Volume 9, Issue 10, October– 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

Exploring the Essential Higher Order Cognitive Skills (HOCS) for the Employability of Engineering Graduates in Bangladesh

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Abstract:- Employability of engineering graduates is largely impacted by their higher order cognitive skills. In addition to their academic knowledge and technical capabilities, graduates need HOCS. Employers give a larger value on HOCS than on technical abilities. For career-long employment sustainability, these skills are essential success factors. Employability is significantly correlated with HOCS. To succeed in the job, engineers require HOCS. Technical skills are valued by employers throughout the hiring process, but as engineering careers progress, employers give more emphasis on HOCS. However, not every level of a person's career requires the same set of HOCS. At a certain point in a career, employers look for different HOCS. Starting with early career, moving through mid-career, and ending with advanced career, this research attempts to uncover those HOCS accountable for workplace success meeting employer's expectations. Both graduates with a diploma and a bachelor's degree in engineering have been covered by this study. The majority of engineers share the same Intelligent Quotient (IQ) on an average. Technical skill gaps are easily bridged with quick trainings. The only things that set engineers apart from the masses are HOCS, which are primarily higher order brain-based executive functions. Employability is influenced by numerous factors. Only the employability's absolute dimension is the subject of the inquiry. Absolute dimension is contingent upon the candidate's skill sets. It is true that having technical abilities is a requirement for employment. But in addition to technical skills, modern employers now prioritize HOCS. It is an indisputable fact that engineer's HOCS play a major role in their Annual Compensation Review (ACR). The study identifies 14 distinct HOCS that engineers need. Since not all skills are equally valuable at every point of a career, they are grouped according to career stage.

Keywords:- *Higher Order Cognitive Skills, HOCS, Non-Technical Skills, Employability.*

I. INTRODUCTION

➢ *Research Background*

The employability of engineering graduates is greatly influenced by HOCS. Beyond their academic background and technical proficiency, graduates require higher order cognitive skills. Above and beyond technical talents, employers place a greater value on HOCS For long-term work sustainability over a career, these abilities are essential. Significant relationships exist between employability and HOCS. To succeed in their careers, engineers require HOCS. When hiring new employees, employers place a high priority on technical talents; but, as engineering careers progress, employers place an even greater emphasis on HOCS. Every level of a person's career has different requirements for HOCS. At particular stages of the career, employers look for specific HOCS. The goal of this study is to pinpoint the cognitive abilities that, at every career stage - from early to advanced - are essential for achieving success in the workplace and meeting employer expectations. Eighty percent of employers of recent engineering graduates stated that one important area in which educational institutions need to improve student training is higher order skills. Studies indicate that graduate's employability is mostly dependent on their HOCS; engineers, on the other hand, are most likely to lack these competencies. This research encompasses graduates holding both a Diploma in Engineering and a Bachelor of Science in Engineering degrees. The majority of diploma engineers pursue B.Sc engineering degrees concurrently with their careers. HOCS are essential for engineers to succeed in their careers, regardless of their degree or diploma.

➢ *Statement of the Problem/Problem to be Solved*

Technical skills are traditionally strong points for engineers. What makes them proud are their hard skills. Students tend to lay greater emphasis on learning technical information while in institute, but they also overlook the fact that engineers must be able to interact with people in addition to machines, which calls for a broad variety of cognitive skills. Even while recruiters value HOCS just as highly as technical skills, Bangladeshi engineering curricula do not adequately address these areas, despite the fact that having these talents greatly increases employability. Nontechnical abilities are necessary for both obtaining and keeping a job. The majority of engineers share the same Intelligent Quotient (IQ) on an average. Technical skill gaps are easily linked with quick trainings. The only things that set engineers apart from the masses are HOCS, which are primarily brain-based higher-order cognitive capabilities. While polytechnics are providing diploma engineers for the nation, universities and colleges are producing graduates and postgraduates. I wish to investigate what HOCS, engineering graduates must possess. The majority of engineers are technically proficient, and they need these abilities for their professions. It is also true that, all HOCS are not always necessary for all stages of career. Certain abilities

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

are more crucial than others. As such, identifying such skills and classifying them according to career level is crucial.

➢ *Research Aims*

The aims of the research are as follows:

- To find the all-possible HOCS for the employability of engineering graduates in Bangladesh.
- How do these HOCS describe employability for the engineers?
- Develop a model based on grounded theory.

➢ *Research Objectives & Research Questions*

Generally, research has two objectives which are as follows:

- Filling knowledge gap and
- Solving problem

Filling knowledge gap is a traditional way of research that is literature-driven and very close to positivism. Deductive reasoning and testing hypotheses statistically are the main attractions of this kind of research which is quantitative. Whereas, solving problem is very close to interpretivism. It is a kind of qualitative research. Interviews and qualitative analysis from the collected data are the main attractions of this kind of research. The objective of this research is to solve problems that how engineering graduates can enhance their employability at the different stages of their career. In order to solve this problem, a certain extent of literature survey would be required which is described in the literature review section. The aim of the research is to produce a readymade guideline to engineering graduates, educational institutes, and industries on how to increase employability at the different stages of engineering career. This is the novelty and newness of this study. This research falls mostly to the solving problem side and partly to the filling knowledge gap side.

➢ *The Central Question*

- What are the possible HOCS that enhance the employability of engineering graduates?

➢ *Sub Questions*

- What are the most important HOCS in the early career of engineering graduates?
- What are the most important HOCS in the mid-career of engineering graduates?
- What are the most important HOCS in the advanced career of engineering graduates?

➢ *Expected Outcomes of the Research*

- Those who are working on curricula development can get complete insights on how to include courses on HOCS.
- In order to improve the HOCS of their engineers, practitioners can also organize the required training programs and get insight.

➢ *Contribution to Existing Knowledge and Practice*

- The academic community can learn important employability skills for engineering graduates in the context of developing nations like Bangladesh, which could add value to the existing literature.
- Based on study findings, academic institutions can provide their students with the minimum of HOCS needed for the graduate in production phase.
- Additionally, industry can obtain readymade guidelines for training of the engineers and improving skills through ongoing training initiatives.

➢ *Scope and Limitations*

The research comprises the following scope:

- Exploring the possible HOCS required for the engineering graduates from the private organizations.

- *Following are the constraints of this study:*

✓ Engineers representing electrical, civil, mechanical and computer engineering departments
✓ Internal factors of employability
✓ Absolute dimension of employability
✓ Data collected from the Dhaka city
✓ Qualitative data from private organizations
✓ Theoretical sampling

II. LITERATURE REVIEW

➢ *What is Skill?*

Skill is the capacity to do an action with excellence (Google, 2024). According to Wikipedia (2024), skill is the acquired capacity to carry out an action with predetermined outcomes in a specific amount of time, energy, or both. Because economics, sociologists, and physiologists all define skills differently, the concept of skill can be a little hazy. In 2011, Professor Green summed up the idea of skill using three schools of thought: in economics, skill is the key component of human capital, which is the potential for future and present income. Income and skill are related. The variable that determines how income is distributed in society is skill. In society, people with higher skill levels make more money. The core idea of skill in sociology is that skills are the main factor that determine social classes. Because those with lower skill levels occasionally earn more money than those with higher skill levels, market valuation is not always based on skill. In psychology, competence and skill are related, and skill is everything that contributes to the development of competency. According to Green (2011), skill is divided into three categories: social (determined by social factors), expandable (improved through training and practice), and productive (value addition). Skills also include mental and physical aptitudes (Barrow, 1987).

➢ *Hard Skills*

Hard skills are technical, domain-specific abilities needed to do particular activities. Hard skills are cognitive abilities that are influenced by an individual's IQ (Ahmad &

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

Idris, 2019). Hard skills cannot be converted; they are created and represented physically (Holbrook, 2009). According to Attia and Salama (2018), hard skills are knowledge that is simple to record and cultivate. From an educational background, hard skills are easily taught, quantified, and measurable. Hard skills are the factual knowledge and technical aptitudes required to carry out tasks in the workplace (Klaus, 2007). Hard skills are characteristics that are directly learned and contribute to the development of engineering expertise. Hard skills are observable, quantitative, and measurable (Rao, 2018).

➢ *Cognitive Functioning*

Processing thoughts is referred to as cognitive functioning. It is described as a person's capacity to carry out the different mental tasks that are most directly related to learning and solving problems. Verbal, spatial, psychomotor, and processing-speed abilities are a few examples. The term "cognition" mostly relates to abilities like speech, remembering, and learning new knowledge. The brain is normally able to form individual ideas and worldviews as well as acquire new abilities in the above listed domains, usually in early childhood. Cognitive decline brought on by aging and illness can result in memory loss and difficulty coming up with words to write or say ("drawing a blank"). For example, multiple sclerosis (MS) can eventually result in verbal fluency loss, memory loss, and difficulty understanding new ideas or facts. Almost everyone is capable of learning or remembering things because humans have a great capacity for cognitive functioning from birth. IQ tests and other assessments are used to measure intelligence, albeit their completeness and accuracy have problems. These tests measure a variety of cognitive skills, including consciousness, memory, awareness, problem-solving, motor skills, analytical ability, and other related concepts. Patients may be given a series of questions to answer or be required to complete tasks. The brain can be most easily shaped to orient to tasks that are relevant to an individual's environment throughout early childhood (Wikipedia, 2024).

Cognitive skill is a notion shared by both more traditional behavioral learning theories and more contemporary cognitive theories. The notion has a quite different meaning in behavioral and cognitive theories, though. According to contemporary theories of cognition, a cognitive skill is a comprehensive ability with a unique background of both quantitative and qualitative developmental progress. Earlier behavioral theories, on the other hand, saw cognitive skills as information packets that could be learned piecemeal. Descriptions of the task analysis process, which was a crucial component of behavioral approaches to instructional design (Anderson & Faust, 1973), provide an illustration of this point of view. Identification and orderly placement of the skill packets systematic acquisition in a predetermined sequence was the aim of training in behaviorally oriented theories. If the student could show that each packet could be remembered or used, and that using the packets successfully led to the achievement of a behaviorally stated educational goal, that would be evidence for the success of the lesson. (Royer, 1993). Compared to the older behavioral theories, contemporary cognitive theories have a radically different viewpoint and instructional objectives. The cognitive skill notion will be thoroughly discussed in the following section of the article due to its significance for assessment concerns and its centrality to cognitive theories. From the standpoint of cognitive theory, cognitive ability. This research will presume that the human information processing system can be split into three hierarchical tiers for the sake of structure and exposition:

- A layer of basic capacities,
- A layer of cognitive skills that are capable of being transformed from controlled to automatic/encapsulated processes, and
- A layer of higher cognitive skills and capacities that are responsible for goal setting and planning of cognitive activity.

Basic capacities are broad talents that, in most cases, are not very susceptible to educational intervention, such as working memory capacity and concept activation speed. Ericsson, Chase, and Faloon (1980) shown that digit span memory may be increased to well over 50 digits by extensive repetition. This shows that extraordinary training efforts can influence performance on tests that are routinely used to assess basic capacities. However, rather than resulting from modifications to fundamental abilities, these performance increases are thought to be the product of better coding practices. This premise is supported by the observation that gains made on a practiced activity do not carry over to other tasks that also require mastery of the same ability. There are various components to the working definition of a cognitive skill used in this article. Firstly, cognitive talents are a combination of certain facts and methods for applying those facts. In other words, declarative and procedural information combine to form cognitive skills. Second, unlike intellectual abilities like intelligence, which are purportedly difficult to alter through training, cognitive skills can be learned via experience and/or training. Third, although they can be used in many different contexts within a specific activity domain, cognitive talents are typically limited to that particular domain. For instance, a cognitive ability used by an experienced electronic troubleshooter can be used for troubleshooting tasks on many kinds of electrical devices. That ability, meanwhile, is probably not transferable to another field of work, like diagnosing internal combustion engines. Ultimately, the acquisition of cognitive skills occurs in a series of sequential phases. The skill is changed from a sluggish, cognitively demanding activity to an automated series of tasks that may put almost no burden on the system thanks to these sequential learning phases. Cognitive skills are brain-based abilities that are necessary for knowledge acquisition, information manipulation, and thinking. They are also referred to as cognitive functions, cognitive abilities, or cognitive capacities. Rather than focusing on real information, they are more concerned with the processes by which people learn, remember, solve problems, and pay attention (Haven, Hussain, & Shahriar, 2019). Declarative and procedural knowledge comprise cognitive skills (Royer, 1993).

➢ *What is Cognition?*

The way a person perceives and navigates the world is referred to as cognition. It is the collection of cognitive

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

functions or processes that underpin almost all of our waking actions as humans. Cognitive skills are the brain-based capabilities required to perform any task, no matter how difficult. Rather than being directly related to information, they have more to do with the processes by which we learn, remember, solve problems, and pay attention. For example, picking up the phone requires perception (hearing the ring tone), decision-making (picking an answer or not), motor skills (moving the receiver), language skills (talking and comprehending language), and social skills (reading tone of voice and relating to other people appropriately). Certain neural networks support various cognitive capacities or skills. For example, the frontal and temporal lobes (behind the forehead) are primarily responsible for memory functions. Because damaged neural networks and areas can impair cognitive function in people with traumatic brain injuries, neurorehabilitation is crucial. Cognitive abilities are brain functions.

Table 1 Cognitive Ability and Brain Function

Cognitive Ability/Brain Function	**Skills involved**
Perception	Recognition and interpretation of sensory stimuli (smell, touch, hearing)
Attention	Ability to sustain concentration on a particular object, action, or thought, and ability to manage competing demands in our environment.
Memory	Short-term/ working memory (limited storage), and Long-term memory (unlimited storage).
Motor skills	Ability to mobilize our muscles and bodies, and ability to manipulate objects. Tap the right hand on the table. At the same time, make a circular movement with the left hand (as if we were cleaning the table).
Language	Skills allowing us to translate sounds into words and generate verbal output.
Visual and spacial processing	Ability to process incoming visual stimuli, to understand spatial relationship between objects, and to visualize images and scenarios.
Executive functions	Abilities that enable goal-oriented behavior, such as the ability to plan, and execute a goal. These include: **Flexibility**: the capacity for quickly switching to the appropriate mental mode. **Theory of mind**: insight into other people's inner world, their plans, their likes and dislikes. **Anticipation**: prediction based on pattern recognition. **Problem-solving**: defining the problem in the right way to then generate solutions and pick the right one. **Decision making**: the ability to make decisions based on problem-solving, on incomplete information and on emotions (ours and others'). **Working Memory**: the capacity to hold and manipulate information "on-line" in real time. **Emotional self-regulation**: the ability to identify and manage one's own emotions for good performance. **Sequencing**: the ability to break down complex actions into manageable units and prioritize them in the right order. **Inhibition**: the ability to withstand distraction, and internal urges.

HOCS, sometimes referred to as higher-order thinking abilities, are sophisticated cognitive abilities that go beyond simple fact perception and memorizing. When we discuss the need for our students to be inventive, creative, and evaluative, we are referring to them. When our thoughts are left to their own devices, a large portion of them are biased, twisted, incomplete, ignorant, or outright prejudiced, claim Paul and Elder (2007). However, the caliber of our thoughts directly affects the caliber of our lives and the things we create, manufacture, or construct.

The capacity to reason logically and systematically in order to comprehend the relationships between concepts and facts is known as critical thinking. It assists us in choosing what to believe. To put it another way, it involves "thinking about thinking" in order to recognize, evaluate, and correct the errors in our thinking. Sound education is built on the foundation of critical thinking. "Ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly, and learn from experience" is the broad definition of higher order cognitive ability (Duckworth, 2019).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

➢ *Employability*

There is no single definition of employability. Academics provided their own definitions of employability. Employability, according to Hills and Pollard (1998), is the capacity to move independently in the labor market in order to realize potential through long-term work. According to Hills and Pollard, employability is made up of four primary components: presentation (skills for landing a job), deployment (career management skills), asset (knowledge, skill, and attitude), and personal and external determinants (family dynamics, the labor market, and macroeconomic issues). A common definition of employability is the ability to help graduates land jobs and advance in their chosen fields of work (Askov and Gordon, 1999). Employability, according to the University of Exeter, is the creation of explicit processes that help students grow in their capacity to use and utilize a variety of chances and skills to improve their own academic learning and make them more marketable to employers (Lee, 2000). The relative shift in obtaining and retaining various forms of employment is known as employability (Brown, 2003). A combination of abilities, information, and character traits that increase a person's likelihood of securing and succeeding in their chosen occupation or occupations, benefiting the workforce, the economy, the community, and oneself (Yorke, 2006). Employability is the capacity to work, get employment, and move between positions and jobs within an organization (Chithra, 2013). Employability was described by the United Kingdom Institute of Employment as the capacity to get, hold, and pursue new employment opportunities when needed (Singh, Thambusamy, & Ramly, 2014). Employability is a process rather than a finished good that comes from learning how to learn (Jeswani, 2016).

The human capital hypothesis, which asserts that employability is more about a person's capacity to perform the job than it is about talent, experience, and other factors, is the underlying theory frequently associated with employability skills development (Schultz, 1963). Employability skills are transferable, meaning they may be applied vertically and horizontally across all industries and work levels, from entry-level to the top of any organization (Sherer and Eadie, 1987). These abilities are referred to as comparability skills. The fundamental abilities required to get, hold, and perform well in a job are known as employability skills (Robinson, 2000). According to the Department of Education, Science, and Training (DEST) (2002), employability skills are those needed to advance within a company, reach one's full potential, and successfully support the strategic directions of the organization. These abilities are also necessary to secure employment. Employability skills are transferable, meaning they may be applied vertically across all industries and horizontally across all career levels, from entry-level to CEO (Cassidy, 2006). Generic skills, or employability skills in engineering, have a strong connection to non-technical skills. Employability skills are transportable and teachable (Lorraine and Sewell, 2007; Yorke, 2006). Employability skills are defined as "skills that make specific knowledge and technical skills fully productive" and are seen to be the abilities needed by practically everyone to perform almost any profession (Watts, 2006). Employability skills have gained popularity since 1980 and are commonly defined as a graduate's preparation for landing a job and advancing in their career (Fugate, 2004). Employability abilities are core skill groupings that are transferable and represent the fundamental functional and enabling knowledge, skills, and attitudes needed in the workplace of the twenty-first century. They are essential for achieving professional success at all occupational and educational levels (Overtoom, 2000). Throughout all occupational families, the American Society for Training and Development (ASTD) in 1990 highlighted 16 skill groups: (1) foundational competencies (reading, writing, computation); (2) communicative competencies (speaking, listening); (3) flexibility competencies (problem-solving, creative thinking); (4) developmental competencies (self-worth, drive and goal-setting, career planning); (5) group competencies (interpersonal skills, cooperation, negotiation); and (6) influencing competencies (knowing corporate culture, sharing leadership). Workplace competencies and foundational skills are included in employability skills, according to the Secretary's report on achieving necessary skills (SCANS) from 1991. Workplace competencies include the following five abilities: technology, systems, information, resources, and interpersonal skills. These skills can all be efficiently utilized by employees to increase productivity. Meanwhile, fundamental abilities, cognitive abilities, and personal attributes are the foundational skills required to raise worker's performance. The Conference Board of Canada (CBC) carried out a study on employability skills in Canada in 1996. Employability abilities can be used in a variety of everyday tasks outside of the job, according to the CBC document. Three primary skill groups make up the employability skills framework that was developed: teamwork skills, personal management skills, and foundational skills. Every group is made up of various skill sets. For instance, using arithmetic, thinking, problem-solving, and communication abilities are all examples of essential talents. The eight skill groups - communication skills, teamwork skills, problem-solving skills, initiative and enterprise skills, planning and organizing skills, self-management skills, learning skills, and technology skills - were highlighted by the Australian Department of Education, Science, and Training (DEST) in 2001. Employers believed that some non-skill-based behaviors and attitudes were just as vital as employability skills and other technical or job-specific abilities. These behaviors and attitudes are referred to as personal characteristics. Loyalty, commitment, honesty and integrity, excitement, dependability, self-presentation, common sense, positive self-esteem, sense of humor, balanced approach to work and home life, pressure tolerance, drive, and flexibility were among the personal qualities. Employability is defined as the following in 2012 by UNESCO Regional Bangkok: (1) communication skills; (2) logical, analytical, and problem-solving skills; (3) personality, confidence, and integrity; (4) flexibility and adaptability; (5) innovation and creativity; and (6) team spirit. These attributes and competencies help job seekers find employment. Three key skill elements - basics, which include problem-solving, communication, information management, and math skills - personal management, which includes positive attitude and behavior, responsibility, adaptability, and skills for continuous learning as well as safe work; and teamwork, which includes the ability to collaborate with others and engage in projects or tasks - are indicative of employability skills.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

Possessing the essential employability skills is not a guarantee of a job. It also depends on outside variables. It is impossible to comprehend employability outside of this dualism. There are two aspects to employability: the absolute (knowledge, skills, and abilities) and the relative (external circumstances) (Chithra, 2013). Employability is, therefore, also a relative term that is subject to the principles of supply and demand in the labor market (Chithra, 2013).

➢ *Theories of Employability*

Having the necessary employability skills does not ensure employment. It also depends on external factors. Employability cannot be understood outside of this dualism. Employability has two components: the relative (outside circumstances) and the absolute (knowledge, skills, and abilities) (Chithra, 2013). According to Chithra (2013), employability is thus also a relative concept that is governed by the laws of supply and demand in the labor market. However, due to their relative employability, graduates may not seem competitive in the labor market even though they are competent in a wide range of positions and jobs. Therefore, employability is a function of both one's positioning in the labor market and one's ability to meet the needs of employers. According to social closure theorists, the primary factor dividing the labor market is variations in educational attainment and kind, and the most significant component of labor market rivalry is the ability to obtain credentials (Hirsch, 1977). On the other hand, positional conflict theory acknowledges that a credential's worth is related to its scarcity value and that other resources may function as forms of capital, particularly if credentials become commonplace (Brown, 2000). The two ideas acknowledge that employability has two dimensions. According to positional conflict theory, employers take into account a candidate's job history, extracurricular activities, Cognitive skills, social competence, and cultural fit, among other factors, in addition to their credentials. While these factors might not have mattered as much in an era of many good jobs, graduates of mass higher education are being pushed to rely more and more on their other skills, experiences, and resources in order to gain a competitive edge in the labor market. Watts in 2006 divided employability in three categories.

- Category1: Graduates are doing odd jobs and taking preparations for higher study or permanent jobs.
- Category2: It is a form of immediate employment. Graduates are work ready and join work without any training.
- Category3: It is sustainable employment. They are not only concerned to get the first jobs but also to remain employed throughout life.

➢ *Models of Employability*

DOTS model (Law & Watts 1977), which consists of:

- Decision learning – decision making skills
- Opportunity awareness – knowing what work opportunities exist and what their requirements are
- Transition learning – including job searching and self-presenting skills
- Self-awareness – in terms of interests, abilities, values, etc.

- *Bennett, Dunne & Carré (1999) proposed a model of course provision in higher education which included five elements:*

✓ Disciplinary content knowledge,
✓ Disciplinary skills,
✓ Workplace awareness,
✓ Workplace experience and
✓ Generic skills.

- *Knight & Yorke in 2004 proposed USEM model as below:*

✓ Understanding (viewed as being broader and deeper than 'knowledge').
✓ Skills (or, preferably, 'skilful practices', which includes the deployment of skills).
✓ Efficacy beliefs (including students' views of themselves and personal qualities)
✓ Metacognition (including students' self-awareness regarding, and capacity to reflection, their learning).

- *Dacre Pool & Sewell in 2007 proposed CareerEDGE model which is as follows:*

✓ Career development learning
✓ Experience (work and life)
✓ Degree subject knowledge, understanding and skills.
✓ Generic skills
✓ Emotional Intelligence

The design of the model reflects an assertion that each component is absolutely essential and one missing element will considerably reduce a graduate's employability.

➢ *Prominent HOCS*

From the literature, the prominent HOCS that affect employability (EMP) are as follows:

- *Higher Order Cognitive Skills (HOCS):*

✓ CTS- Critical Thinking Skills
✓ PSS – Problem Solving Skills
✓ ECS – Effective Communication Skills
✓ DMS – Decision-Making Skills

➢ *Theoretical Framework or Conceptual Framework*

The conceptual framework, which some methodologists refer to as a "theoretical framework," is one of the trickiest aspects of qualitative research that many beginners find hard to understand. Since all other components of the qualitative research project flow from it, it really ought to have been the first piece of research design presented. The conceptual framework, to use certain colloquialisms as metaphors, is the theoretical glue that holds all of the preliminary design decisions together.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

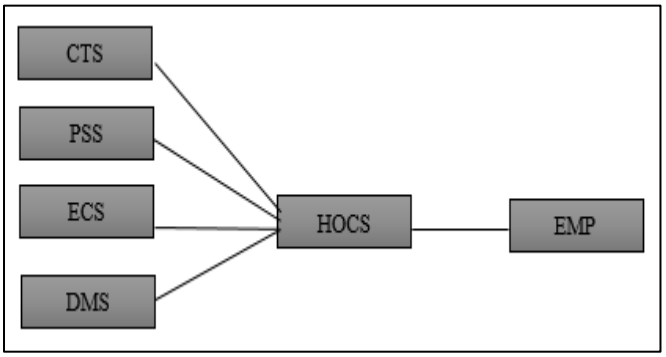

Fig 1 Conceptual Framework or Theoretical Model

➢ *Research Philosophy & Research Approach*

- *Research Philosophy and Research Paradigms*

My ontological assumption is that there is no single reality. Reality is different from participant to participant. There are many HOCS responsible for the employability of engineering graduates. Certain HOCS are important at certain career stage of graduates. Epistemology: the way of acquiring knowledge is the interview that makes my research qualitative. From the collected data, a new theory is developed using grounded theory which is inductive reasoning. Axiology is all about values and ethics. Researcher is an active tool in research however, I tried to keep myself free from bias as much as possible. I did not try to influence my beliefs among the participants but rather collect honest feedback from the interviewees. My research paradigm falls into constructivism which is similar to interpretivism where theory is being developed by inductive reasoning. Establishing the relationship between HOCS and employability using grounded theory.

➢ *Grounded Theory Research*

A methodology known as "grounded theory" is used to carefully examine qualitative data in order to comprehend human processes and develop theory - that is, theory that is built from the ground up or based in the data. Sociologists Anselm L. Strauss and Barney G. Glaser, who investigated disease and death in the 1960s, developed the methodology. Later authors including Juliet Corbin, Adele E. Clarke, and Kathy Charmaz have reinterpreted their original work (Saldana, 2011). In order to achieve abstraction and a range of dimensions to the attributes of the emergent categories, grounded theory is an analytical method that continuously compares small data units, mostly but not solely acquired from interviews, through a series of cumulative coding cycles. The goal of traditional grounded theory is to develop a core, or central category, that conceptually captures the essence of the research. The creation of a theory regarding the processes seen is based on this core, or central category. Characteristics of Grounded Theory:

- Focus - Developing a theory grounded in data from the field
- Type of the problem that suits best - Grounding a theory in the views of participants
- Discipline Background -Drawing from Sociology
- Unit of Analysis - Studying a process, action or interaction involving many individuals
- Data collection form - Usually primarily interviews with 20-60 interviews
- Data Analysis Strategy - Analyze data through open coding, axial coding and selective coding
- Written Report - Generating a theory illustrated in figure

III. RESEARCH METHOD

➢ *Research Methodology*

My research methodology is as follows:

- The approach of the study: Qualitative Approach
- Design of the study : Grounded Theory
- Area of the study: Dhaka City
- Population: Engineering firms and industries in Dhaka City
- Sample: 31 interviewees
- Sampling technique: Purposive (Theoretical Sample)
- Data collection techniques: In-depth interview and FGD.
- Data collection tools: Interview checklist
- Data analysis: Manual

Interviews of 31 participants and their findings and listed and validated by another group of experts through FGD.

➢ *Instrumentation*

The industry experts are interviewed using both structured and unstructured methods to obtain qualitative data. Grounded Theory inquiry is then utilized to create a theory.

➢ *Demographic/Work Background Information*

The following information on participants was collected in the survey:

- Age: 35Y to 60Y
- Gender: Male and Female
- Class standing: Senior Level
- Characterization of work: Independent

➢ *Ethical Consideration*

In order to gain the audience's confidence and trust, I took all essential precautions.

- Taking consent from the interviewee
- Voluntary involvement of the participant
- Participant’s confidentiality and anonymity
- Standards, regulations, and institutional rules
- No false promise

➢ *Validation*

The study report has gained credibility by correctly referencing and maintaining references throughout. Using the test-retest approach, validity has been established. After gathering qualitative data from professionals in the field, Focus Group Discussions (FGD) were conducted to reevaluate the gathered information. In both situations, we obtain comparable results, which supports the validity of the study.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

IV. DATA ANALYSIS & DISCUSSION

Skills which are characterized by the brain-based executive functions are called HOCS. Skills are very important for the employability; however, the research focuses on the necessitated skills for the engineers by the employers of Bangladesh. Off course, I am not against the technical skills which are always considered as the foundation skills for the engineers but these technical skills become valueless without the proper combination with HOCS. Employers value HOCS as same as technical skills and sometimes more than the technical skills. From the qualitative data, I tried to find out the important HOCS for the engineering graduates of Bangladesh. All HOCS are not equally important for all career stages ranging from early career to mid-career to advance career. HOCS are more or less equally important for all stages of the career. Grounded theory technique is applied to construct a mode which is grounded on data. The theory is developed by using the three popular coding techniques namely: Opening Coding, Axial Coding and Selective Coding.

➢ *Opening Coding*

All skills have been identified from the interviews. Each skill is considered as concept. While interviewing the experts, the significance of those skills and their insights were noted. All concepts are important for the engineering graduates. About 14 HOCS are noted which have incredible significance in the workplace for the engineering graduates. Listed skills are portrayed in the following section. We have found 14 skills and listed them serially. These skills are found important during the interview session.

Table 2: List of Skills During the Interview

1.	Abstract Thinking	8.	Remembering
2.	Problem Solving	9.	Paying Attention
3.	Abstract Reasoning	10.	Critical Thinking
4.	Decision Making	11.	Creative Thinking
5.	Effective Communication	12.	Analytical Thinking
6.	Quick Learning	13.	Positive Thinking
7.	Learn from Experience	14.	Design Thinking

➢ *Axial Coding*

The main objective of this step is to categorize these skills with a view to building a suitable construct. From the surveyed literature and opinion from the experts, the main construct has been introduced namely; Higher Order Cognitive Skills (HOCS). The skills which are characterized by the executive functions of brain are constructed as HOCS.

➢ *Category A: HOCS*

1.	Abstract Thinking	8.	Remembering
2.	Problem Solving	9.	Paying Attention
3.	Abstract Reasoning	10.	Critical Thinking
4.	Decision Making	11.	Creative Thinking
5.	Effective Communication	12.	Analytical Thinking
6.	Quick Learning	13.	Positive Thinking
7.	Learn from Experience	14.	Design Thinking

➢ *Selective Coding*

The objective of the Selective Coding is to bring all skills under a single umbrella. All these skills are employability skills. Therefore, employability comprises of Higher Order Cognitive Skills (HOCS).

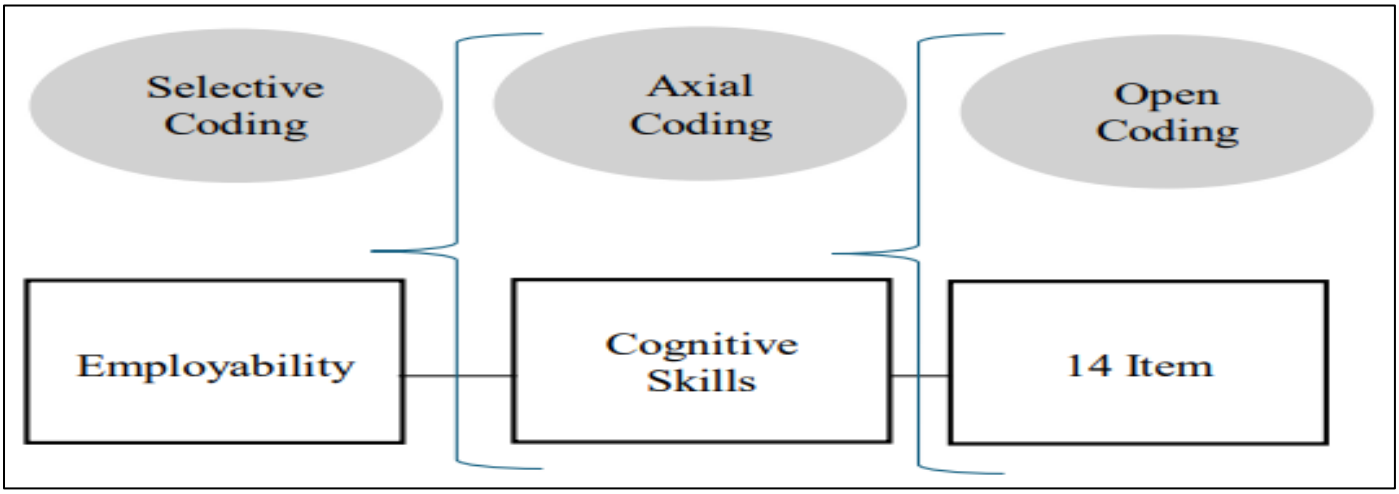

Fig 2 Selective Coding of Employability

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

➢ *Fact1: Employability is HOCS Driven*

Technical skills that are taught at the time of graduation become less important with the passage of a career. It is tough for employers to differentiate candidates based on HOCS during the selection process. Most of the interviews are based on technical skills. There are multiple levels of the screening process. The first level of the hiring process is technical skills driven. However, the final level is HOCS focused. Multiple candidates are sent to the final level for a single vacant position. Most of the engineers have similar IQ levels. At the final level, the employer uses HOCS checkers to differentiate applicants and hire the desired candidate with the required technical skills and superior HOCS. Here, we can see that HOCS single out engineers from the crowd at the time of selection. HOCS help to get the initial employment quickly. Most of the employers of engineering firms value HOCS not only in the selection process but also in the sustainability of the employment throughout the career. Gaps in technical skills can be taught with a short training but it is very challenging to equip an engineer with the required HOCS. Employers suggest that they do not fire engineers not having the technical skills but rather HOCS.

HOCS have a significant impact on employability. Employers added that yearly appraisal mostly depends on HOCS. In Annual Compensation Review (ACR), 20% to 30% of the questions are related to technical skills whereas, 70% to 80% of questions are related to HOCS. Therefore, employability depends on the HOCS at large. Many engineers are very good at technical abilities but very poor at demonstrating HOCS in the workplace are considered worthless by the employers. Those engineers cannot continue their jobs. Employers value HOCS on top of technical abilities therefore, job retention mostly depends on these nontechnical skills.

The wonderful finding of this research is that engineering careers are HOCS oriented. Let's say an engineer graduates at the age of 22 and his/her retirement year is 60. His/her length of service is 38 years. Out of his/her 38 years, hardly 5 to 8 years are technical skills centric and the rest 30 to 33 years are HOCS centric. Therefore, HOCS explain 85% {(33/ (33+5) *100% ~ 85%} employability whereas, technical skills explain 15% {(5/ (33+5) *100% ~ 15%}.

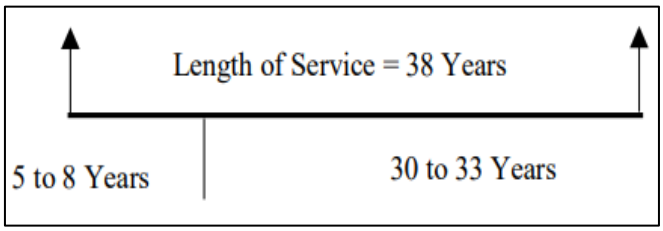

Fig 3 Contribution of HOCS in Career

There is another truth for computer engineers that creativity goes down with time. Initially, 5 to 10 years is the most creative period for the computer Engineers. However, after 10 years, engineers enter into management, and using HOCS, they earn a handsome salary. Creativity is high for the engineers in the junior and mid-level. The advanced level is HOCS driven.

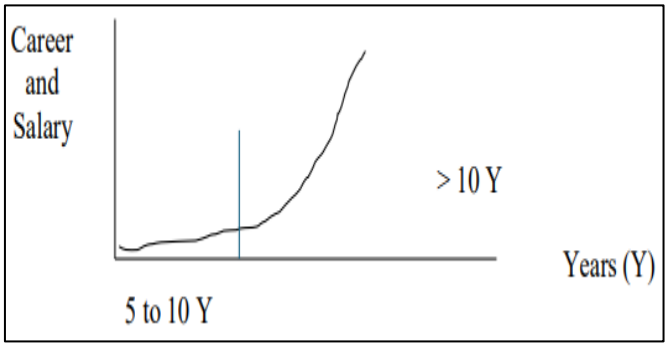

Fig 4 Significance of HOCS in career for the Computer Engineers

Undoubtedly, Employability is HOCS driven. Employability is all about getting, keeping, and doing well on a job. Employer's satisfaction largely depends on HOCS.

➢ *Fact2: Contribution of HOCS on Employability in Percentage*

The research suggests that the engineering career is divided into three stages namely; early career, mid-career and advanced career therefore, HOCS explain employability differently in three stages which are as follows:

Table 3 Contribution of Cognitive Skills on Employability in Percentage

Skills/Career Stage	Early Career	Mid-Career	Advanced Career
HOCS	Up to 50%	50% to 80%	80% to 90%

➢ *Fact3: Required HOCS at the different stages of the career*

Required HOCS at the different stages of career which are follows in the following section:

Early-Career (Abstract Thinking, Problem Solving, Reasoning, Effective Communication, Quick Learning, Remembering, Paying Attention, Creative Thinking, Positive Thinking and Design Thinking)

Mid-Career (Problem Solving, Decision Making, Effective Communication, Learn from Experience, Critical Thinking, Analytical Thinking and Positive Thinking)

Advanced-Career (Problem Solving, Decision Making, Effective Communication, Learn from Experience, Critical Thinking, Analytical Thinking and Positive Thinking)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

➢ *Fact4: Does the Engineering Curriculum have Sufficient Courses to Learn Cognitive Skills Perfectly?*

It is the fact that the national engineering curriculum does not have provision for the HOCS courses explicitly rather a few humanities and management courses. I have surveyed the engineering syllabi of both B.Sc and Diploma in Engineering and interviewed a few teaching professionals and got the similar results. National engineering curriculum should incorporate a minimum course to train students on HOCS at the time of their graduation.

➢ *Fact5: How can we Improve the HOCS of Engineers at the Institute level?*

My research findings would be a readymade guideline for the institutes on which they can inject skills to the students at the time of graduation. Curriculum must be innovative to accommodate all changes in the contemporary world.

- Expand the implementation of international skills qualification framework as a mandatory requirement for all educational institutions and skills training institutes
- Pilot HOCS courses at institutions
- Assess foundational skills for students
- Train teachers for enhanced pedagogical skills
- Development of skills based new curriculum
- Renovate curriculum with industry feedbacks

➢ *Fact6: How can we Improve the HOCS of Engineers at the Organizational Level?*

My research findings would be a readymade guideline for the industry on which they can impart training to their newly hired engineers throughout the career. Learning HOCS are lifelong process. None can be a master of HOCS at a time.

- Organization should arrange training for their engineers on continuous development of HOCS
- Conduct market analysis for new skills
- Delivery of workplace-based skills training programs for their employees

V. UNDERSTANDING OF DISCOVERED SKILLS

A. Cognitive Skills

➢ *Abstract Thinking*

Technical or engineering thinking, which forms the basis of problem-solving design, is what engineers refer to as abstract thinking. In the current century, engineers are required to engage in enough speculation to be able to freely address technical difficulties. Future engineers' intellectual prowess will be diminished if they are unable to recognize and correct their errors. technical design, or the creation of new goods requiring technical thinking, employs the majority of student graduates from engineering institutions (Waks, 2011). It is expected that feeling more powerful comes from thinking more abstractly. Compared to both a concrete-thinking and a control condition, abstract thought was associated with higher feelings of control over the environment, higher preferences for high-power occupations, and a greater sensation of power. This reciprocal relationship between abstract thought and power raises the possibility of power structures being inadvertently maintained (Smith, 2008).

➢ *Creative Thinking*

Engineers need to be creative thinkers, and innovation comes from creative thinking. The intuition facilitates creative thought. It includes the following types of thinking: inductive thinking, logical & deductive thinking, causal thinking, divergent thinking, and convergent thinking (Bartzer, 2001).

- Without convergent thinking, the understanding between people becomes impossible, while without divergent thinking (the strongest expression of the productivity of human thinking) the problems with more solutions cannot be solved, the creation is not possible.
- Without causal thinking, that is without observing and understanding the relation "cause-effect", the reflection, by thinking, of the reciprocal conditionings and determinations existing between the objects and phenomena of the reality becomes impossible.
- Without logical and deductive thinking there don't exist not even the capacity to respect rigorously the lows and rules of an exact reasoning, to look for and justify the truth, to accept only those theses which result out necessarily from the link of true judgments (theoretically and experimentally proved), to reflect the causal relation of the phenomena and diverse objective aspects of the reality and to maintain in the frame of the same premise during the whole reasoning.
- Without inductive thinking there is missing the capacity to generalize and to determine the essential and common characteristics of a group of objects, facts and related concepts, in order to develop notions, to formulate definitions and to characterize objects, phenomena and processes.

➢ *Critical Thinking*

Perception, memory, idea formation, language, and symbol use are all interconnected processes and structures that make up thinking. These are the fundamental cognitive abilities that support reasoning, learning, and problem solving. Thinking includes a wide range of processes, such as envisioning, remembering, problem-solving, free association, daydreaming, and concept generation (Psychology Dictionary, 2014).

For the purpose of meeting ABET criteria and preparing them for careers as effective practitioners, engineering students nowadays are required to demonstrate a broader range of thinking abilities. There are eight components to critical thinking that encompass the way it looks at, evaluates, and considers intellectual work. Eight sorts of questions that are somewhat present in all critical thinking are derived from these eight Elements (Welch, Hieb, & Graham, 2015):

- What is the Purpose?
- What is the Point of View?
- What are the Assumptions?
- What are the Implications?

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

- What Information is needed?
- What Inferences are being made?
- What is the most fundamental Concept? and
- What is the Question that is being answered?

The standards used to assess the caliber of critical thinking are outlined in the intellectual standards. For instance, the reasoning establishes pertinent assumptions or has a clear goal. Intellectual traits are those that come with being a mature, analytical thinker and are something that people develop throughout time. It is hoped that as students move through the curriculum, they will grow into and display these qualities. Put another way, pupils will eventually acquire metacognitive skills related to critical thinking. Thinking critically involves challenging, analyzing, interpreting, evaluating, and passing judgment on what we read, hear, say, or write. "Able to judge or discern" is how the Greek word kritikos, which means "critical," originates from. Making trustworthy decisions based on trustworthy information is a key component of good critical thinking. Utilizing critical thinking does not entail being pessimistic or fixating on flaws. It entails having the mental clarity to dissect an issue or a piece of data, grasp it, and apply our understanding to make a well-informed choice or judgment (e.g., building a bridge, expressing one's viewpoint in response to a piece of opinion writing, or comprehending a political motive). A critical thinking mentality is believed to come naturally to those who use it frequently, but this is not the case for everyone. These are qualities that can be acquired and enhanced with use and practice. Arguments are most frequently linked to critical thinking in the academic setting. It may be required of us to formulate our own arguments or to consider others' arguments critically. Therefore, in order to improve our critical thinking skills, we must learn how to (Monash, 2024):

- Clarify our thinking purpose and context
- Question our sources of information
- Identify arguments
- Analyze sources and arguments
- Evaluate the arguments of others and
- Create or synthesize our own arguments.

The process of applying logical, skeptic, and objective analyses and evaluations to the available facts, evidence, observations, and arguments in order to develop a judgment is known as critical thinking. A critical thinker is someone who exercises critical thinking abilities or has received training and education in its disciplines. Critical thinking encompasses self-directed, self-disciplined, self-monitored, and self-corrective mental habits. According to philosopher Richard W. Paul, a critical thinker's mind integrates their personality with intellectual prowess. A dedication to overcoming egocentrism and sociocentrism, as well as adherence to strict standards of excellence and attentive command of their application in effective communication and problem solving, are prerequisites for critical thinking (Wikipedia, 2024). What Is Critical Thinking? - University of Louisville Ideas to Action, n.d. states that critical thinking is the intellectually rigorous process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication as a guide to belief and action.

➢ *Decision Making*

Most people think of decision-making as the mental process one goes through to decide on a course of action. Engineers are taught to tackle issues with a comparatively more logical and pragmatic mindset. Efficiency, practicality, and cost minimization are more important to engineers than style and flair. Gaining insight into the way the engineering mind processes information and responds to it might help one understand how the human mind works and how to make better judgments.

According to Ullman (2001), a decision is a commitment to use resources. One of the most basic and intricate psychological functions that people frequently engage in is decision-making. It might be challenging to define decision making precisely because people carry out a range of duties and, as a result, make several distinct kinds of decisions every day. A decision, in Jonassen's view, is an ill-structured dilemma in which a person must weigh several options and choose one (Jonassen, 2012). There are two approaches to comprehending the decision-making process. From a logical standpoint, the goal of decision-making is to maximize utility. A naturalistic viewpoint holds that beliefs and past experiences have a greater influence on decisions than logic. Under three different types of circumstances, decisions are made (Roth, 2007).

- Risk: the information is unavailable, but probabilistic models can be used because the distributions of random variables are known.
- Uncertainty: the probability distributions are unavailable, but other obstacles are known (such as radiation affecting transmission from an antenna)
- Ambiguity: functional form is unknown, and trial-and-error testing may be needed even to determine inputs and outputs.

➢ *All decisions can be sorted into one of four categories (Yates & Tschihart, 2006):*

- Choices: selection of a subset from a larger set of alternatives
- Acceptances/rejections: the binary decision
- Evaluations: assigning worth to an option
- Constructions: attempting to create an ideal solution given available resources

➢ *The Brown University Division of Engineering (Brown University, n.d.) has defined the typical engineering decision making process as follows:*

- Define clearly the objectives of solving a specific problem
- Generate all possible solutions
- Predict the outcome of each solution
- Determine the best solution by balancing the pros and cons along with

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

- Cost and benefit

➢ *Effective Communication*

Technical experts may do any task more successfully if they truly understand communication. Good communication is essential for achieving desired results. Our technological environment is growing more complicated, and we must be able to interact successfully with a greater range of individuals. Technical workers in the new millennium must be proficient communicators who can work well under a range of conditions and with individuals of different origins, skills, and cultures (Cerri, 2000). The foundation of excellent communication is the way the human brain interprets both spoken and nonverbal cues, as well as the inherent structure of language. The communication process becomes a predictable closed system with input, output, and feedback when we have a solid grasp of how humans perceive, communicate, and think. Instead of being a "hit-and-miss" procedure, the communication process lends itself to study and comprehension when it is seen within the context of a "system." Understanding that every human being is like a satellite traveling through space and collecting information about the cosmos the universe of life is the first step toward effective communication. Every individual utilizes their senses to collect information about the world around them, in the same way that a satellite uses its equipment to do the same. They create a meaningful "map" of reality based on the information gathered from their senses, which they utilize to navigate the environment and make decisions. This "map" of reality serves as a filter through which people can concentrate their attention and select information from their environment. All additional information that comes in through the senses is filtered through this "map of reality," including other people's communications. When all of the filters are "operating," communicating may be challenging. The incoming messages will be "filtered" by the listener according to the "biases" of those filters. Conversely, if the filters are not activated, the listener will receive the messages without any bias from the filters.

Consequently, the capacity to communicate in a way that avoids or at least minimally activates the listener's "filters" constitutes successful and outstanding communication. The speaker can be fairly certain that the listener will "hear" the communication in an objective manner if the listener's "filters" are not activated throughout the communication interaction. Effective communication is attributed by some to the sender (speaker), while others attribute it to the listener. Others, however, may argue that both sides bear some of the blame. Since only the sender is aware of the precise meaning of the communication, the author holds the sender to be the real party accountable for effective communication. The "7-Step Communication Process" defines a strategy for effective communication that can be used in any situation. The steps are presented here.

- The first step in effective communication is to understand which representational system the listener is operating within. By understanding the real-time representational system, the speaker can "match" that system, thereby ensuring that the communication will be in an acceptable mode to the listener. This specific technique of using verbal and non-verbal communication can effectively remove most if not all the filters from the listener's side of the conversation. This allows the communicator to be much more effective.

- The second step in effective communication utilizes the techniques of mirroring, matching, pacing and leading of verbal and non-verbal communication cues. These tools allow the speaker to build unconscious rapport with the listener, thus placing the listener in a more receptive mode. This process reduces the effects of the listener's "filters" and allows the speakers messages to be received more openly.

- The third step in effective communication is to uncover the listener's complex maps or paradigms of reality. This questioning process can be quick and elegant and ensures that the speaker understands the paradigms that must be matched in order to initiate and continue effective communication.

- The fourth step in effective communication is for the speaker to send the message. At this point, rapport has been established and the communication process can proceed in such a way that the sender can present ideas and issues and the listener will be receptive to them. This does not necessarily mean that the listener will agree with the sender's position, but at the very least, that the listener will hear the sender's message in an unbiased way.

- The fifth step in effective communication is for the sender to "check" to determine if the message was received by the listener as intended. In fact, it is important to point out again that the responsibility for effective communication rests with the sender; only the sender knows what the intended message is. Depending upon the filters engaged by the listener, the message could be interpreted in a wide variety of ways. Therefore, the fi& step is for the speaker to ask questions and watch for non-verbal cues to determine whether the message was received by the listener as intended.

- The sixth step in effective communication is to go back to steps 1,2, or 3 to set the stage to send the message again if it was not received as intended.

- The seventh step in effective communication is to send the next message using steps 1, 2, or 3 if the message was received as intended.

In order to support student's learning and better equip them for their future employment, communication skills are a crucial part of engineering education. Also discussed is the significance of emotional intelligence (EQ). In order to encourage student learning, recommendations are given for the development of communication skills. One such suggestion is that communication skills be integrated throughout the curriculum rather than being taught as a stand-alone subject in engineering curricula that are already jam-

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

packed. Additionally, several prospective topics for additional study are mentioned (Riemer, 2007). An ever-widening set of abilities is needed for engineering graduates to be relevant in the global context of the new millennium. This requires effective communication, which is acknowledged by both academia and business.

It is acknowledged that language and communication abilities are critical components of a modern engineer's education. The inclusion of communication skills, as seen in many business curriculum, will help to reinforce these abilities in a variety of circumstances. This is especially true if students see that communication is a crucial component and that it counts toward a portion of their final grade. A crucial component of continuous learning that will eventually aid in the process of lifelong learning is the inclusion of language and communication enhancement courses. The simplification of basic communication skills should enable progress in engineering and, in fact, engineering education. EQ and communication skills, which support these competencies, should ideally be introduced to and developed in pupils at least as early as secondary school. But as they are abilities that may still be learned as adults and would support lifelong learning, they should be promoted at the university level if they are absent from the national school curriculum (Riemer, 2007).

B. Paying Attention Skills

Strong communication abilities are highly valued by employers in engineers; nevertheless, listening and communication skills are often lacking in recent engineering graduates. Effective communication is greatly aided by listening, as it provides the student with information that increases their knowledge base.

Since it's a participatory process where listeners build meaning, it focuses more on interpretation. Metacognition, which includes content, task, and strategy knowledge, has a positive impact on the learning process of listening. Metacognition-the study of one's own learning-allows students to evaluate their own performance and comprehension.

Metacognitive techniques impact the degree of learning output; the fit between new and existing knowledge; the awareness of learners' knowledge and ignorance; the necessity for increased exposure and practice; the significance of taking notes and practicing often; the importance of feedback and training; Five broad learning areas have been identified: interest, task complexity and demands, monitoring, planning, using strategies, and openness to feedback when knowledge is lacking. Additionally, self-regulation has been used to build transferable skills, knowledge, and attitudes across learning environments.

Self-directed and action-oriented learning benefit greatly from the application of listening skills. The oral presentations gave the students practical experience, which aided in their comprehension and acquisition of the fundamentals. Additionally, it assisted the students in utilizing their listening abilities to broaden the scope of their learning in the most useful method and adapting and applying their knowledge to tackle new challenges in the given circumstance (Singh, 2019).

C. Problem Solving Skills

Among engineers, one of the most frequently debated issues has been Industry 4.0. Non-technical abilities will soon be just as vital as technical skills, if not more so. Additionally, IR4.0 will result in employment displacement, with robots and artificial intelligence taking over the majority of tasks (Tapsir, S.H. and Puteh, M., 2018). Defining Higher Education in Malaysia (4.0). Employers use a variety of strategies and initiatives to make sure engineering students take the initiative to develop their problem-solving abilities. Engineering students should learn how to solve problems at work because many businesses are implementing reward systems, paying more, and moving up the ladder for problem-solving. The issues that emerged in the workplace and in classrooms are completely unrelated. One of the most crucial skills that businesses look for in new engineers is the ability to solve problems. Employers always favor hiring "work ready" engineers for positions within their companies. This is only feasible if the newly graduated engineers have had enough exposure to the industry setting and have solved engineering-related difficulties before they graduate. An internship or industrial training program is crucial in this situation. This is due to the fact that engineering students only get the chance to deal with engineering-related problems when they are attached to industries.

Engineering students with strong technical capabilities are taught well in universities through the application of mathematical problem-solving techniques. Engineering students can use these mathematical problem-solving abilities to solve engineering-related issues. Thus, throughout engineering student’s time in the industry, companies and institutions need to pay closer attention to them. (Azmi, Noordin, & Subramaniam, 2020).

➢ *Quick Learning*

Acquiring skills and information through quick learning is a highly personalized, self-driven approach. This may help our careers with the knowledge and abilities we have gained. Our sense of self-worth might also be improved. In brief, the blog discusses the potential effects of rapid learning on our personal and professional lives. According to Rai (2022), it also addresses the following other crucial areas of rapid learning:

- It may help to realize the passion
- It may transform us from a mediocre to an excellent professional at workplace
- It may help us to stay relevant in modern times
- It may help us to upgrade ourself
- It may help us to learn things, which were very difficult and time consuming few years back

➢ *Abstract Reasoning*

In addition to being used as a problem-solving technique, abstract reasoning is also used to create reasoning pathways and organize and organize the reasoning process itself. As a

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

result, it is a very useful tool for designers to organize the process of finding solutions and to make important choices as they are designing. Abstract reasoning is such a common solution seeking technique in design that one could notice numerous instances of its application in a typical design process:

- *Four "Dimensions" of Abstract Reasoning:*

✓ Qualitative DR
✓ Qualitative IR
✓ Analogical reasoning
✓ Abductive reasoning

✓ *Qualitative DR:*

DR is a popular method of reasoning that is applied to issue solving on a daily basis. A type of thinking known as deductive reasoning (DR) is the process of mentally going from a general premise to a logical and specific conclusion. It can be used to solve problems methodically or infer cause-and-effect relationships by building valid conclusions, which must be true given that their premises are true. Conventional DR uses a rigorous logic-based approach to analyze true/false or "if...then" relationships. An abstract version of that process is called qualitative data recovery (qualitative DR); it finds trends (qualitative correlation) of variables with regard to each other; how variables affect each other; and whether two objectives or variables are indifferent, conflicting, or synergistic.

✓ *Qualitative IR:*

The cognitive process that deduces a probabilistic conclusion from a set of specific facts is known as inference reasoning (IR). This kind of thinking can be applied to increase knowledge in the face of uncertainty and/or provide the best approximation or reasoning for a response given particular circumstances. IR is a sort of context-dependent reasoning that is often utilized in tasks requiring pattern identification or prediction. It is driven by prior knowledge. Klauer categorizes inference into two primary types: (1) Inference (IR) - the detection of rules or regularities. (2) Generalizing outside the bounds of experience (a process called inductive inference). Klauer claims that the fundamental component of inferential regression (IR) is the comparison of qualities or elements, which allows for the discovery of similarities, dissimilarities, or both, as well as the further generalization of patterns.

✓ *Analogical Reasoning:*

Every day, people utilize analogies to solve issues or comprehend and explain various events. In fact, professionals advise using analogical reasoning to choose the most effective approach to an issue. Analogical reasoning focuses on mapping the structures or relations valid in one domain onto another, which may be less familiar or even unknown, whereas DR discloses the necessary outcomes of a set of conditions and IR establishes the likelihood of an outcome. In fact, this type of reasoning is known as the consistent mapping between relational (and especially casual) knowledge of two domains in which the structures to be mapped are selected on the grounds of the similarity between the novel and the familiar one.

✓ *Abductive Reasoning:*

In the context of design, abductive reasoning is characterized as the kind of reasoning when a conclusion is proactively sought through conjecture. When abduction was first conceptualized, it was compared to an intuitive process that aims to infer a cause from an effect. However, most recent definitions concentrate on its application to planning, explanation, and choosing the most appropriate explanation for the data given a paradigm premise. In abductive reasoning, validation of a claim is not feasible, in contrast to deductive and inductive reasoning, where the conclusion is supported by mathematical or logical relations. On the other hand, a reasonable argument could be made to refute a claim. Consequently, the conclusion drawn by abductive reasoning is valid up until a test using actual evidence invalidates it. Whatever the definition's emphasis or format, it is obvious that abduction's fundamental characteristics set it apart from both inductive and deductive reasoning. In abductive reasoning, designers gather estimations of the circumstance and start to construct several hypotheses that would satisfy the scenario, in contrast to deductive reasoning (DR), which draws just one valid conclusion from the premises. These reasons are not provided until the performance models that are produced have been examined and examined, at which point the designer is able to arrive at a sound and reasonable conclusion.

D. Remembering Skills

The various goals and competencies that teachers establish for their pupils are categorized using Bloom's Taxonomy (learning outcomes). Benjamin Bloom, a University of Chicago educational psychologist, first suggested the taxonomy in 1956. The following six learning levels are now included in the nomenclature, which was modified lately.

- Remembering: Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
- Understanding: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
- Applying: Carrying out or using a procedure for executing, or implementing.
- Analyzing: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.
- Evaluating: Making judgments based on criteria and standards through checking and critiquing.
- Creating: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

➢ *Positive Thinking*

A new field called "positive psychology" focuses on optimistic thinking, feelings, and behaviors that maximize human potential in a variety of areas, including work, stress management, and health. Positive thinking helps us handle stress better since it makes us feel less dangerous. Positive thinking helps people be constructive and creative by

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

encouraging them to see the positive side of things. Positive emotions and other concepts like optimism, hope, joy, and wellbeing are associated with positive thinking. According to McGrath (2004), the word "positive thinking" refers to a general attitude that permeates one's thoughts, conduct, feelings, and speech. A positive mindset allows ideas, phrases, and visualizations that support development, achievement, and growth to enter the mind. Thoughts that suggest self-criticism or devaluation are considered negative thinking. The perspective of a depressed individual is dominated by these thoughts. Negative thinkers expect awful things to happen since they don't think things will go as planned. Their ability to handle everyday stressors degenerates, leading to issues with their mental and physical well-being. Psychologists have traditionally only studied negative mental states. Positive psychology and positive thinking are related. There is a connection between stress and optimistic thinking. Health and Positive Thoughts when faced with stress, there are two main advantages to adopting an optimistic outlook (Khalid & Naseem, 2010). The idea of positive thinking has been examined from a number of angles by psychologists. However, the belief that positive thinking entails having optimistic expectations for the future is shared by the majority of viewpoints. It is believed that such expectations automatically affect behavior (Scheier & Carver, 1993).

➢ *Analytical Thinking*

The Curriculum-2013 states that thinking abilities are a taught skill, i.e., analytical thinking abilities rather than mechanistic thinking (routine). By using a certain learning model or learning technique, analytical thinking abilities can be strengthened. This study looks at learning approaches that enhance the capacity for analytical thought. Context-based learning (CBL), guided inquiry, group investigation, problem-based learning (PBL), and the model of analytical thinking skills training process are among the learning methods. Infographics (Information and Graphics) and MURDER (Mood, Understand, Recall, Digest, Expand, Review) are two techniques used to enhance analytical thinking abilities. According to the study's findings, the model and learning strategy for enhancing analytical thinking abilities typically begin with a problem. The problem is then formulated to be proven with the help of the group by looking up pertinent information, conducting observations and experiments, drawing conclusions from the results, and communicating. In order to create legitimate, useful, and successful learning models for teaching analytical thinking skills, the shortcomings of each model and learning technique will be examined (Sartika, 2018).

➢ *Designing Thinking*

In order to find alternate tactics and answers that might not be immediately obvious with our initial level of understanding, Design Thinking is an iterative process in which we try to understand the user, challenge assumptions, and reframe challenges. Simultaneously, Design Thinking offers a method to issue resolution that is solution-based. It is a set of practical techniques combined with an approach to thinking and functioning. The core of design thinking is a strong desire to comprehend the needs of the target market for the goods or services we are creating. It enables us to watch and get empathetic toward the intended user. We may ask more questions by questioning the problem, the assumptions, and the implications with the aid of design thinking. By redefining the problem from a human-centric perspective, generating a plethora of ideas during brainstorming sessions, and using a hands-on approach during prototyping and testing, Design Thinking proves to be highly beneficial when addressing challenges that are unclear or unidentified.

Continuous experimentation is another aspect of Design Thinking, including concept and idea testing, prototyping, drawing, and trying out. The Phases of Design Thinking Today, there are numerous variations of the Design Thinking process that range in number from three to seven steps, phases, or modes. All iterations of Design Thinking are, nevertheless, extremely similar. The same concepts, initially outlined by Nobel Prize winner Herbert Simon in The Sciences of the Artificial in 1969, are shared by all iterations of Design Thinking. The following are the five stages of design thinking:

- Empathise – with our users
- Define –users' needs, their problem, and our insights
- Ideate – by challenging assumptions and creating ideas for innovative solutions
- Prototype – to start creating solutions
- Test – solutions It is important to note that the five phases, stages, or modes are not always sequential

A general definition of design thinking is an analytical and creative approach that gives people the chance to experiment, build and prototype models, get feedback, and rethink. The literature has identified a number of qualities (such as creativity and visualization) that a competent design thinker should have (Razzouk & Shute, 2012).

➢ *Learn from Experience*

Acquiring new skills through education, employment, or life experiences is known as learning by experience. It highlights how experiences can impact the learning process and is also referred to as experiential learning. Opportunities for learning can be found in both course-based and non-course-based activities. According to indeed.com, these can include undergraduate research, capstone projects, internships, service-learning, community service, studying abroad, and culminating experiences like student teaching. Learning from experience has an array of benefits that can contribute to our education, including:

- A better grasp of concepts: Through experiential learning, we have the chance to apply ideas and data in a real-world setting where we have an active role. As we interact with the information, it can become easier to learn.
- Creative opportunities: Learning by experience is one of the best ways to learn creative problem-solving. Through real-world experiences, we can discover multiple ways to solve a challenge and receive encouragement to find a unique solution to tasks.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1901

- Opportunities to reflect: we can reflect on our actions and how the outcome might vary from other colleagues. This analysis can help us understand how we can apply these concepts to different circumstances.
- Learning from mistakes: We might find that some approaches work better than others when engaging in hands-on work. We learn which methods work and discard those that don't, which becomes a valuable portion of the learning process.

VI. CONCLUSION

Employability depends on many factors. The research focuses only the absolute dimension of the employability. Absolute dimension depends on the skill sets of the candidates. It is true that technical skills are must have skills to get jobs. However, the contemporary employers value HOCS on top of the technical skills. It is also true that using the HOCS, an engineer can explore his/her creativity across the organization. Employers expect engineer are to be operational with all necessary skill sets of cognitive domains. It is a hard truth that Annual Compensation Review (ACR) mostly depends on the cognitive skills of engineers. In Bangladesh, engineers are not involved in product development or enhancement rather than providing services to the customers and assembling parts except the job nature of computer programmers. So, engineers can acquire all kinds of technical skills within 5 to 8 years from their career journey. Engineers can acquire new technical skills by a short training. Therefore, the life of engineers is HOCS dominated. The research finds 14 are HOCS. All skills are not equally important for all stages of the career therefore, the skills are clustered in career stage wise. Hence the following section has been portrayed:

Early-Career (Abstract Thinking, Problem Solving, Reasoning, Effective Communication, Quick Learning, Remembering, Paying Attention, Creative Thinking, Positive Thinking and Design Thinking)

Mid-Career (Problem Solving, Decision Making, Effective Communication, Learn from Experience, Critical Thinking, Analytical Thinking and Positive Thinking)

Advanced-Career (Problem Solving, Decision Making, Effective Communication, Learn from Experience, Critical Thinking, Analytical Thinking and Positive Thinking)

Engineers need all these skills during their career path. Understanding the insight of these skills have been chaptered separately. Educational institute and industry can get a readymade guideline for renovating engineering curriculum and training modules respectively.

VII. LIMITATIONS OF THE STUDY AND FUTURE RESEARCH

There are three direct limitations found in this study. One of the limitations is that there is only a limited population of engineering professionals who participated in this study. In addition, the second limitation is that the research focuses only the absolute dimension of employability. The third limitation encountered in this study concentrates four engineering disciplines namely Electrical, Computer, Civil and Mechanical Engineering. The research aims to address the problems and solutions of both Diploma in Engineering and B.Sc in Engineering graduates. In future, separate guideline for the Diploma in Engineering and B.Sc in Engineering graduates will be produced that will be more specific from the generic consideration.

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