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STUDY ON DEVELOPING NECESSARY EMPLOYABILITY SKILLS IN ENGINEERING STUDENTS BY ENGINEERING EDUCATIONAL INSTITUTES AND THEIR EDUCATION PROGRAMS IN SRI LANKA

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ABSTRACT

The professional qualifications that students earned during their university careers were significant determinants of graduates' employability. However, engineering education literature has suggested that the employability capability of engineering graduates does not meet the expectations of many modern local industries. This study aims to identify engineering program outcomes and the academic environment at the educational institute that contribute to the employability skills development of engineering students in Sri Lanka. Available literature was reviewed in order to identify engineering program outcomes and skills-improvement opportunities through engineering education programs. Also, the employability skills required for work as engineering employees in Sri Lanka were identified using related existing sources of secondary data. Accordingly, 14 major employability skills required for engineers and 3 main employability skills development factors during the life of the education institute were identified. Based on the literature reviews, a conceptual model was developed as the output for further exploration of the topic.

1. INTRODUCTION

1.1 Overview of Sri Lanka's economy and Engineering Education System

Rapid changes in the economy nowadays are creating higher demands for employability skills in the workforce. As globalization spreads across all industries, the labor market is becoming more competitive and dependent on the level of knowledge and skills. Employers, in particular, have high expectations for new engineering graduates to perform well in their organizations as soon as they are hired. Sri Lanka's growth and competitiveness have catalyzed its economy's growth toward services and high-value engineering industries. Sri Lankan universities hold the main responsibility for producing qualified engineering graduates who are equipped with the necessary knowledge and skills expected by the rapidly growing industry. (Shyamalee, et al, 2014) The additional professional qualifications that students earned during their university careers were significant determinants of graduates' employability in the country. (Chandrakumara, D., 2014) The required employability skills may differ from one engineering discipline to another and are decided by the nature of the work involved in each discipline. Industry now needs engineers with passion, systems thinking, an ability to innovate, an ability to work in multicultural environments, an ability to understand the business context of engineering, interdisciplinary skills, communication skills, leadership skills, an ability to adapt to changing conditions, and an eagerness for lifelong learning. (National Science Board, n.d., as cited in Khalid et al., 2013). In order to ensure that the fresh engineering graduates are capable of giving their full contribution to the development of the industry, Sri Lankan universities should examine whether they are well equipped to provide the necessary employability skills.

The academic institutions must provide an updated curriculum, modern facilities and equipment, efficient student services, responsive organization and administration, and educators must possess effective teaching techniques and strategies to ensure and maximize the learning of the students. Also, being aware of the required employability skills and the performance scores expected by employers, fresh engineering graduates would be able to start their professional career with a smooth transition from an academic environment to a professional life. Having awareness of the employability skills of fresh engineering graduates in their specialized disciplines will help them succeed in their careers.

1.2 Organizations' expectation about employability: Skill gap identification

For some time, engineering education literature has suggested that the employability capability of engineering graduates does not meet the expectations of many local modern industries.

In Sri Lanka, the higher education sector had not kept up with these shifts and was not producing sufficient graduates with the necessary skills that employers were seeking. Although universities provide good theoretical knowledge, they rarely emphasize soft skills such as industriousness, teamwork, leadership skills, creativity, and communication skills.

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There was also a gap in the quality of higher education in lagging regions such as the Northern and Eastern Provinces. (Sri Lanka: Developing Students with Practical Skills for Employability and Competitiveness, n.d.)

1.3 Aim

This research was carried out to identify the engineering program outcomes and the effect of the academic environment at the educational institute on developing employability skills in Sri Lankan engineering students.

1.4 Objectives

- Identification of Employability Skills Required for an Engineer
- Identification of the program learning outcomes of engineering curriculums
- Identification of the effect of the academic environment/life on developing engineering employability skills
- A conceptual model designing

2. METHODOLOGY

The study began with a review of published reports and literature on employers' expectations about the employability and skill gap of fresh engineering graduates in Sri Lanka. Then the required skills were identified, and the learning outcomes of the engineering program and life at the university were identified by referring to the literature. Based on them, 14 employability skills were identified: communication skills, problem-solving skills, technical skills, teamwork abilities, leadership and management skills, motivation, industry knowledge, analytical mind, interpersonal skills, creativity, stress management, time management, lifelong learning, social skills, and responsibilities. These skills have been chosen because almost every engineering accreditation, including the Accreditation Manual for Engineering Degree Programs 2021 of the Institution of Engineers Sri Lanka (IESL), expected them to be equipped by engineering graduates. Also, some other documents and data related to higher education in Sri Lanka, such as the Sri Lanka Qualifications Framework (SLQF) and other past research data, were taken into consideration when constructing the conceptual model. However, in this survey, IT graduates skills are not considered.

3. DISCUSSION AND FINDINGS

3.1 Based on the findings, the employability skills that are expected by employers,

1. Communication skills- According to the IESL accreditation manual, (2014), this is defined as "communicating effectively on complex engineering activities with the engineering community and society at large, such as being able to comprehend and write effective reports and designs.
2. Problem solving skills- An engineering employee cannot have problem solving skills without developing their critical thinking skills. In an engineering firm, technical problems, misunderstandings, and miscommunications are inevitable. These may cause damage or bring a department, project, or entire company at risk, though, if the people in charge have no problem-solving skills. IESL (2014) states that it is "Identify, formulate, research literature, and analyze complex engineering problems, reaching substantiated conclusions using the first principles of mathematics, the natural sciences, and engineering sciences."
3. Technical skills Having- the right technical skills for a job candidate means having good education, credentials, and experience working in the same position or one that is similar. It includes being up-to-date with today's technology and aware of industry trends and news.
4. Teamwork abilities- An engineer needs to have the ability to work as part of the team. Most engineers work with a team, and no engineer can work alone on a certain project unless they're an independent engineering/design consultant. That means they have to be comfortable working with other people. This is vital to the completion of a project.
5. Leadership and management skills- Engineers ought to be leaders and managers- They also need to be able to motivate others if they want them to follow their guidance. Leadership is a never-ending path and the ultimate success on their personal development journey. (Agrawal1 & Dasgupta2, 2018)
6. Motivation Motivation means enthusiasm and commitment- Industry knowledge Applying knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems is another requirement to work as an engineer in the industry. (IESL, 2014)
8. Analytical mind- An engineer must have a strong analytical mind. Being an engineer will make them encounter different problems and situations.
9. Interpersonal skills- As an engineer, interpersonal skills mean that he must be able to have a positive attitude towards himself, others, and circumstances. They show their interpersonal skills by cooperating in the workplace, interacting with people in a friendly and professional manner, and being responsible and accountable for work assigned to them.

10. Creativity- A creative mind is able to combine prior experiences in new ways to create a solution to a problem. Creativity is a very important skill that employers will be on the lookout for. (Mowlaee, 2018).
11. Stress management- Engineering projects can be challenging, so a candidate needs to be reliable under stress.
12. Time management- Managing time and priorities - setting timelines and doing proper planning, coordinating tasks individually and with others, being resourceful, and adapting resource allocations to cope with contingencies.
13. Lifelong learning- The ability to recognize the need to undertake lifelong learning, and possessing / acquiring the capacity to do so is covered under this attribute.
14. Social skills and responsibilities- Society trusts engineers as they have a primary duty to protect public safety, health, and welfare, the failure of which may result in severe injuries or even deaths.

3.2 Skills Development in Education institute/University

Academia is playing a huge role in filling the gap between the academic programs of engineering students and industry skill requirements by acting as facilitators and potentially developing such skills through campus life. A combination of employability skills and an engineering degree should ensure students meet the high expectations of their employers. There is a direct impact of teaching quality on students' employability. (Kowang et al., 2022) Psychosocial learning environment also encourage students to practice social interaction and communication, hence promotes desirable attributes for student employability (Garavaglia et al., 2012, as cited in Kowang et al., 2022).

Technical writing, public speaking, writing across the curriculum, speeches and presentations in all classes, and similar types of programs can help engineering students learn to communicate better. By participating in extracurricular activities and organizing events on and off campus, the students can explore a number of qualities in their personalities, like leadership skills, planning and enterprising skills, and interpersonal skills. (Kaushal, 2016)

Expectations for engineering students also include stress management and time management skills, along with integrity, perseverance, and confidence. These are attributes that go hand in hand with the above-listed skills and do not need a special explanation. Technical skills and computing skills are mandatory for all engineers. These skills can be acquired by developing certain attributes and making some behavioral changes. For instance, communication skills in English can be developed by regular practice of the language and by developing the four skills of listening, speaking, reading, and writing. Along with practicing those skills, if one consciously works to build his or her vocabulary, he or she can easily make communication skills a strength. Besides, using the language more and more can bring fluency and confidence to the speaker. (Kaushal, 2016) College is perceived to be the best place to develop team spirit, and "it is said that possession of team spirit is one of the major skills" (Kaushal, 2016, as cited in Rao, 2010, p. 89). For Abell and Napoleon (2008), feeling valued and part of a group is a basic need, so "when you create team spirit and identity, staff members will see themselves as a group of people all working for a common goal, rather than a bunch of individuals competing with each other". Furthermore, by creating team spirit, students can demonstrate they are "open to communication from everyone". One learns to work as a team in the classroom and by playing various sports like cricket, volleyball, basketball, and football. Secondly, life on campus has immense opportunity for participating in various formal and informal events, and, while participating in myriad academic or other events, the students are exposed to the basic functioning of the team. All extracurricular activities, in some way or another, inculcate team spirit. (Abell and Napoleon, 2008, as cited in Aggarwal, 2016) An easy way for aspiring engineers to acquire analytical skills could be by using their reasoning on numbers and calculations daily. It is often said that engineering students require sound knowledge of mathematics and science, but it is often seen that after joining an engineering college, the students become callous and ignore their regular studies. Most of the engineering colleges have also reported that students study one day before the examination. This might be in part due to the emphasis on test scores rather than learning (Kaushal, 2016, as cited in Holtgreive, 2016).

In any case, analytical skills cannot be developed even if the student has the aptitude for them, as these skills require regular practice mathematical problems or puzzles, anything that challenges the mind and tests their intelligence. Knowledge can be acquired easily by voluntarily learning something new. This way, by forcing themselves out of their comfort zone, students can train themselves to deal with change and prepare for any unexpected change. Negotiation skills are somewhat difficult to acquire, as there isn't any clear attribute to develop them. With the right mix of interpersonal skills, convincing power, knowledge, and the right attitude, however, the art of persuasion can be learned. Active listening and general awareness of business and industries at large can facilitate commercial skills in the students. Commercial awareness skills can easily be developed as they can be self-accessed by reading the market value, work culture, services, products, and production of companies of interest.

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3.4 How to improve engineering skills at university/ The Role Academia Can Play in Developing These Skills

Whether we call them soft skills or employability skills, academia and students must realize their importance and work to acquire them. By acting as facilitators, academia can significantly contribute to filling this gap. Students should be initiated into the awareness of these skills and their significance; secondly, encouraging self-analysis in the students to identify their strengths and specific attributes will facilitate goal setting. Lastly, once the clarity of strengths and attributes has been achieved, students should acquire these skills by maximizing participation in activities and courses that endorse those skills. This entire exercise will change the present scenario, in which we are training a mass of students without any specific attributes to make a mark in the industry. Gerson and Gerson, in their book Technical Communication, opined: These skills are important because they help show how the candidate is the candidate has not been trained in the job for which he is applying, he can still be a valuable employee.

3.5 Conceptual model

Figure 1 below demonstrates the visual representation of the conceptual model designed to study the employability skills development of engineering graduates at their educational institutes.

Here, all factors in the engineering course curriculum and academic life were assumed to significantly influence the prescribed engineering employability skills development. Therefore, a second-order model was developed based on the literature findings for further analysis.

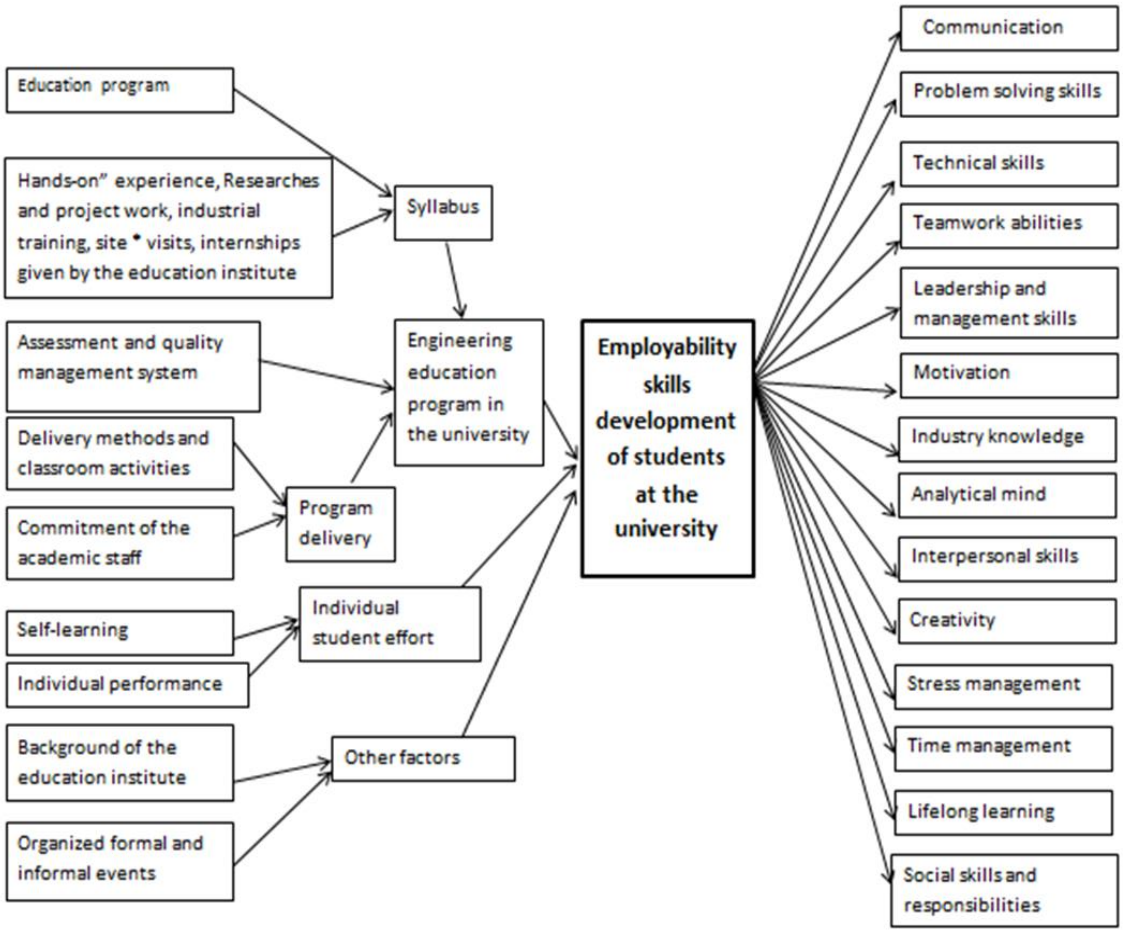

Figure 1: Conceptual model

4. CONCLUSIONS

Through this research, the engineering program outcomes and the effect of the educational institute that contributes to developing the employability skills of Sri Lankan engineering students were identified. Based on the findings, 3 main factors in the education program and the academic environment at the education institute that will contribute to the development of 14 employability skills were identified. The combination of these 14 engineering employability skills, along with an engineering degree, will ensure that students meet the high expectations of their employers. (Kaushal, 2016)

As the next stage of this research, a questionnaire will be designed, and SPSS statistical software will be used to validate the conceptual model in a quantitative study.

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