry and TVET institution by using the opinions from responded perception to enhance employment. The researcher will collect data in light of conceptual TIAIB Model. The study was conducted on the Bridging the Skills Gap as per industries requirements by comparing Curriculum and programme outcomes that mean the research find out 2 issues (1) Skills Gap as per Labor Market (2) And Bridging this Skills to the Institute. And focus out 2 issues for effecting the Development a pedagogic model for Bridging the Skills Gap (1) To recommend a model of curriculum development to cope up the skills requirements of industries in Bangladesh (2) To design a teaching-learning strategic framework for minimizing the skills gap with TVET institute (Govt. Polytechnic) and Industries in Bangladesh. So that this collaborating approaches between Institute and Industries make a path for enhance employability.

A Mixed method (Quantitative & Qualitative) will be used in this research, which includes research design, area of the study, population, sample and research tool and data analysis procedure. The method will be employed in this research is descriptive type of mixed method (Quantitative & Qualitative) research. Descriptive research will be introduced to gathering of information about prevailing condition for the description and interpretation purposes.

To describe the current condition, practices and situation descriptive method of research is suitable, which based on fact-finding and accurate interpretation of the findings. Since this study is concerned with the present status of TVET institution and industries relationship and the identification of skills gap between the requirement of industry and skills provided by the TVET institution. Data will analyzed using descriptive statistics. And it will be purposive sampling.

3.2 Research field

Researcher considered the field of study is industry experts and institutes experts. And find out a crystal clear view of present areas of skills gap of TVET (polytechnic) graduates at workplace.

The field of study under industries are graduate of mechanical engineering of Govt. Polytechnic (TVET) Institutes who engage in job, HR department, Engineering department and under institutes are instructors, placement expert, curriculum specialist, TVET administrator or expert. The respondent geographical location were whole Bangladesh.

3.3 Population and sample

The number of participants for this study is about 210 from 2 categories. However out of 210 sample size total 210 nos participants responded back. That means 100% participants ensured the responded. The participant of this study are Industrial Expert and Institutional Expert. The selected categories are:

Table 1: Showing Sample Details

Sl	Category	Responded expertise	Responder of Research	Total
1	Industry Expert	HR Department	10	120
2		Engineering Department	20	
3		Graduate of mechanical engineering of Govt. Polytechnic (TVET) Institutes who engage in job	90	
4	Institute expert	Instructors	40	90
5		Job Placement expert from institute	25	
6		TVET Administrator/Expert	15	
7		Curriculum Specialist	10	
Grand Total				**210**

The researcher followed few characteristics of experts to select them as research participant.
Characteristics of participant:

- The selected participants were highly skilled and experienced personnel.
- The eligible participants for the research were marked up to the supervisor level or higher for Industry and other responded are very potential for this study.

- The new graduate of Govt. Polytechnic of Mechanical Engg. who enter the different field of job market
- All participants of this research obtained a minimum educational certificate to understand the language and value of the research.

3.4 Research tool

The researcher will examine the gap in employability skills (soft and hard skills) for the purpose of constructing a survey questionnaire and taking into account the following tools: Polytechnic education program results, current mechanical engineering curriculum, teaching-learning framework for theories and laboratories, and student evaluation method. The survey questionnaire will be prepared by researcher with the piloting on the polytechnic institutions and selected industries in Bangladesh. After that, this survey questionnaire will be send to the faculty member of TVE department for validation test. The survey questionnaire that used in this study, have three (3) sections (Section A, Section B and Section C). Section A of the questionnaire contains general information, Section B is the survey questionnaire, and Section C is the textual answer of the open-ended (qualitative) questionnaire. In section B the researcher set-up 38 nos of research questionnaires with 3 nos of objectives. The participant's opinions for objective one in 13 items, objective two in 13 items, and objective three in 12 items were measured using a five-point Likert scale.

Table 2: Five-point Likert scale

Likert Scale	Acronyms	Points
Strongly Disagree	SD	1
Disagree	D	2
Neutral	N	3
Agree	A	4
Strongly agree	SA	5

Each participant will be allowed to freely and voluntarily participant and responds to the questionnaire. Participants will be informed about the confidentiality of his/her opinions and identity and they will be also informed that they are free to withdraw their participation at any

time. The questionnaire will be distributed to the participant physically and or via online. The researcher will be available for giving further clarifications regarding the required responses.
The researcher arranged a half-day workshop for validation the recommended Model of Curriculum Development by 9 nos of respondents among 210 nos like curriculum specialists and instructors. And the researcher will be arranged also a half-day workshop for validation of this Teaching-learning strategic framework by 11 nos of respondents among 210 nos like TVET administrators and instructors.

3.5 Data collection procedure

A close-ended questionnaire was used during data collection in this study with few open-ended questionnaire to textually answer by the participants. Each participant was allowed to freely and voluntarily participant and responds to the questionnaire. Participants were informed about the confidentiality of his/her opinions and identity and they were also informed that they are free to withdraw their participation at any time.
The questionnaire was distributed to the participates physically and via online. Most of the time researcher was available face to face or via mobile phone for giving further clarifications regarding the required responses.

3.6 Data analysis procedure

The answers of the close-ended questionnaire were assigned with some score before. The scores of each item were aggregate to provide corresponding score for each component. To conduct a meaningful analysis the negative items were reverse coded. Descriptive statistics like frequency, percentage, means, and standard deviation were used in this study for data analysis purpose. To examine the hypothesis of each item of the questionnaire, a Chi-square (X^2) test was conducted (non-parametric), with sig. value ($p < 0.05$). Data analysis was performed using Statistical Package for Social science software (IBM SPSS v: 25). Also Category percentage for each opinion and weighted average (WA) were calculated and then tabulated, followed by its detailed interpretation. The criteria of Five Likert scale is interpreted in below;

Table 3: Interpretation of weighted average based on five point Likert scale

Weighted Average	Weighted Average Interpretation
5.00 ≥ WA ≥ 4.50	Strongly agree-SA (5)
4.50 > WA ≥ 3.50	Agree- A (4)
3.50 > WA ≥ 2.50	Neutral- N (3)
2.50 > WA ≥ 1.50	Disagree- D (2)
1.50 > WA ≥ 0.00	Strongly Disagree- SD (1)

The above Interpretation of weighted average based on five point Likert scale shows that 5.00 ≥ WA ≥ 4.50 means the respondents opinion Strongly Agree and their opinions have high confidence, 4.50 > WA ≥ 3.50 means the points between 4.50 to 3.50 which indicates Agree, 3.50 > WA ≥ 2.50 indicates respondents opinion are undecided and which need to analysis and Chi-square (X^2) test is important, 2.50 > WA ≥ 1.50 indicates respondents opinion are disagree with the negative statement, and 1.50 > WA ≥ 0.00 means respondents opinion Strongly Disagree and the statements are strongly unacceptable. These tests were considered in the study basically for identifying the areas of skills gap for employment between TVET institution and industry, importance to makeup the employability skills by curriculum model development, and teaching-learning strategy to meet the skills gap.

For the open-ended or textual data analysis researcher followed the thematic analysis. Thematic analysis is to identify themes, i.e. patterns in the data that are important or interesting, and use these themes to address the research or say something about the research issue.

3.7 Ethical consideration

The study followed the tradition and did not break any rules and regulation acted upon the data collection process in Bangladesh or the enterprises contribute to the study. Following the rules of research data collection, this study do not disclose the name and identity of any participant and the response from the participant will strictly use only for the research purposes. Data gathered from industry and institutes was strictly kept confidential. The researcher ensured the participant about all condition and rules of the certain questionnaire before participant gives his valuable response.

CHAPTER 4 - DATA ANALYSIS AND INTERPRETATION

4.1 Data analysis and interpretation

In this section, statistical procedures are presented that were used to analyze both the continuous and categorical data collected from industries expert and institutions expert in Bangladesh. The respondents data obtained through questionnaires have been tabulated in forms of frequencies and percentages. The first section of this chapter discusses about demographic data of the participants. The second section involves analysis of data related to the first, second, and third research question. Chi-square (x^2) test was conducted by testing the components at 0.05 significant levels. Weighted average, means and standard deviations were also calculated.

4.2 Frequency Distribution

Statistics

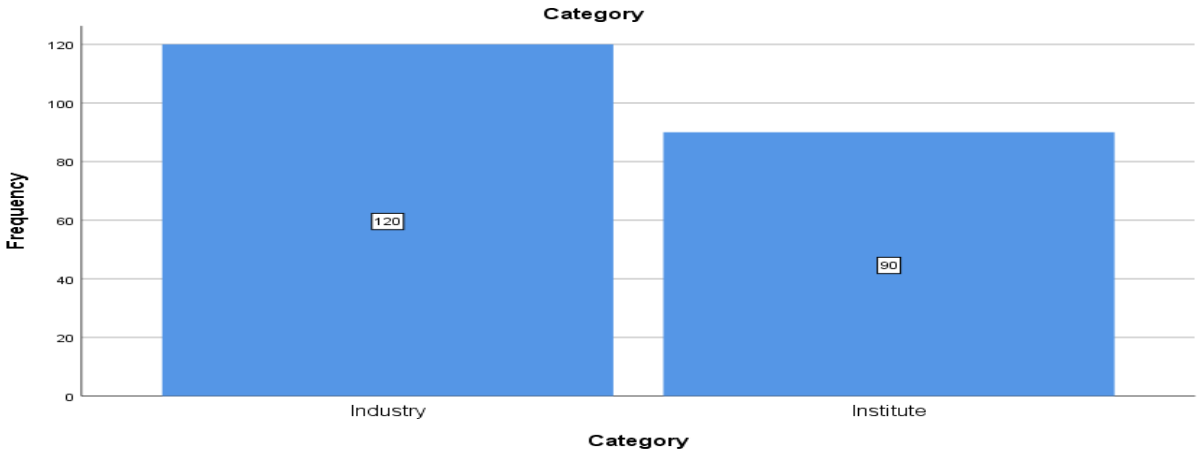
Category

N	Valid	210
	Missing	0

The number of participants 210 nos. All the respondents participate the research questionnaires.

Category

		Respondents	Percent	Valid Percent	Cumulative Percent
Valid	Industry	120	57.1	57.1	57.1
	Institute	90	42.9	42.9	100.0
	Total	210	100.0	100.0	



The category of responded are industrials expert and institutions expert. 120 nos participants from industry as an expert and 90 nos of nos participants from TVET institutes as an institute's expert

Statistics

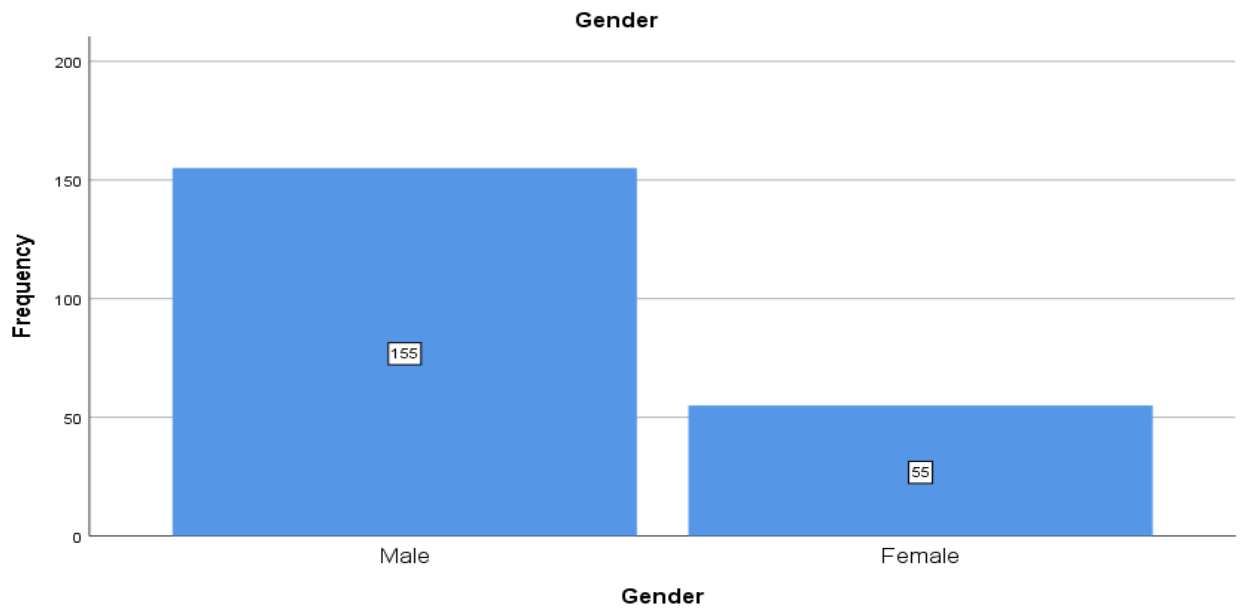
		Gender	Category	Job Title	Age
N	Valid	210	210	210	210
	Missing	0	0	0	0

The number of participants 210 nos. Categorical variable is gender, category, job title and age. There was not any missing of any participants because all the responded answer or attain to all the research questionnaires.

4.3 Gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	155	73.8	73.8	73.8
	Female	55	26.2	26.2	100.0
	Total	210	100.0	100.0	

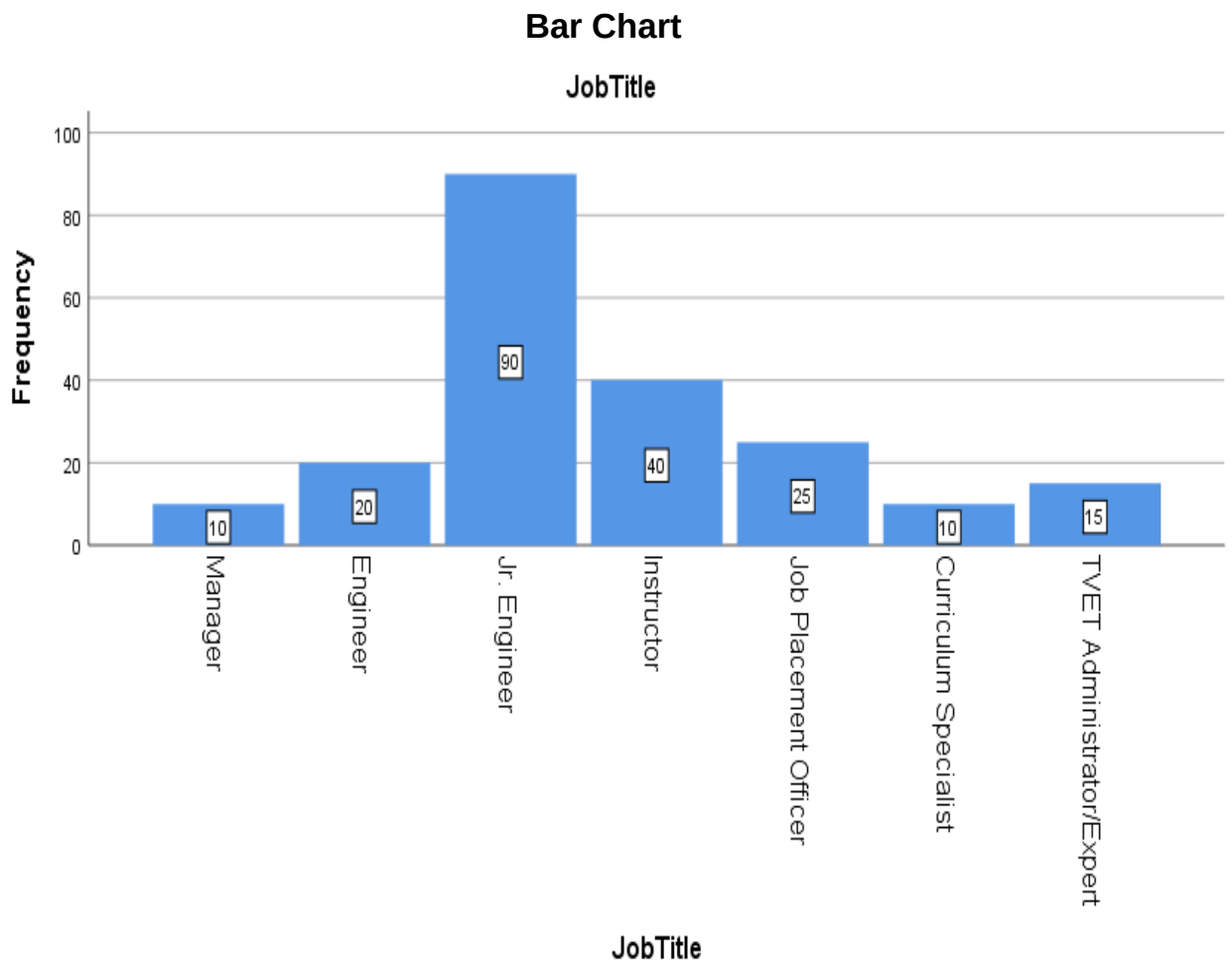


In the research 155 nos of male and 55 nos of female from both the industries and institutions categories, whereas the percentage of male is 73.8 % and female is 26.2%.

4.4 Job Title (Designation)

Job Title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Manager	10	4.8	4.8	4.8
	Engineer	20	9.5	9.5	14.3
	Jr. Engineer	90	42.9	42.9	57.1
	Instructor	40	19.0	19.0	76.2
	Job Placement Officer	25	11.9	11.9	88.1
	Curriculum Specialist	10	4.8	4.8	92.9
	TVET Administrator/Expert	15	7.1	7.1	100.0
	Total	210	100.0	100.0	



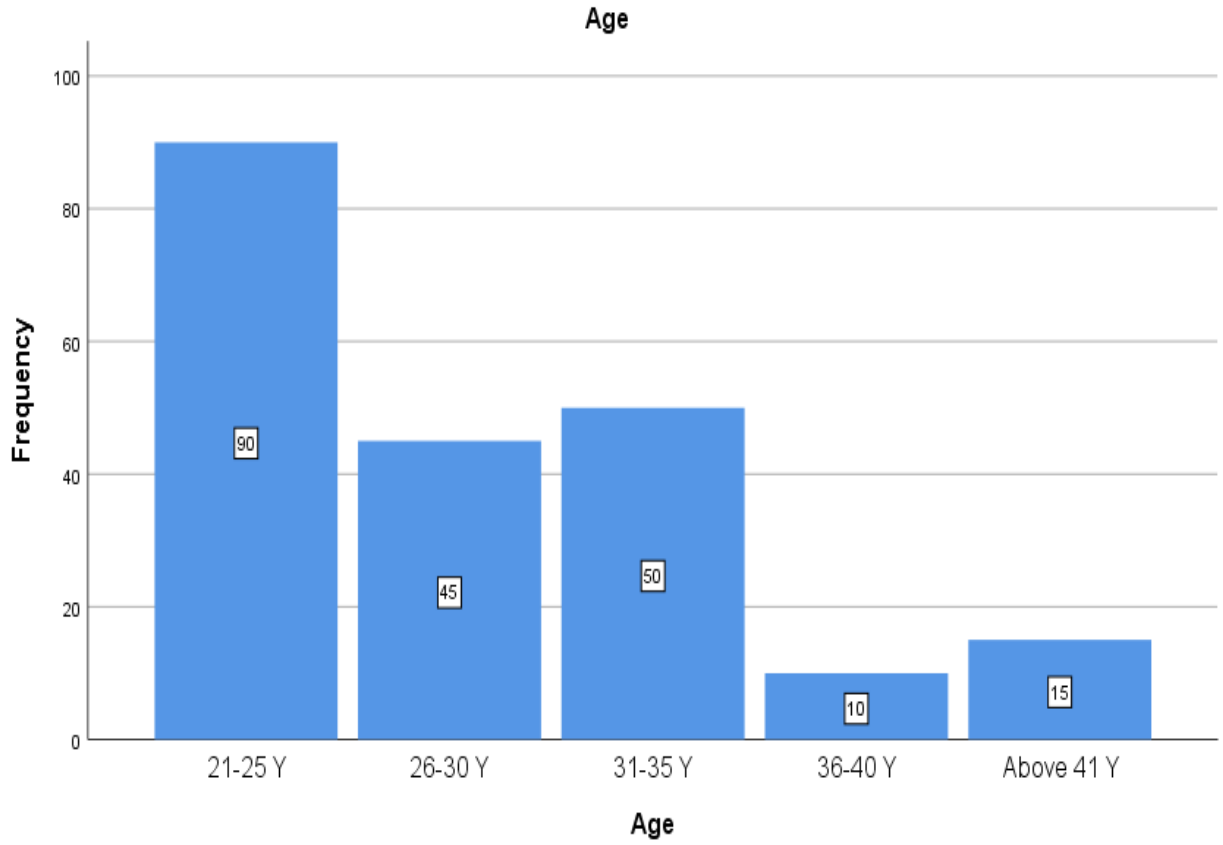
The researcher collected the data from HR department, Engineering Department, and TVET (polytechnic) graduates who engaged in job considered as an industrial expert. And Instructor, Job Placement Officer, Curriculum Specialist, and TVET Administrator/Expert considered as an institutions expert. 42.9 % data are collected from TVET (polytechnic) graduates who engaged in job and they are the prime responded who basically face the situation. 4.8 % data from HR department, 9.5% data from engineering department. This 14.3 % responded directly assess the TVET (polytechnic) graduates for employment. Others 19 % from instructors, 11.9 % from Job placement department of TVET institutions, 4.8 % from Curriculum Specialist, and 7.1 % from TVET Administrator/Expert.

4.5 Age

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21-25 Y	90	42.9	42.9	42.9
	26-30 Y	45	21.4	21.4	64.3
	31-35 Y	50	23.8	23.8	88.1
	36-40 Y	10	4.8	4.8	92.9
	Above 41 Y	15	7.1	7.1	100.0
	Total	210	100.0	100.0	

Bar Chart



Researcher also considered the age for collected the data. Maximum responded of the participants are between 21-25 Y and minimum responded are between 36-40 Y.

4.6 Reliability Analysis (Cronbach's alpha)

Objective 1: (Areas of skills gap)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.997	.997	13

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.680	3.614	3.752	.138	1.038	.001	13
Inter-Item Correlations	.962	.890	.996	.107	1.120	.001	13

Objective 2: (Recommended of Model of curriculum development)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.993	.993	13

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.617	3.557	3.648	.090	1.025	.001	13
Inter-Item Correlations	.915	.824	.987	.163	1.197	.001	13

Objective 3: (Design Teaching-learning strategic framework)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.998	.998	12

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.678	3.652	3.719	.067	1.018	.000	12
Inter-Item Correlations	.972	.940	.991	.052	1.055	.000	12

210 respondents were considered in the sample and questionnaires were distributed to them. The reliability of the data was tested before doing any parametric test.

In statistics, Cronbach's alpha is the used for estimate of the reliability of a psychometric test. Cronbach's alpha can be viewed as the expected correlation between the items that measure the same construct. Estimates of Cronbach's alpha can take on any value less than or equal to 1, including negative values. But, statistics consider only the positive values for reliability test. Higher values of alpha are more desirable. Using the rule of thumb, some professionals thought that, variable require a reliability of equal or higher 0.70 if the items is more than 10 nos or equal to 10 nos is acceptable to use an instrument. The overall reliability coefficient (Cronbach‟s alpha) is (.997) for objective 1, (.993) is for objective 2, and (.998) is for objective 3. Which signified that the internal consistency of instrument is good enough to measure the variables.

4.7 Descriptive Statistics

Descriptive Statistics								
	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
ASGSS	210	36.00	9.00	45.00	6970.00	33.190	12.260	150.327
ASGHS	210	16.00	4.00	20.00	3077.00	14.652	5.488	30.123
ASGAP	210	52.00	13.00	65.00	10047.0	47.842	17.719	313.980
MCDEV	210	52.00	13.00	65.00	9874.00	47.019	17.386	302.296
TLSFRM	210	48.00	12.00	60.00	9268.00	44.133	16.183	261.915
Valid N (list wise)	210							

The above table basically described the status of three objective, but ASGSS and ASGHS individually indicated the areas of soft skills and hard skills gap. Though the ASGAP also described the indication of 1st objective. MCDEV and TLSFRM indicated the 2nd and 3rd objective of the study. The minimum value in the above table indicate the minimum score of every category, the maximum value indicate the maximum score of the every category. The sum value indicated the total value of the every category. And the mean value indicated the average score of every category. The standard deviation value indicated the standard deviation of every category.

Descriptive Statistics

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
ASGSS	210	-.759	.168	-.704	.334
ASGHS	210	-.681	.168	-.807	.334
ASGAP	210	-.738	.168	-.723	.334
MCDEV	210	-.769	.168	-.705	.334
TLSFRM	210	-.784	.168	-.659	.334
Valid N (list wise)	210				

Analysis of Objective 1

(The areas of Skills gap of the Polytechnic graduate in the field of Mechanical Engineering considering industry demand)

Table 4: Analysis of Objective 1

Sl	Statements	N		SD	D	N	A	SA	WA	Chi-Square	df	Asm. Sig.
1	Polytechnic graduates are weak in interpersonal skills in the workplace.	210	f	23	25	25	57	80	3.70	23.046	4	0.000
			%	10.95	11.90	11.90	27.14	38.09				
2	Polytechnic graduates are weak in critical thinking skills in the workplace.	210	f	23	28	22	57	80	3.68	21.335	4	0.000
			%	10.95	13.33	10.47	27.14	38.09				
3	Polytechnic graduates are weak in creativity & innovation skills in the workplace.	210	f	26	25	22	57	80	3.67	22.794	4	0.000
			%	12.38	11.90	10.47	27.14	38.09				
4	Polytechnic graduates are weak in adaptability skills in the workplace.	210	f	23	25	22	57	83	3.72	21.701	4	0.000
			%	10.95	11.90	10.47	27.14	39.52				
5	Polytechnic graduates are weak in self-motivation skills in the workplace.	210	f	23	25	22	63	77	3.70	28.441	4	0.000
			%	10.95	11.90	10.47	30.00	36.66				
6	Polytechnic graduates are weak in time management skills in the workplace.	210	f	24	26	23	57	80	3.68	22.157	4	0.000
			%	11.42	12.38	10.95	27.14	38.09				
7	Polytechnic graduates are weak in problem-solving skills in the workplace.	210	f	26	28	25	51	80	3.62	17.472	4	0.002
			%	12.38	13.33	11.90	24.28	38.09				
8	Polytechnic graduates are weak in decision-making Skills in the workplace.	210	f	23	25	22	51	89	3.75	16.123	4	0.003
			%	10.95	11.90	10.47	24.28	42.38				
9	Polytechnic graduates are weak in teamwork skills in the workplace.	210	f	23	25	22	68	72	3.67	35.094	4	0.000
			%	10.95	11.90	10.47	32.38	34.28				
10	Mechanical graduates of polytechnic institutes are weak in drawing and drafting skills in the workplace.	210	f	23	28	25	54	80	3.67	19.506	4	0.001
			%	10.95	13.33	11.90	25.71	38.09				

11	Mechanical graduates of polytechnic institutes are weak in their professional skills in the workplace in the workplace.	210	f	26	25	24	54	81	3.66	20.426	4	0.000
			%	12.38	11.90	11.42	25.71	38.57				
12	Mechanical graduates of polytechnic institutes are weak in technological skills in the workplace.	210	f	23	25	25	54	83	3.71	19.872	4	0.001
			%	10.95	11.90	11.90	25.71	39.52				
13	Mechanical graduates of polytechnic institutes are weak in Hands-on skills in the workplace.	210	f	27	29	22	52	80	3.61	17.710	4	0.001
			%	12.85	13.80	10.47	24.76	38.09				

Statement one: It was observed that overall 65.23% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in interpersonal skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.70 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (23.046) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (23.046) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in interpersonal skills in the workplace.

Statement Two: It was observed that overall 65.23% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in critical thinking skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.68 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (21.335) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (21.335) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in critical thinking skills in the workplace.

Statement Three: It was observed that overall 65.23% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in creativity & innovation skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (22.794) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (22.794) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in creativity & innovation skills in the workplace.

Statement Four: It was observed that overall 66.66 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in adaptability skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.72 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (21.701) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (21.701) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in adaptability skills in the workplace.

Statement Five: It was observed that overall 66.66 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in self-motivation skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.70 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (28.441) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (28.441) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in self-motivation skills in the workplace.

Statement Six: It was observed that overall 65.23% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in time management skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.68 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (22.157) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (22.157) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in time management skills in the workplace.

Statement Seven: It was observed that overall 62.37 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in problem-solving skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.62 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.002, which is less than 0.05 level of significance. Chi-square observed (x^2o) (17.472) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (17.472) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in problem-solving skills in the workplace.

Statement Eight: It was observed that overall 66.66 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in decision-making Skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.75 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.003, which is less than 0.05 level of significance. Chi-square observed (x^2o) (16.123) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (16.123) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in decision-making Skills in the workplace.

Statement Nine: It was observed that overall 66.66 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Polytechnic graduates are weak in teamwork skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (35.094) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (35.094) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Polytechnic graduates are weak in teamwork skills in the workplace.

Statement Ten: It was observed that overall 63.08% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Mechanical graduates of polytechnic institutes are weak in drawing and drafting skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (19.506) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (19.506) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Mechanical graduates of polytechnic institutes are weak in drawing and drafting skills in the workplace.

Statement Eleven: It was observed that overall 64.28% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Mechanical graduates of polytechnic institutes are weak in their professional skills in the workplace in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.66 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (20.426) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (20.426) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that

Mechanical graduates of polytechnic institutes are weak in their professional skills in the workplace in the workplace.

Statement Twelve: It was observed that overall 65.23% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Mechanical graduates of polytechnic institutes are weak in technological skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.71 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (19.872) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (19.872) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant Mechanical graduates of polytechnic institutes are weak in technological skills in the workplace.

Statement Thirteen: It was observed that overall 62.85% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Mechanical graduates of polytechnic institutes are weak in Hands-on skills in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.61 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (17.71) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (17.71) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Mechanical graduates of polytechnic institutes are weak in Hands-on skills in the workplace.

Table 5: Summary of the analysis Objective 1

Items No	WA	Chi-square observed (x^2)	Chi-square critical (x^2)	Remarks
1	3.70	23.046	9.49	The statement is accepted and statistically significant.
2	3.68	21.335	9.49	The statement is accepted and statistically significant.
3	3.67	22.794	9.49	The statement is accepted and statistically significant.

4	3.72	21.701	9.49	The statement is accepted and statistically significant.
5	3.70	28.441	9.49	The statement is accepted and statistically significant.
6	3.68	22.157	9.49	The statement is accepted and statistically significant.
7	3.62	17.472	9.49	The statement is accepted and statistically significant.
8	3.75	16.123	9.49	The statement is accepted and statistically significant.
9	3.67	35.094	9.49	The statement is accepted and statistically significant.
10	3.67	19.506	9.49	The statement is accepted and statistically significant.
11	3.66	20.426	9.49	The statement is accepted and statistically significant.
12	3.71	19.872	9.49	The statement is accepted and statistically significant.
13	3.61	17.710	9.49	The statement is accepted and statistically significant.

4.8 Analysis of Objective 2

(Recommend a model of curriculum development to meet the skills requirements of industries in Bangladesh)

Table 6: Analysis of Objective 2

Sl	Statements	N		SD	D	N	A	SA	WA	Chi-Square	df	Asm. Sig.
1	The curriculum of TVET institutions is not up-to-date based on industries demand.	210	f	24	28	25	55	78	3.64	19.190	4	0.001
			%	11.42	13.33	11.90	26.19	37.14				
2	Curriculum review is important for Curriculum development.	210	f	24	28	29	54	77	3.64	18.925	4	0.001
			%	11.42	13.33	13.80	25.71	36.66				
3	Curriculum development is a continuous process for TVET institutions based on technological changes.	210	f	26	27	28	53	76	3.60	17.784	4	0.001
			%	12.38	12.85	13.33	25.23	36.19				
4	Need analysis of occupational skills based on workplace skills is essential for Curriculum development.	210	f	24	28	25	54	79	3.65	19.015	4	0.001
			%	11.42	13.33	11.90	25.71	37.61				
5	Employability skills (soft and hard) verification and selection are necessary parts	210	f	25	28	26	53	78	3.62	18.634	4	0.001

	for Curriculum development.		%	11.90	13.33	12.38	25.23	37.14				
6	TVET institutions Curriculum should be focused on employability skills.	210	f	24	30	25	60	61	3.59	27.381	4	0.000
			%	11.42	14.28	11.90	28.57	29.04				
7	The bridging strategy of TVET institutions and industry's will be recommended in the areas of soft skills and hard skills for employability improvement.	210	f	24	33	23	60	70	3.57	25.866	4	0.000
			%	11.42	15.71	10.95	28.57	33.33				
8	The curriculum will be a guide to enhance the soft skills and hard skills of TVET students.	210	f	24	29	26	59	72	3.60	18.715	4	0.001
			%	11.42	13.80	12.38	28.09	34.28				
9	Industrial experts should be engaged in the curriculum development process.	210	f	27	27	27	60	69	3.56	15.842	4	0.003
			%	12.85	12.85	12.85	28.57	32.85				
10	TVET institutions and industry collaboration will be made a fruitful curriculum.	210	f	26	28	24	52	80	3.63	34.466	4	0.000
			%	12.38	13.33	11.42	24.76	38.09				
11	The curriculum model should follow the models of subject-centered, learner-centered, and problem-centered design.	210	f	25	27	24	57	77	3.64	23.135	4	0.000
			%	11.90	12.85	11.42	27.14	36.66				
12	Teaching-learning and assessment strategies are mentation in the curriculum.	210	f	26	26	23	57	78	3.64	23.108	4	0.000
			%	12.38	12.38	10.95	27.41	37.14				
13	The curriculum should be validated by curriculum specialists, industrial specialists, and institution specialists.	210	f	24	28	24	57	77	3.64	22.744	4	0.000
			%	11.42	13.33	11.42	27.14	36.66				

Statement one: It was observed that overall 63.33% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: The curriculum of TVET institutions is not up-to-date based on industries demand. Mean value of this statement is higher than 3.5 (4.49

> 3.64 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (19.190) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (19.190) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that the curriculum of TVET institutions is not up-to-date based on industries demand.

Statement Two: It was observed that overall 62.37% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Curriculum review is important for Curriculum development. Mean value of this statement is higher than 3.5 (4.49 > 3.64 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (18.925) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (18.925) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Curriculum review is important for Curriculum development.

Statement Three: It was observed that overall 61.42% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Curriculum development is a continuous process for TVET institutions based on technological changes. Mean value of this statement is higher than 3.5 (4.49 > 3.60 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (17.784) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (17.784) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Curriculum development is a continuous process for TVET institutions based on technological changes.

Statement Four: It was observed that overall 63.32 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Need analysis of occupational skills based on workplace skills is essential for Curriculum development. Mean value of this statement is higher than 3.5 (4.49 > 3.65 > 3.5) which means the statement is accepted. The

Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (19.015) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (19.015) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that need analysis of occupational skills based on workplace skills is essential for Curriculum development.

Statement Five: It was observed that overall 62.37 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Employability skills (soft and hard) verification and selection are necessary parts for Curriculum development. Mean value of this statement is higher than 3.5 (4.49 > 3.62 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (18.634) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (18.634) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Employability skills (soft and hard) verification and selection are necessary parts for Curriculum development.

Statement Six: It was observed that overall 57.61% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: TVET institutions Curriculum should be focused on employability skills. Mean value of this statement is higher than 3.5 (4.49 > 3.59 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (27.381) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (27.381) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that TVET institutions Curriculum should be focused on employability skills.

Statement Seven: It was observed that overall 61.90 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: The bridging strategy of TVET institutions and industry's will be recommended in the areas of soft skills and hard skills

for employability improvement. Mean value of this statement is higher than 3.5 (4.49 > 3.57 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.002, which is less than 0.05 level of significance. Chi-square observed (x^2o) (25.866) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (25.866) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that the bridging strategy of TVET institutions and industry's will be recommended in the areas of soft skills and hard skills for employability improvement.

Statement Eight: It was observed that overall 62.37 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: The curriculum will be a guide to enhance the soft skills and hard skills of TVET students. Mean value of this statement is higher than 3.5 (4.49 > 3.60 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.003, which is less than 0.05 level of significance. Chi-square observed (x^2o) (18.715) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (18.715) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that the curriculum will be a guide to enhance the soft skills and hard skills of TVET students.

Statement Nine: It was observed that overall 61.42 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Industrial experts should be engaged in the curriculum development process. Mean value of this statement is higher than 3.5 (4.49 > 3.56 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.003, which is less than 0.05 level of significance. Chi-square observed (x^2o) (15.842) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (15.842) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Industrial experts should be engaged in the curriculum development process.

Statement Ten: It was observed that overall 62.85% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts

were positive (agree/strongly agree) regarding the statement: TVET institutions and industry collaboration will be made a fruitful curriculum. Mean value of this statement is higher than 3.5 (4.49 > 3.63 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (34.466) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (34.466) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that TVET institutions and industry collaboration will be made a fruitful curriculum.

Statement Eleven: It was observed that overall 63.80 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: The curriculum model should follow the models of subject-centered, learner-centered, and problem-centered design. Mean value of this statement is higher than 3.5 (4.49 > 3.64 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (23.135) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (23.135) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that The curriculum model should follow the models of subject-centered, learner-centered, and problem-centered design.

Statement Twelve: It was observed that overall 64.55 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Teaching-learning and assessment strategies are mentation in the curriculum. Mean value of this statement is higher than 3.5 (4.49 > 3.64 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (23.108) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (23.108) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant Teaching-learning and assessment strategies are mentation in the curriculum.

Statement Thirteen: It was observed that overall 63.80 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: The curriculum should be validated by curriculum specialists, industrial specialists, and institution specialists. Mean value of this statement is higher than 3.5 (4.49 > 3.64 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (22.744) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (22.744) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that the curriculum should be validated by curriculum specialists, industrial specialists, and institution specialists.

Table 7: Summary of the Analysis of Objective 2

Items No	WA	Chi-square observed (x^2)	Chi-square critical (x^2)	Remarks
1	3.64	19.190	9.49	The statement is accepted and statistically significant.
2	3.64	19.925	9.49	The statement is accepted and statistically significant.
3	3.60	17.784	9.49	The statement is accepted and statistically significant.
4	3.65	19.015	9.49	The statement is accepted and statistically significant.
5	3.62	18.634	9.49	The statement is accepted and statistically significant.
6	3.59	27.381	9.49	The statement is accepted and statistically significant.
7	3.57	25.866	9.49	The statement is accepted and statistically significant.
8	3.60	18.715	9.49	The statement is accepted and statistically significant.
9	3.56	15.842	9.49	The statement is accepted and statistically significant.
10	3.63	34.466	9.49	The statement is accepted and statistically significant.
11	3.64	23.135	9.49	The statement is accepted and statistically significant.
12	3.64	23.108	9.49	The statement is accepted and statistically significant.
13	3.64	22.744	9.49	The statement is accepted and statistically significant.

4.9 Analysis of Objective 3

(Design a teaching-learning strategic framework for minimizing the skills gap with TVET institutes and industries in Bangladesh)

Table 8: Analysis of objective 3

Sl	Statements	N		SD	D	N	A	SA	WA	Chi-Square	df	Asm. Sig.
1	In the workplace, both hard skills and Soft skills are essential.	210	f	24	26	23	59	78	3.67	24.448	4	0.000
			%	11.42	12.38	10.95	28.09	37.14				
2	Institutes taught hard skills and Soft skills, which are required in the workplace.	210	f	23	26	24	58	79	3.69	23.440	4	0.000
			%	10.95	12.38	11.42	27.61	37.61				
3	TVET Institutions' teaching-learning strategies should be in accordance with industry needs.	210	f	23	27	25	57	78	3.67	22.857	4	0.000
			%	10.95	12.85	11.90	27.14	37.14				
4	Bridging strategies between industries and institutions are important for TVET graduates to build workplace skills.	210	f	23	27	24	56	80	3.68	21.132	4	0.000
			%	10.95	12.85	11.42	26.66	38.09				
5	Development of teaching-learning strategies, instructors should receive capacity development training on regular basis.	210	f	23	25	23	60	79	3.70	25.359	4	0.000
			%	10.95	11.90	10.95	28.57	37.61				
6	The institute should create a counseling and career planning department to serve as a center for demand-driven graduate development.	210	f	23	25	22	58	82	3.72	22.739	4	0.000
			%	10.95	11.90	10.47	27.61	39.04				
7	Industry experts should engage as guest lecturers to develop the learners' soft and hard skills.	210	f	24	26	24	57	79	3.67	22.668	4	0.000
			%	11.42	12.38	11.42	27.14	37.61				
8	Industrial training and industrial visit in relevant fields are very important for students' development of workplace skills.	210	f	24	26	23	63	74	3.65	29.487	4	0.000
			%	11.42	12.38	10.95	30	35.23				

9	Institutes should modify laboratory equipment and machinery to meet industry needs.	210	f	23	25	23	67	72	3.67	34.376	4	0.000
			%	10.95	11.90	10.95	31.90	34.28				
10	Project-based laboratories classes are important for professional skills development.	210	f	23	25	24	64	74	3.67	30.955	4	0.000
			%	10.95	11.90	11.42	30.47	35.23				
11	During the development of laboratory equipment and machinery in institutes, industry specialists were involved.	210	f	23	25	22	67	73	3.68	33.679	4	0.000
			%	10.95	11.90	10.47	31.90	34.76				
12	Industries should finance modifications to TVET institutes' laboratory equipment and machinery.	210	f	23	25	23	66	73	3.67	32.965	4	0.000
			%	10.95	11.90	10.95	31.42	34.76				

Statement one: It was observed that overall 65.23% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: In the workplace, both hard skills and Soft skills are essential. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (24.448) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (v) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that in the workplace, both hard skills and Soft skills are essential.

Statement Two: It was observed that overall 65.22% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Institutes taught hard skills and Soft skills, which are required in the workplace. Mean value of this statement is higher than 3.5 (4.49 > 3.69 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (23.440) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (23.440) > x^2c

(9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that institutes taught hard skills and Soft skills, which are required in the workplace.

Statement Three: It was observed that overall 64.28% industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: TVET Institutions' teaching-learning strategies should be in accordance with industry needs. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (22.857) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (22.857) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that TVET Institutions' teaching-learning strategies should be in accordance with industry needs.

Statement Four: It was observed that overall 64.75 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Bridging strategies between industries and institutions are important for TVET graduates to build workplace skills.. Mean value of this statement is higher than 3.5 (4.49 > 3.68 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (21.132) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (21.132) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that bridging strategies between industries and institutions are important for TVET graduates to build workplace skills.

Statement Five: It was observed that overall 66.18 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Development of teaching-learning strategies, instructors should receive capacity development training on regular basis. Mean value of this statement is higher than 3.5 (4.49 > 3.70 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is

less than 0.05 level of significance. Chi-square observed (x^2o) (25.359) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (25.359) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that development of teaching-learning strategies, instructors should receive capacity development training on regular basis.

Statement Six: It was observed that overall 66.65 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: The institute should create a counseling and career planning department to serve as a center for demand-driven graduate development. Mean value of this statement is higher than 3.5 (4.49 > 3.72 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (22.739) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (22.739) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that the institute should create a counseling and career planning department to serve as a center for demand-driven graduate development.

Statement Seven: It was observed that overall 64.75 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Industry experts should engage as guest lecturers to develop the learners' soft and hard skills. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.002, which is less than 0.05 level of significance. Chi-square observed (x^2o) (22.668) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (22.668) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that the Industry experts should engage as guest lecturers to develop the learners' soft and hard skills.

Statement Eight: It was observed that overall 65.63 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Industrial training and industrial visit in relevant fields are very important for students' development of workplace skills.

Mean value of this statement is higher than 3.5 (4.49 > 3.65 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.003, which is less than 0.05 level of significance. Chi-square observed (x^2o) (29.487) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (29.487) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that industrial training and industrial visit in relevant fields are very important for students' development of workplace skills.

Statement Nine: It was observed that overall 66.18 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Institutes should modify laboratory equipment and machinery to meet industry needs. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (34.376) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (34.376) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that institutes should modify laboratory equipment and machinery to meet industry needs.

Statement Ten: It was observed that overall 65.70 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Project-based laboratories classes are important for professional skills development. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (30.955) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (30.955) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that Project-based laboratories classes are important for professional skills development.

Statement Eleven: It was observed that overall 66.66 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: During the development of

laboratory equipment and machinery in institutes, industry specialists were involved. Mean value of this statement is higher than 3.5 (4.49 > 3.68 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.000, which is less than 0.05 level of significance. Chi-square observed (x^2o) (33.679) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (33.679) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that during the development of laboratory equipment and machinery in institutes, industry specialists were involved.

Statement Twelve: It was observed that overall 66.18 % industrial expert and institutes experts opined in the category of agree and strongly agree on statement one, which implies most of the experts were positive (agree/strongly agree) regarding the statement: Industries should finance modifications to TVET institutes' laboratory equipment and machinery. Mean value of this statement is higher than 3.5 (4.49 > 3.67 > 3.5) which means the statement is accepted. The Chi-square test was conducted at df = 4 with significant value of 0.001, which is less than 0.05 level of significance. Chi-square observed (x^2o) (32.965) was greater than the Chi-square critical (x^2c) (9.49), that is x^2o (32.965) > x^2c (9.49), for which the null hypothesis, responses on this item is not statistically significant, is rejected. Therefore it was statistically significant that industries should finance modifications to TVET institutes' laboratory equipment and machinery.

Table 9: Summary of the analysis objective 3

Items No	WA	Chi-square observed (x^2)	Chi-square critical (x^2)	Remarks
1	3.67	24.448	9.49	The statement is accepted and statistically significant.
2	3.69	23.440	9.49	The statement is accepted and statistically significant.
3	3.67	22.857	9.49	The statement is accepted and statistically significant.
4	3.68	21.132	9.49	The statement is accepted and statistically significant.
5	3.70	25.359	9.49	The statement is accepted and statistically significant.
6	3.72	22.739	9.49	The statement is accepted and statistically significant.
7	3.67	22.668	9.49	The statement is accepted and statistically significant.

8	3.65	29.487	9.49	The statement is accepted and statistically significant.
9	3.67	34.376	9.49	The statement is accepted and statistically significant.
10	3.67	30.955	9.49	The statement is accepted and statistically significant.
11	3.68	33.679	9.49	The statement is accepted and statistically significant.
12	3.67	32.965	9.49	The statement is accepted and statistically significant.

Analysis of Open-ended questions

There are 3 nos of open-ended question for all the participants. All the participant means 210 nos of responded participating the textual answer for individual question. Researcher found the areas of soft skills and hard skills in the workplace and how the skills gap fulfill from the institutions to enter before the job market. The responded written their ideas, views, and perceptions about soft and hard skills gap as well as the suggestion to bridge the skills gap between TVET graduates and employers to improve their employability. Each and individual question found a lots of ideas, views, and perceptions. The researcher listed all the answer against individual question. After that the researcher analysis the individual answer by thematic analysis. Which actually focused the importance of responded recommendation or suggestion or understanding against individual question.

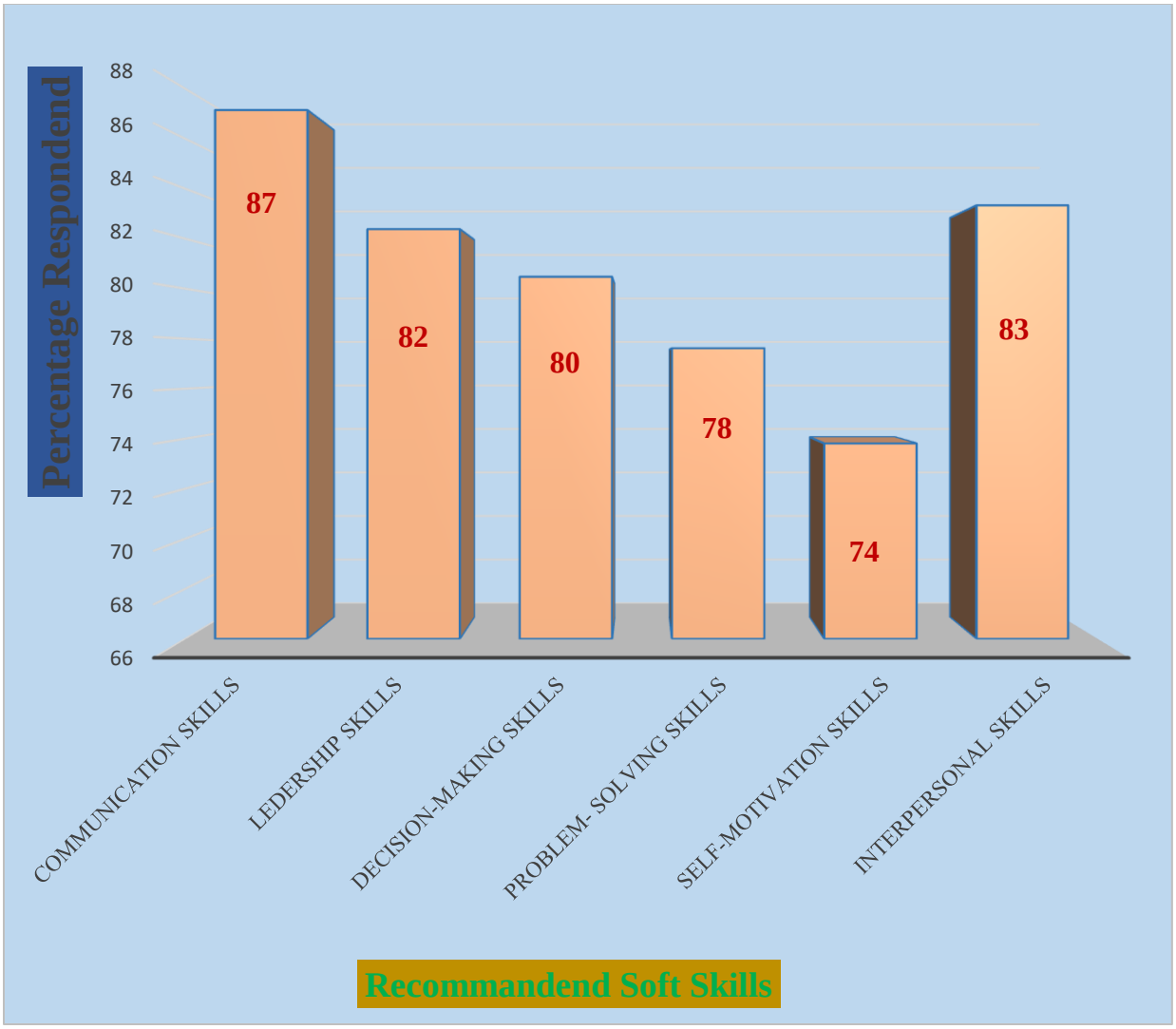


Figure 2: Recommended the required soft skills for TVET graduates in the workplace

The researcher found and categorized 6 nos of the theme of soft skills from responded textual answers. In each area of the theme, the researcher counts the number of the same answer among 210 nos of respondents. The researcher calculated the average percentage of counted areas of soft skills under a theme. The average responded percentage of themes are for communication skills 87%, for leadership skills 82 %, for decision-making skills 80 %, for problem-solving skills 78%, for self-motivation skills 74%, and for interpersonal skills 83%.

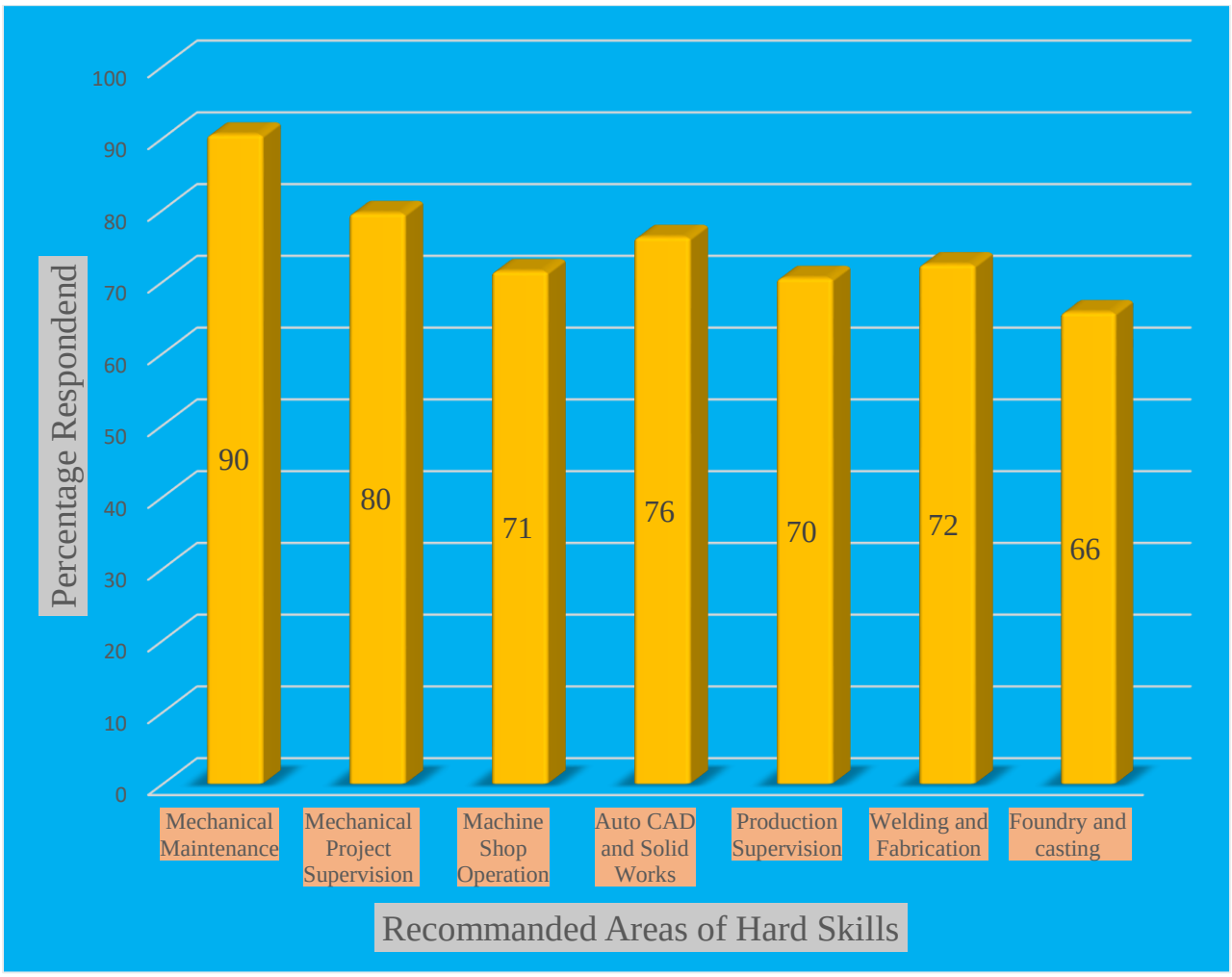


Figure 3: Recommended required hard skills for Mechanical Graduates of polytechnic institutions for the workplace

The researcher found and categorized 7 nos of the theme of hard skills from responded textual answers. In each area of the theme, the researcher counts the number of the same answer among 210 nos of respondents. Then the researcher calculated the average percentage of counted areas of hard (technical) skills under a theme. The average responded percentage of themes are for mechanical maintenance skills 90%, for mechanical project supervision skills 80 %, for machine (conventional & non-conventional) shop operation skills 71 %, for Auto CAD and solid works (drawing and drafting) skills 76%, for production (manufacturing) supervision skills 70%, for welding and fabrication skills 72%, and for foundry and casting skills 66%.

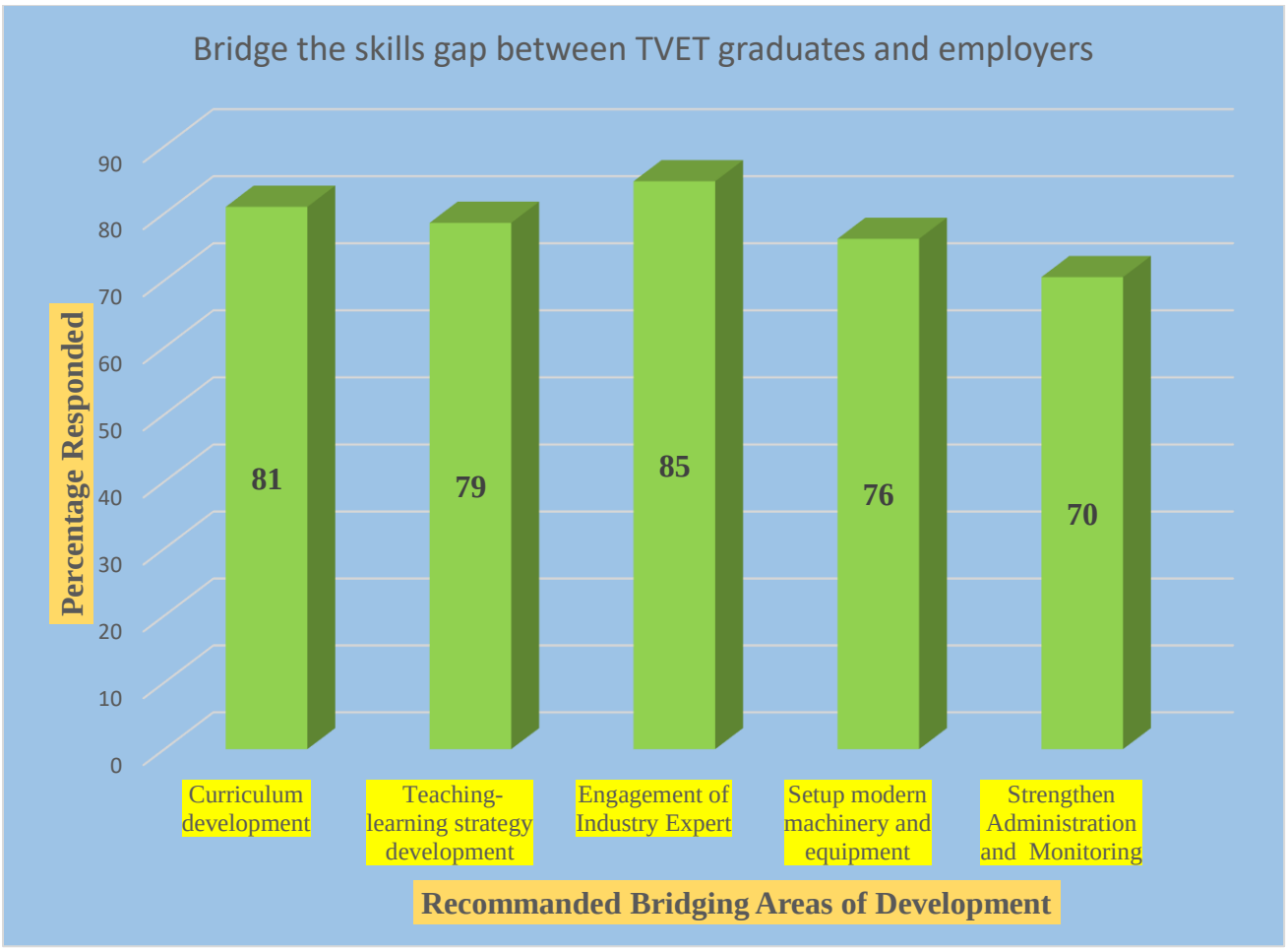


Figure 4: Suggestion to bridge the skills gap between TVET graduates and employers to improve employability

The researcher found and categorized 5 nos of the theme of bridging suggestion from responded textual answers. In each area of the theme, the researcher counts the number of the same answer among 210 nos of respondents. Then the researcher calculated the average percentage of counted areas of bridging suggestion under a theme. The average responded percentage of themes are for curriculum development or curriculum up-to-date 81%, for teaching-learning, and assessment strategy development 79%, for engagement of industries expert in institute 85%, for setup modern machinery and equipment's 76%, and for strengthen administrating and monitoring system.

CHAPTER 5 - DISCUSSIONS AND CONCLUSIONS

5.1 Summary

The purpose of the study is to identifying the skills gap of the TVET graduate in light of skills required of industries in Bangladesh, recommended a model of curriculum development cope up the skills requirements of industries, and developed a teaching-learning strategic framework to minimizing the skills gap of TVET graduate considering industries in Bangladesh to enhance employability. The study was carried out on the basis of the following objectives:

- What are the areas of skills gap of the Polytechnic graduate in the field of Mechanical Engineering considering industry demand?
- How recommend a model of curriculum development cope up the skills requirements of industries in Bangladesh?
- How teaching-learning strategic framework minimizing the skills gap with TVET institute and Industries in Bangladesh?

The study highlighted the skills (soft skills and hard skills) gap of the TVET graduate in light of skills required in industries in Bangladesh. The analysis reviled that the participant gave overall positive opinion towards the skills (soft skills and hard skills) gap of the TVET graduate in light of skills required in industries in Bangladesh, up-to-date curriculum development as per industries, and a teaching-learning strategic framework to minimizing the skills gap of TVET graduate considering industries. For the statement wise opinion, 210 nos responded responses were on a five-point rating scale i.e. strongly agree to strongly disagree. Category percentage, weighted average, chi-square test were conducted on the responses of each statement of the questionnaires to analyze and interpret the data through SPSS software version 25 and to check whether responses opinion on the statement is significant or not.

5.2 Findings

Findings of the study classified in three sections:

- Finding from research statements or research questionnaires

- Finding according to the objectives.
- Finding according to the open-ended question

In section one there are three categories with total 38 nos of research questionnaires or items or statements, in section two there are three research objectives, and the open-ended question there are three textual question.

5.2.1 Findings from research statement

- Most of the TVET (polytechnic) graduates in Bangladesh have a Soft skills Gap in accordance with the industry's needs.
- Most of the Mechanical engineering TVET (polytechnic) graduates in Bangladesh have a hard skills Gap in accordance with the industry's needs.
- Most of the TVET (polytechnic) students have no previous ideas about employability skills in light of skills required of industries in Bangladesh.
- There is no industry-institute collaboration strategy to meet up the skills gap among TVET (polytechnic) graduates in Bangladesh.
- The curriculum of TVET institutions is not up-to-date in accordance with the industry's needs.
- Baseline survey for occupational skills are not available before curriculum development.
- Lack of teaching-learning strategy for development of soft skills and hard skills for TVET (polytechnic) institutions.
- Instructors of TVET institutions are not train up regularly for capacity development training in skills and knowledge.
- TVET institutions laboratories, equipment's and machineries are not updated.
- Institutes have no strategies to engagement of industrial expert in teaching-learning and practical assessment.

5.2.2 Findings according to objective

Objective One: The results from the analysis showed that there is a skills (soft skills and hard skills) gap of the polytechnic graduate in the field of mechanical engineering considering industries

demand. The analysis and interpretation of collected data indicates that the overall responses on this objective was statically significant and accepted. The overall weighted average is 3.68 and chi-square (x^2) test is 21.975. So that it means the areas of skills gap of the polytechnic graduate in the field of mechanical engineering considering industries demand is believable.

Objective Two: The results from the analysis showed that a model of curriculum development to meet the skills requirements of industries in Bangladesh is important. The analysis and interpretation of collected data indicates that the overall responses on this objective was statically significant and accepted. The overall weighted average is 3.62 and chi-square (x^2) test is 21.985. So that it means a model of curriculum development to meet the skills requirements of industries in Bangladesh is obligatory.

Objective Three: The results from the analysis showed that a teaching-learning strategic framework is needed for minimizing the skills gap with TVET institutes and industries in Bangladesh. The analysis and interpretation of collected data indicates that the overall responses on this objective was statically significant and accepted. The overall weighted average is 3.68 and chi-square (x^2) test is 27.009. So that it means designing a teaching-learning strategic framework is needed for minimizing the skills gap with TVET institutes and industries in Bangladesh is acceptable.

5.2.3 Finding according to open-ended questions

- The thematic areas of soft skills gaps are: communication skills, leadership skills, decision-making skills, problem-solving skills, self-motivation skills, and interpersonal skills.
- The thematic areas of hard skills gaps are: mechanical maintenance skills , Mechanical project supervision skills , machine (conventional & non-conventional) shop operation skills , Auto CAD and solid works (drawing and drafting) skills, Production (manufacturing) supervision skills ,Welding and fabrication skills , and foundry and casting skills .
- The thematic bridging areas of industry-institute collaboration are: Curriculum development or curriculum up-to-date, teaching-learning and assessment strategy

development, engagement of industries expert in institute, setup modern machinery and equipment's, and strengthen administrating and monitoring system.

5.3 Recommendation

This study investigated Industrial Expert (HR and engineering department, graduate of mechanical engineering who engage in job) and Institutional Expert (instructors, job placement expert from institute, TVET administrator/expert, curriculum Specialist) perception about to identifying the skills gap of the TVET graduate in light of skills required in industries in Bangladesh to enhance employability with three specific objectives (i) To find out the areas of Skills gap of the Polytechnic graduate in the field of Mechanical Engineering considering industry demand , (ii) To recommend a model of curriculum development to cope up the skills requirements of industries in Bangladesh , (iii) To design a teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh to established "Developing a pedagogical model for bridging the skills gap between TVET institutions and industries in Bangladesh". After analyzing, discussion of finding the objective wise recommendation of researcher are given below:

Recommendation of Objective One:

I. It is very important to awareness students about soft skills development by engaging industrial expert. And prepare a guideline for soft skills development and the some of the areas of guideline carried a percentage of marks for semester final examination. Example: Power point presentation for each subject, research based assignment for each subject, etc.
II. Founded list of the recommended hard skills are priority of the TVET students and administrator of the institutes. And also focused on development the muscular dexterity, hand-on skills, modern technological skills, machine operation and maintenance skills, etc.
III. Industrial expert engagement is important in laboratory classes for developing the hard skills.
IV. Industry-institute collaboration is a vital issues which imposed by the government by provided law.
V. Established a bridging hub/center in institutions among institutions, industry expert and government representative which execute from institutions.

Recommendation of Objective Two:

The researcher recommended below IIBTD Model of Curriculum development for the TVET institutions to cop up the industries based required skills. The researcher arranged a half-day workshop for validation of this IIBTD Model of Curriculum Development by 9 nos of respondents among 210 nos like curriculum specialists and instructors. The IIBTD Model of Curriculum development is theoretically approved. The researcher believes that this theoretical IIBTD Model of Curriculum Development can cope with the required employability skills of TVET graduates considering the industries of Bangladesh. The curriculum of TVET institutions have to be up-to-date and review in every 3 years based on industries demand.

Figure 5: Recommended a IIBTD Model of Curriculum Development

As per objective two, the researcher developed a curriculum development model to cope with the required skills of industries. The model is integrated with the researcher's conceptual TIAIB model, DACUM, and Hilda Taba's curriculum development model. The recommended Model of Curriculum Development is the theoretical IIBTD model of Curriculum Development. In this IIBTD model, there is a permanent relationship between industrial experts and institutional experts by preparing a knowledge-sharing committee. Before developing the curriculum this KSC (Knowledge sharing committee) sat together in a day-long workshop to share the industry's requirements of skills and present curriculum status. After that, a selected team works in a field for an occupation-based baseline survey on knowledge and skills needed by industries. Then they present their findings in front of KSC for validation and diagnosis of skills needed for TVET students. After that KSC formulated a program/learning objectives and outcomes. And then next institutions' experts organize courses and content from validation and diagnosis of skills needed for TVET students, then organizing teaching-learning materials. Next provided effective teaching-learning and finally evaluation by the institute's expert. Then again industrial experts and institutional experts discuss and share knowledge sharing. Some of the major point are:

I. Industrial expert in relevant occupation have to be engaged in curriculum development.
II. The curriculum should be validated by curriculum specialists, industrial specialists, and institution specialists.
III. As per finding areas of soft skills and hard skills have to be introduced in the period of curriculum development.
IV. Arranged regular basis a knowledge shearing workshop between Industrial expert and institute expert by the institutional authority / administrator.
V. Piloting the recommended model of curriculum development.

Recommendation of Objective Three:

The researcher recommended below Teaching-learning strategic framework for TVET institutions minimizing the skills gap. The researcher arranged a half-day workshop for validation of this Teaching-learning strategic framework by 11 nos of respondents among 210 nos like TVET administrators and instructors. The strategic framework is theoretically approved. The researcher

believes that this Teaching-learning strategic framework minimizing the skills gap with TVET institute and Industries in Bangladesh.

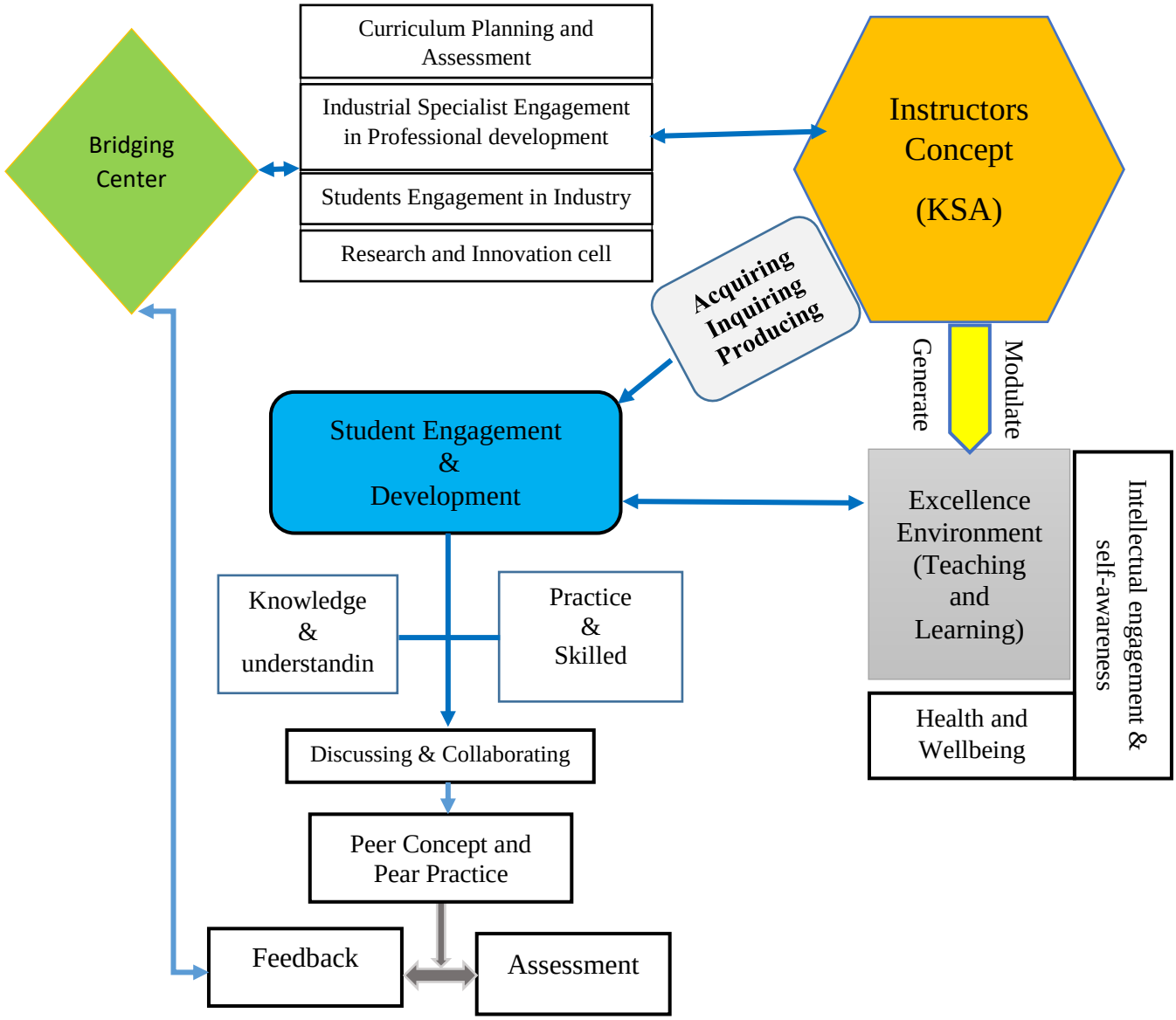


Figure 6: Teaching-learning strategic framework

As per objective three, the researcher developed a Teaching-learning strategic framework to minimize the skills gap between TVET institutes and Industries in

Bangladesh. The strategic framework is integrated with the researcher's conceptual TIAIB model and a Pedagogical model of the education state. In this teaching-learning strategic framework, it is very important to build a bridge center among industry experts and instructors as an institution's experts. The prime activity of the bridge center is knowledge and skills sharing for ideas generated by instructors and industrial experts. In most of the cases bridge center works with curriculum planning and assessment, industrial expert's engagement for student's professional development, Students Engagement in Industry, Research and Innovation for institutional and industrial development.

The teaching-learning strategic framework focused on the teacher's knowledge, skills, and attitude to the student's engagement and development as well as the institutional excellence environment. Basically in one sentence, a teaching-learning strategic framework is a strategic framework that ensures the learner's understanding and skills. So the teaching-learning strategic framework instructor concept directly works with an excellent environment and student engagement and development. Instructors generate and modulate the environment by ensuring intellectual engagement and self-awareness of health and wellbeing. And acquiring, inquiring, and producing the student engagement and development. Where students discuss & Collaborating knowledge and practice and group work. After that assessment of the learners about their development and feedback on the status to the bridge center for further discussion between industry experts and instructors as an institution's experts. Some of the major point are:

- The teaching-learning strategic framework will be developed both the hard skills and Soft skills.
- TVET Institutions' teaching-learning strategies should be in accordance with industry needs.
- Development of teaching-learning strategies, instructors should receive capacity development training on regular basis.
- Industrial training and industrial visit in relevant fields are very important for students' development of workplace skills.
- Institutes have to be advised modify laboratory equipment and machinery to meet industry needs.
- Project-based laboratories classes are important for professional skills development.
- Industrial experts engaged to modifying the laboratories classes

5.4 Implication

Developing a pedagogical model for bridging the skills gap between TVET institutions and industries in Bangladesh. The identified areas of skills (soft skills and hard skills) gap of the TVET graduate in light of skills required in industries in Bangladesh to enhance employability may provide as a guideline for TVET students. Jobless TVET graduate may recognize the area of skills (soft skills and hard skills) which may essential for his/her immediate employment. Industries institutes collaboration meet up these areas of skills gap by the knowledge sharing discussion with TVET facilitator/ instructors. TVET facilitator may include the areas of soft skills and hard skills in TVET (polytechnic) sector for mechanical engineering so that the future graduates will have these skills. These identified areas of hard skills and soft skills may include in curriculum for competency development of TVET graduates which will facilitate to nationally-recognized in diploma in engineering curriculum for mechanical technology.

Industries cooperation in skill development may reduce the repetition of skill development program; reduce the competition of TVET graduate for the same skill training. Industries collaboration with TVET institution's skill training program will provide clear picture of skills acquired by TVET graduates. Collaboration of industrial management and TVET facilitator will significantly improve the skills development program without increasing the financial support and resources. More so, identifying the skills gap between industry and institution may provide knowledge about the industries skills requirement.

To incorporate the industries need for future skills recommend a model of curriculum development for TVET institutions to cope up the skills requirements of industries in Bangladesh. And also designed a teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh

Existing literature: This study provides an insight into a new areas of soft skills and hard skills gap and make up this gap the study provided a strategical collaborating plan for TVET institutes and industries. Also provided a recommend a model of curriculum development for TVET institutions to cope up those identified skills requirements of industries with designed a teaching-

learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh. Which was not been reported in prior literature.

Practice: The findings of this study may serve as an insight to the progress made so far, against the goals related to the skills development in TVET (polytechnic) institution of Bangladesh.

5.5 Conclusion

The title developing a pedagogical model for bridging the skills gap between TVET institutions and industries in Bangladesh. The aim of the study was identified the areas of skills (soft skills and hard skills) gap of the TVET graduate in light of skills required in industries in Bangladesh to enhance employability. It is may provide as a guideline for TVET students, instructors, administrators, policy makers, and TVET specialist. The researcher also recommend a model of curriculum development for TVET institutions to cope up the skills requirements of industries in Bangladesh. This model of curriculum development work as a required based skills development of industries. Furthermore the researcher designed a teaching-learning strategic framework for minimizing the skills gap with TVET institute and Industries in Bangladesh. And this teaching-learning strategic framework is a very effective and transparent structure for instructors, administrators, students, and industries expert.

All the three objectives identified the result and provided the recommendation. The researcher confident that the finding areas of soft skills and hard skills gap is very important for TVET graduate and to bridge this skills gap industries-institutions collaboration is time needed. To minimize the skills gap of TVET graduates the developed model of curriculum development is very significant and if the institutes implement this teaching-learning strategic framework that will be minimizing the skills gap with TVET institute and Industries in Bangladesh.

Reference

Okon, E. E. (2019). Vocationalisation of TVET through institution industry collaboration: bridging the skill gap. *Nigerian Journal of Business Education (NIGJBED)*, *6*(2), 421-443.

Ayonmike, C. S., & Okeke, B. C. (2016). Bridging the skills gap and tackling unemployment of vocational graduates through partnerships in Nigeria. *Journal of Technical Education and Training*, *8*(2).

Oviawe, J. I., Uwameiye, R., & Uddin, P. S. (2017). Bridging skill gap to meet technical, vocational education and training school-workplace collaboration in the 21st century. *International Journal of vocational education and training research*, *3*(1), 7-14.

Singh, B., & Tolessa, M. B. (2019). TVET-Industry Linkage and Collaboration in Ethiopia: A Necessity for Improving Employability Skill. *International Research Journal of Engineering and Technology*, *6*(11), 3526-3532.

Diop, M. (2020). *The Effectiveness of TVET (Technical and Vocational Education and Training) in Bridging the Skills Gap in Rwanda*. Wilmington University (Delaware).

Usoro, A. D., Essien, E. O., & George, W. K. (2018). Bridging TVET Psychomotor Skills Gap in Tertiary Institutions for Self-Reliance and Economic Recovery. 6.

Raihan, A. (2014). Collaboration between TVET institutions and industries in Bangladesh to enhance employability skills. *International Journal of Engineering and Technical Research (IJETR)*, *2*(10), 50-55.

Mitiku, G., Zeleke, B., & Adem, B. Examining the Role of TVET-Industry Partnership on the Acquisitions of Employability Skills of Polytechnic Graduates in Oromia.

Widiastuti, I., Saputra, T. W., Noviansyah, W., & Trianingsih, L. (2021, March). TVET Institutions' Perspective on Implementation of Public-Private Partnerships Model in The

Southeast Asia Countries. In *Journal of Physics: Conference Series* (Vol. 1808, No. 1, p. 012007). IOP Publishing.

McGunagle, D., & Zizka, L. (2020). Employability skills for 21st-century STEM students: the employers' perspective. *Higher education, skills and work-based learning*.

Islam, T. (2018). *Skills gap assessment between TVET institutes and industries of Bangladesh: Electronics Industries perceptions* (Doctoral dissertation, Department of Technical and Vocational Education, Islamic University of Technology, Board Bazar, Gazipur, Bangladesh).

Lowyck, J. (2002). Pedagogical design. In *Handbook on information technologies for education and training* (pp. 199-217). Springer, Berlin, Heidelberg.

Scupelli, P., Wasserman, A., Wells-Papanek, D., & Brooks, J. (2018, August). The futures of design pedagogy, learning, and education. In *21st DMI: Academic Design Management Conference, Next Wave* (pp. 1-2).

Huang, T. C., & Shu, Y. (2010). A study on curriculum development model constructed for computer and information engineering education. In *A paper presented at the Joint International IGIP-SEFI Annual Conference, Trnava, Slovakia*.

Mohanasundaram, K. (2018). Curriculum design and development. *Journal of applied and advanced research*, *3*(1), 4-6.

United Nations Educational, Scientific and Cultural Organization. (2012). Youth and skills: Putting education to work. *EFA Global Monitoring Report, 2012*.

McKenney, M. J., & Handley, H. A. (2019, November). Identifying and quantifying personnel skill gaps. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 63, No. 1, pp. 332-336). Sage CA: Los Angeles, CA: SAGE Publications.

Paju, B. (2021). An expanded conceptual and pedagogical model of inclusive collaborative teaching activities.

Bhuttah, T. M., Xiaoduan, C., Ullah, H., & Javed, S. (2019). Analysis of curriculum development stages from the perspective of Tyler, Taba and Wheeler. *European Journal of Social Sciences*, *58*(1), 14-22.

Gulzar, A. A. (2021, May 1). *Educare*. Retrieved from Educare: https://educarepk.com/taba-model-of-curriculum-development.html

Sanyog Bhattarai, M. S. (2022). *Training Manual on DACUM: Developing a curriculum* . Metro Manila: Colombo Plan Staff Collage (CPSC).

Appendix A

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
Department of Technical and Vocational Education
Board Bazar Gazipur – 1704 Dhaka Bangladesh

QUESTIONNAIRE

Dear Respondent/Sir,

A humble request for completion of the below questionnaires

As a student of Master of Science in TVE (Mechanical Engineering specialization) of Islamic University of Technology (IUT), I am conducting academic research by supervising **Prof. Dr. Md. Abu Raihan, Professor, TVE Department**, entitled "**Developing a pedagogical model for bridging the skills gap between TVET institutions and industries in Bangladesh".** In this endeavor, I wish to collect data from **Industrial experts** (HR Department, Manager of Engineering Department, Graduates student who engaged in Job) and **Institutional experts** (Instructors, Job Placement cell, Administrator, Curriculum Specialist of TVET System, others officials of TVET System).

Your response will strictly be used only for research purposes. Your name and identity will always be kept confidential and must be treated with strict confidentiality.

Please note that your honest response will have a significant impact on this research and will be highly appreciated.

Terminologies Used

TVET: Technical and Vocational Education and Training

Institutions: Polytechnic Institution in Bangladesh, and Relevant Authority of System

Industries: Workplace of Polytechnic graduates of Mechanical Engineering and Authority of workplace

Section A: General Information

Please choose the best answer that applies to you and circle one correct letter (A, B, C, D, E or F)

1. **Which category are you from?**

   A. Industry

   B. Institute

2. **What is your gender?**

   A. Male

   B. Female

3. **What is your Job title?**

   A. Manager

   B. Engineer

   C. Jr. /Sub. Asst. Engineer

   D. Instructor

   E. Curriculum Specialist

   F. TVET Administrator/ TVET Expert

4. **What is your Age Level?**

   A. 21-25 Years

   B. 26-30 Years

   C. 31-35 Years

   D. 36-40 Years

   E. Above 41 Year

***Section B*: Research questions**

Questionnaire for objective 1: Find out the areas of skills gap of the polytechnic graduate in the field of mechanical engineering considering industries demand.

For each of the questions below, tick (✓) the response that best characterizes how you feel about that statement.

(Strongly disagree=1, Disagree=2, Neutral=3, Agree=4, strongly agree=5)

Sl	Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Polytechnic graduates are weak in interpersonal skills in the workplace.					
2	Polytechnic graduates are weak in critical thinking skills in the workplace.					
3	Polytechnic graduates are weak in creativity & innovation skills in the workplace.					
4	Polytechnic graduates are weak in adaptability skills in the workplace.					
5	Polytechnic graduates are weak in self-motivation skills in the workplace.					
6	Polytechnic graduates are weak in time management skills in the workplace.					
7	Polytechnic graduates are weak in problem-solving skills in the workplace.					
8	Polytechnic graduates are weak in decision-making Skills in the workplace.					
9	Polytechnic graduates are weak in teamwork skills in the workplace.					
10	Mechanical graduates of polytechnic institutes are weak in drawing and drafting skills in the workplace.					
11	Mechanical graduates of polytechnic institutes are weak in their professional skills in the workplace in the workplace.					
12	Mechanical graduates of polytechnic institutes are weak in technological skills in the workplace.					
13	Mechanical graduates of polytechnic institutes are weak in Hands-on skills in the workplace.					

Questionnaire for objective 2: Recommend a model of curriculum development to meet the skills requirements of industries in Bangladesh

For each of the questions below, tick (✓) the response that best characterizes how you feel about that statement.

(Strongly disagree=1, Disagree=2, Neutral=3, Agree=4, strongly agree=5)

Sl	Statements	Disagree	Strongly disagree	No option	Agree	Strongly agree
1	The curriculum of TVET institutions is not up-to-date based on industries demand.					
2	Curriculum review is important for Curriculum development.					
3	Curriculum development is a continuous process for TVET institutions based on technological changes.					
4	Need analysis of occupational skills based on workplace skills is essential for Curriculum development.					
5	Employability skills (soft and hard) verification and selection are necessary parts for Curriculum development.					
6	TVET institutions Curriculum should be focused on employability skills.					
7	The bridging strategy of TVET institutions and industry's will be recommended in the areas of soft skills and hard skills for employability improvement.					
8	The curriculum will be a guide to enhance the soft skills and hard skills of TVET students.					
9	Industrial experts should be engaged in the curriculum development process.					
10	TVET institutions and industry collaboration will be made a fruitful curriculum.					
11	The curriculum model should follow the models of subject-centered, learner-centered, and problem-centered design.					
12	Teaching-learning and assessment strategies are mentation in the curriculum.					
13	The curriculum should be validated by curriculum specialists, industrial specialists, and institution specialists.					

Questionnaire for objective 3: Design a teaching-learning strategic framework for minimizing the skills gap with TVET institutes and industries in Bangladesh

For each of the questions below, tick (✓) the response that best characterizes how you feel about that statement

(Strongly disagree=1, Disagree=2, Neutral=3, Agree=4, strongly agree=5)

Sl	Statements	Disagree	Strongly disagree	No option	Agree	Strongly agree
1	In the workplace, both hard skills and Soft skills are essential.					
2	Institutes taught hard skills and Soft skills, which are required in the workplace.					
3	TVET Institutions' teaching-learning strategies should be in accordance with industry needs.					
4	Bridging strategies between industries and institutions are important for TVET graduates to build workplace skills.					
5	Development of teaching-learning strategies, instructors should receive capacity development training on regular basis.					
6	The institute should create a counseling and career planning department to serve as a center for demand-driven graduate development.					
7	Industry experts should engage as guest lecturers to develop the learners' soft and hard skills.					
8	Industrial training and industrial visit in relevant fields are very important for students' development of workplace skills.					
9	Institutes should modify laboratory equipment and machinery to meet industry needs.					
10	Project-based laboratories classes are important for professional skills development.					
11	During the development of laboratory equipment and machinery in institutes, industry specialists were involved.					
12	Industries should finance modifications to TVET institutes' laboratory equipment and machinery.					

Section C: Open-ended questions

1. **List the names of the soft skills which are required for TVET graduates in the workplace?**

2. **List the names of the hard skills which are required of mechanical graduates from polytechnic institutes for the workplace?**

3. **Is there any suggestion: how to bridge the skills gap between TVET graduates and employers to improve their employability?**

Thanks for your maximum support,

Kind Regards

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