Students Skills Assessment with the Purpose to Increase their Employment Possibilities

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ABSTRACT

Incorporation of employability skills in the industrial engineering curriculum to bridge the gap between industry and institutions of higher education has become a major issue. This study seeks to asses both employability skills and retentability threshold of the industrial engineering students. The employability skills were assessed based on the skills that require training, skills that are needed for job performance and skills that are received and emphasized in the industrial engineering curriculum. Two batches of questionnaires are administered to the participants of the study. The first batch is administered online to students, employed alumni and faculty members. The second batch is distributed to instructors of industrial engineering core courses. Seven cogent employability skills of the thirty-six employability skills items that were previously reported are employed in the evaluation. Of the seven employability skills, following management, leadership and information technology skills are identified as skills that require additional training. The responses toward skills required for job performance and skills that are received/emphasized in the curriculum are ranked higher by participants based on the percentage of agreement. This study advocated that the perception of participants provides greater insight into the skills items that should be emphasized in the industrial engineering curriculum to enhance the employability of graduates. On the another hand, employability aptitude survey cognitive test is proposed to assess the retentability threshold of the students with the view of appraising the capabilities of engineering students in readiness for engineering positions. Numerical ability, space visualization, numerical reasoning, and symbolic reasoning responses are adapted into the model. 106 undergraduate students of the Department of Industrial Engineering at Eastern Mediterranean University selected

across freshman, sophomore, junior and senior in the 2016-2017 academic years assessed their aptitudes through the proposed EAS cognitive tests. Analysis of variance is employed to analyze the model and the results indicate that there is a significant difference between students' abilities in terms of raw scores and respective academic levels. Academic years and CGPA groups are found to have significant effects on the student's percentile. Additionally, strong correlations between CGPA and the student's percentile are found. However, space visualization ability is not affected by academic progression.

Keywords: aptitude, EAS-cognitive tests, student's percentile, engineering, rententability-threshold, battery score, attitudes, curriculum; employability skills, performance skills, training

ÖZ

Endüstri ve yüksek öğretim kurumları arasındaki boşluğu kapatabilmek adına endüstri mühendisliği müfredatına istihdam edilebilirlik becerilerinin dahil edilmesi günümüzde önemli bir konu haline gelmiştir. Bu nedenle bu çalışma, endüstri mühendisliği öğrencilerinin hem istihdam edilebilirlik becerilerini hem de kalıcılık eşiğini değerlendirmeyi amaçlamaktadır. Bu çalışmada istihdam edilebilirlik becerileri, eğitim gerektiren beceriler, iş performansı için gerekli beceriler ve endüstri mühendisliği müfredatında kazanılan/vurgulanan becerilere göre değerlendirilmiştir. Bu bağlamda çalışmanın katılımcılarına iki grup anket uygulanmıştır. İlk grup anket öğrencilere, çalışan mezunlara ve öğretim üyelerine çevrimiçi olarak uygulanırken; ikinci grup anket ise, endüstri mühendisliği temel derslerinin eğitmenlerine uygulanmıştır. Daha önce rapor edilen otuz altı istihdam edilebilirlik becerisi maddesinin yedi ikna edici istihdam edilebilirlik becerisi bu değerlendirme anketlerinde kullanılmıştır. Yedi istihdam edilebilirlik becerisinden yönetim, liderlik ve bilgi teknolojisi becerileri ek eğitim gerektiren beceriler olarak tanımlanmaktadır. Müfredatta kazanılan/vurgulanan iş performansı için gerekli becerilere ve bu becerilere yönelik tepkiler katılımcılar tarafından ortak bir görüş ile daha üst sırada yer almaktadır. Tüm bunlar ışığında bu çalışma, katılımcıların algısı, mezunların istihdam edilebilirliğini artırmak için endüstri mühendisliği müfredatında vurgulanması gereken beceri öğelerine daha fazla iç görü sağladığını savunmaktadır. Öte yandan, istihdam edilebilirlik yetenek anketi, bilişsel test, mühendislik pozisyonlarına hazır durumdaki mühendislik öğrencilerinin yeteneklerini değerlendirmek amacıyla öğrencilerin kalıcılık eşiğini değerlendirmek için önerilmiştir. Sayısal yetenek, uzay görselleştirme, sayısal muhakeme ve sembolik muhakeme tepkileri de bu modele

uyarlanmıştır. Doğu Akdeniz Üniversitesi, Endüstri Mühendisliği Bölümü'nden 2016-2017 akademik yıllarında birinci, ikinci, üçüncü ve son sınıftan seçilen 106 lisans öğrencisi, önerilen EAS bilişsel testler aracılığıyla yeteneklerini değerlendirmişlerdir. Modeli analiz edebilmek adına Varyans analiz yöntemi kullanılmış ve sonuçlar öğrencilerin ham puanlar ve ilgili akademik seviyeler açısından yetenekleri arasında önemli bir fark olduğunu göstermiştir. Bu araştırmanın sonuçlarına bakılarak, akademik yıllar ve CGPA (genel not ortalaması) öğrencinin yüzdelik oranında önemli etkileri olduğu bulunmuştur. Ayrıca, genel not ortalaması ve öğrencinin yüzdelik oranı arasında kuvvetli korelasyon gözlemlenmiştir. Ancak, uzay görselleştirme yeteneği akademik ilerlemeden etkilenmemiştir.

Anahtar Kelimeler: yetenek, EAS-bilişsel testler, öğrenci yüzdesi, mühendislik, kiralanabilirlik eşiği, pil puanı, tutumlar, müfredat; istihdam edilebilirlik becerileri, performans becerileri, eğitim

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LIST OF ABBREVIATIONS

ABET	Accreditation Board for Engineering and Technology
CAT	Cognitive Ability Tests
CH	Cumulative Hours of studies
CT	Critical Thinking
EAS	Employee Aptitude Survey
EMU	Eastern Mediterranean University
FM	Following Management
GMA	General Mental Ability
GCA	General Cognitive Ability
IE	Industrial Engineering
IP	Interpersonal
IT	Information Technology
KPI	Key Performance Index
L&N	Literacy and Numeracy
LS	Leadership Skill
SCANS	Secretary's Commission on Achieving Necessary Skills
SNJ	Skills Needed in Job performance
SREC	Skills Received or Emphasized in Curriculum
SRT	Skills Required additional Training
WE	Work Ethic

Chapter 1

INTRODUCTION

1.1 Nature of the Problem

The new economy fueled by technology and globalization has led to the creation of a high-wage, high-skilled and high-performance workplace that is demanding for a new skill set from graduates, thus bringing about the concern for employability. The importance of higher education in the development and training of employable graduates has been a matter of ongoing debate for many decades. Education has been termed as organizations meant for innovation, mobility, change, adaptation and developing long-term competences. The evolution and rapid emerging job-space requirements since the beginning of this 21st era have made it absolutely conditional on the intrinsic skills possessed by individual and thus demanding more acumen hinged on adequate skills set to secure and retain a job (Shivoro, Shalyefu, & Kadhila, 2017). Due to that fact engineering jobs have been really influenced by the resultant effects of globalization, diverse work styles and technological advancements. Therefore, continuous appraising of the skills set of the engineering students is sacrosanct for enhancing the employability of the graduates. The imbalance in the skills garnered at the higher institution from those expected on the job that has existed over the years, is due largely to the prioritization of the academic learning at the expense of the reality as it is being demanded by the emerging job functions (Matthews & Mapstone, 2018).

It is obvious considering the evolving nature of the job environment that the delivery of basic qualitative and quantitative transferable skills by graduates from various institutions is non-negotiable for the survival of the thriving industries. Government and other stakeholders have put in measures by which the employability of graduates can be enhanced. Such measures are the introduction of key performance index (KPI) by which universities are evaluated. This was promulgated to prioritize education and ensure that students are well equipped with requisite skills essential to be employable and retain the employment (Blom & Saeki, 2011).

1.2 Present Situation

Several studies have been carried out to appraise the level of the skill set of some graduates with the view of assessing the viability and the productivity of those graduates in the labour market. Obviously, the job responsibilities of today's work environment are changing from the traditional functions and it take a more dynamic and versatile graduate to adequately fit in. A new range of definite technical skills are needed to meet the demands of technology and that of business, this is coupled with the significant prominence employers are giving to personal and generic skills at the workplace. This is because the roles managers and supervisors play are becoming more important, and as a result requires a fine combination of astute communication and technical skills (National_ESS, 2003). For this reason, the engineering curriculum has received a number of criticisms in that it barely develops personal and transferable skills in graduates. Other interpersonal and generic skills have been reported to be in shortage by employers. For example, technicians with software and IT skills have been said to be scarce and managers with good management skills are quite rare not to mention the lack of communication skills amongst salespersons (National_ESS, 2003).

UNESCO (2010) stated that the current trend by higher Institutions of learning in fostering the dynamic graduate employability through skills acquisition with a well-structured and developed curriculum should be seen as a global phenomenon. Darwish & Dyk (2016) reported the need for research that is geared toward revitalizing and revamping the existing curriculum in order to design and deliver a more resourceful, practical-oriented and entrepreneurship-driven curriculum that is capable of producing more skillful and employment-ready graduates. The onus is now vested on the graduates to acquire basic skills that will enhance their propensity for excellence on the specific job function. Sin, Tavares & Amaral (2017) opined that it is of great benefit for the industry and the graduates if they are well equipped with a wide range of technical skills that are essential for productivity. Industry sectors advocates for a sharp focus on the employability of qualified graduates because the investment made in education is a kind of capital, which is positively associated with economic prosperity (Hesketh, 2000). The reasons could be classified majorly in two folds; first, the time and energy required for training a new graduate could be dissipated into more productive activities in the production schedule. Second, the cost requirements for training the employee could result in a cost overrun. Therefore, invariably, seasoned graduate level skills will be beneficial to the student in particular and subsequently to the society at large.

1.3 Statement of the Problem

How can the faculty members, employed alumni students and undergraduate students differ in their attitudes to the Skills which are Received/Emphasized in Curriculum (SREC), Skills Required additional Training (SRT), and Skills Needed in Job performance (SNJ) with seven dimensions of basic Literacy and Numeracy (L&N), Critical Thinking (CT), Leadership Skill (LS), Following Management (FM),

Interpersonal (IP), Information Technology (IT), and Work Ethic (WE) in enhancing the competencies of industrial engineering graduates? Additionally, investigations should be done on how the participants' responses give various rankings for the importance of the seven employability skills regarding to their attitudes about the SREC, SRT and SNJ. On the other hand, an assessment should be done on the students' rate of retention from the first academic year through to graduation according to their cognitive abilities.

1.4 Purpose of the Study

This research aims to evaluate the progression of the students' perceptions in the industrial Engineering IE department at EMU regarding to their attitudes on the seven employability skills. The attitudes of students' responses were considered in two directions; skills that were received or emphasized in college (SREC) and skills that required additional training (SRT). Additionally, three groups of participants (senior students, employed alumni, and faculty) were selected and their attitudes compared to find out if there were any significant differences between their responses in the three dimensions; SREC, SRT and skills needed for job performance (SNJ). To achieve the objectives of the study we will assess the relationships between the demands for improving skills by taking into consideration the viewpoints of the participants from their responses in the questionnaire. Additionally, an investigation will be carried out to determine if the program objectives for the Industrial Engineering Department at EMU are being achieved during the academic years. Moreover, the relationship between the curriculum and the seven employability skills will be analyzed to find out which one needs improvement in each of the core courses taught in the department. This study offers an important new outlook on professional curriculum development;

to decide on its weaknesses and its ability to enhance skills and increase the chance of graduates' employability.

This study would like to confirm if the undergraduate students of the IE program in EMU will possess the under listed skills, behaviors and knowledge at the time of their graduation:

a) The ability to effectively apply the knowledge of engineering, mathematics, and science.
b) The ability to design experiments, conduct experiments, as well as the ability to analyze data and interpret data.
c) The ability to design a component, process or system with the aim of meeting needs all within the realistic social, economic, ethical, environmental, political, health and safety, sustainability and manufacturability constraints.
d) The ability to effectively function on a multi-disciplinary team.
e) Ability to recognize, formulates, and solves engineering problems.
f) The understanding of ethical responsibility and professionalism.
g) The ability to effectively communicate.
h) The extensive education required to understand the influence of engineering solutions in an economic, global, societal and environmental context.
i) The appreciation of the need for, and an aptitude to engage in life-long learning.
j) The knowledge and familiarity with contemporary issues.
k) The ability to use skills, techniques, and contemporary engineering tools required for engineering practice (IE Department, 2018).

As well as this study will emphasize the essence of cognitive skills for employment-driven skills development during academic learning. This study assesses the array of

abilities through four of the Employee Aptitude Survey (EAS) tests to determine battery and percentile models for monitoring students' progression and efficiency. Thus, this offers a new perspective to determining and assessing students' rate of retention from the first academic year through to graduation. This is with the view of evaluating for enhancing graduate's readiness and propensity for employability.

1.5 Research Questions

This study will seek to answer the following research questions:

a) How do the perceptions of respondents differ regarding skills that require additional training, skills needed in job performance and skills received or emphasized in curriculum?

b) Which of the seven employability skills is highly important based on the attitudes among the three categories of SRT, SNJ and SREC?

c) Which of the seven employability skills should be the focus and intensively trained in the curriculum of the IE students?

d) Do academic advancements have any significant effects on the students' abilities?

e) Which of the students' abilities (numerical ability, space imagining, numerical reasoning, and symbolic reasoning) is affected by these academic levels?

f) Does the age of the students have any significant effect on the students' performance?

g) Is there any correlation between CGPA and percentile?

1.6 Significance of the Study

The results from this dissertation will develop the existing literature on primary employability skills learned in higher education institutions which are required for getting a job and entering the workforce, as well as to make a deduction on how these skills translate into the prospect to advance a career.

The importance of the seven employability skills that are needed for graduates of the industrial engineering department of EMU will be analyzed in three dimensions of attitudes (SREC, SRT and SNJ) and the opinions of lecturers who design and teach the courses will be collected. The questionnaires were designed in such a way that makes it possible for the study to be done from multiple points of view, this is necessary for an apt conclusion.

In addition, this study uses the EAS to examine the progressing of students throughout the academic years. The outcome from EAS will provide academic staff with a good understanding of the abilities acquired by IE students during their studies. This enhanced understanding will improve the ability to create academic courses which will teach the skills that the university graduates require while carrying out their professional responsibility. Therefore, IE graduate in EMU will be better prepared to go into the workforce and carry out what is required of them on the job.

1.7 Study Limitations

The participants in this study were represented by faculty members of Industrial Engineering department at Eastern Mediterranean University, plus the department alumni and undergraduate students only. Since this study was conducted in one university that is in one geographical region, the outcomes cannot be generalized elsewhere. Consequently, precaution should be taken regarding the generalizability and interpretation of the findings. The perceptions of participants were analyzed using ANOVA models. The study was conducted only to assess the seven types of employability skills that needed for IE students. Hence, it is important for the reader be aware that this study like other self-reported research is based on the respondents'

own perceptions or their view of reality. Therefore, the results of this research should not be generalized to other universities.

Skills that were not the focus of this study are another concern as to what extent competencies can be changed by enhancement these skills in the curriculum. Therefore, the reader should take caution regarding the findings in this study that are related with competencies. On the other hand, the lack of responses that received from employed alumni students (i.e. sample size), was a source of fear for the researcher while gathering data, as it was difficult to communicate with them directly to persuade them to participate in this study. The alumni group was the only way to communicate with them. Finally, since part of this study was conducted during the outbreak of Corona Pandemic and great global economic stress. Therefore, the participants might have been affected by the current economic environment that affects the performance of companies, and the perceptions of graduates, faculty.

1.8 Definition of Expressions

The following expressions are defined as they are used in this research.

1.8.1 Skills

Skills are behaviors displayed and exhibited when aptitudes, knowledge and character traits are applied. According to some school of thought, skills are simply knowledge, competencies, procedures, attitudes, and aptitudes that are required to construe, coordinate and complete different activities. This attributes have been structured according to SCANS (1991), into 3 human functioning stages which consist of knowledge, skills, and attitudes.

1.8.2 Basic Skills

As opined by SCANS (1991), basic skills are the capacity to complete mathematical and arithmetic operations, speak and listen. Mathematics and Arithmetic skill comprises of elementary approaches and computations needed to solve applied problems through appropriate mathematical techniques. Listening skill is the ability to receive, construe, process, and give feedback to verbal communications. Moreover, speaking skill is the ability to connect ideas together and communicate them in words.

1.8.3 Thinking Skills

This includes creative reasoning, problem solving, decision making, and the ability to learn and reason (SCAN, 1991). Creative thinking is the ability to establish new concepts, plans, and designs. It is also an offshoot of decision making skill that take prominent roles in identifying goals and scopes, create substitutes, assess risks, and appraise policies.

1.8.4 Interpersonal Skills

These skills ensure the ability to function in a team, assisting others to learn, extend customer services, negotiate agreements, team leading, resolve differences and conflicts, and ability to function well in a multi-ethnic multi-racial organization (Heimler, 2010).

1.8.5 Management Skills

The ability to recognize, plan, organize, and allocate time, finances, material, and staff (SCANS, 1991).

1.8.6 Leadership Skills

SCAN (1991) identified transactional, charismatic, visionary, strategic, and transformational types of leadership as different, yet slightly related concepts that describe the various shades of leadership styles.

1.9 Industrial Engineering

Industrial Engineering is the application of principles and techniques to the development, design, and setting up of systems that involve materials, people, energy, information, and equipment to ensure that the production of goods and services are achieved more efficiently. Industrial engineers work is multidisciplinary, and mostly connected typically with how to plan, set up, control and improve production activities which include product innovation, manufacturing, provision of services, organizational information flow and transportation (IE Department, 2018).

1.9.1 Fields of Industrial Engineers Work

Industrial engineers can be employed profitably in various fields throughout the industry. Some areas of potential employment include process control, technology management, flexible manufacturing systems, systems engineering, planning and control of inventory and production systems, operations research, optimization, ergonomics, computer applications, multi-objective decision making, performance evaluation, administrative duties and simulation, machine scheduling, service sector (IE Department, 2018).

1.9.2 IE Department at Eastern Mediterranean University (EMU)

The Industrial Engineering Department of EMU was established in the 1994-1995 academic year as an arm of the Engineering faculty. Table 1 illustrates the undergraduate student enrollment and graduation data through academic years 2012 – 2017 (IE Department, 2018).

Table 1: IE undergraduate student enrollment and graduation

Academic Year	Freshman	Sophomore	Junior	Senior	Total (+)	BS Graduates
2012 - 2013	35	16	17	114	182	59
2013 - 2014	43	31	12	63	149	30
2014 - 2015	53	49	24	39	165	27
2015 - 2016	55	63	39	35	192	21
2016 - 2017	51	52	52	41	196	16

1.10 Organization of the Study

The dissertation is organized as follows:

Chapter two gives a summary and review of related literature. The third chapter explains the methodology applied, particularly in data collection. Chapter four contains the findings and discussion the results of statistical analyses. Finally, the fifth chapter covers the conclusion and recommendations for practice, development of employability skills and future researches.

Chapter 2

LITERATURE REVIEW

2.1 Historical Background

The shift from an agricultural to a manufacturing and industrialized economy began an enormous change in the way work was understood. Up until that point in the late nineteenth century, the majority of the workforce were not educated and had very little skills. These minimal and basic skills were adequate for the job of moving objects, adjusting machinery and assembling of mechanical devices that were available at the time (Carnevale, 1996). Only about 10% of the workforce back then had supervisory or managerial capabilities. With pronounced advancement in technology, the information and service economy began to emerge. This raised the demand for a more skilled workforce which can efficiently manage an organization's environment; internally and externally. As a result, the demand for institutions of higher education increased as enrollment into various professional programs gradually increased. As the 21st century dawned, the quality and the employability of graduates from the institutions of higher education became a growing concern, and so was the nature of the workplace (Van Horn, 1995).

2.2 Employability

Several studies in two decades past have been carried out to fully describe employability skills and to lay emphasizes on its importance. De Grip, Van Loo & Sanders (2004) provided a 3-level emploayability framwork to attempt to detail in a core, broader and all-embracing dimension, the concept of employability. The ability

of an individual to secure and retain a job within a particular labor market was termed the core level. The level is propelled with a sense of commitment to continue learning and the ability to absorb skills from the good of the workplace. The need to always emphasize on the development of graduate characteristics and some factors that can influence or enhance the opportunity to land a job have been established by (Mcquaid & Lindsay, 2005).

Holmes (2013), examined three competing perspectives on employability, termed as possessive, positional and processual approaches to increase the propensity of the graduate to be employable. The analysis, show that the employability-as-possession approach has a lot of weaknesses. One of alternative, that based on notions of social positioning, offers little clear and positive guidance on how we might interfere at the level of the curriculum. However, the processual approach can to be theoretically strong, to be empirically supported to provide a basis for curriculum.

Cranmer (2006), Two approaches have been proposed to define ways that can be taught in universities and colleges for increasing the opportunities of students' employability. One is the enhancement of the employability of students through the use of the school curriculum; other focuses on an equivalent and independent group geared towards the improvement of generic and study of a skill that enhances employability.

2.2.1 Curricula, Employability and Employment

Over time, as being evidently witnessed, most career directions and experiences are gained on-the-job. This is the sequel to the unproven facts, surprisingly though, that majority of students only mastered courses taught in classrooms for the sake of passing

examinations without imbibing them into knowledge that can be leveraged on The job. Most often, these theoretical and practical exercises become rusty almost immediately after examinations are passed and the degree is conferred. Most graduates seem to be at lost whenever it beckons on them to apply these principles in reality. However, SCANS (1991) identified that the teaching of this functional skills will be more successful if the students are made to realize the importance of the skills they are learning at the institution to the real life beyond the classroom. This understanding has to be imbibed early so as to make sure that these students attain to their full potentials. In addition, this fitting together of functional skills and curricula should involve more of supervision and assessment of hands-on training.

Faculty members should also give additional consideration to the practical side in contrast to the theoretical one, so as to foster effective teaching objectives (Cao, Chapman, & DeJaeghere, 2011). Real training of engineers is all about creating cohesion of theory and praxis. In their study of what a good engineering lecturer looks like, Davies, et al., (2006) identified three keys traits of a good engineering lecturer; giving well-structured and clear presentations, enthusiasm and the use of real-life, practical engineering examples supported with industrial experience. An engineer's tutoring has to happen in real life contexts. This is a complete move away from the days when engineering professors believe that their technical discipline is the most important thing and students should handle the issue of incorporating all they are being taught into their professional practices. This does not imply that training of employable engineers should move from imparting knowledge to teaching just skills, but a movement from teaching-to-know to teaching-to-be-able.

Pegg et al. (2012) described employability as graduates' understandings, accomplishments, personal awareness of the skills and expertise possessed that can enhance many opportunities to secure and retain employment for the betterment of the economy, society and labor force. Moreover, Bridgstock (2009) and Harvey (2001) all advocated the need to distinguish between employment and employability especially when the motive for graduate employment is based on the pointers of employability.

Anderson (2004), different approaches have been adapted to ensure the delivery of the necessary skills required by the stakeholders and pointed out that one of the ways of equipping engineering students is by defining different courses that is targeted on satisfying the employers as well as meeting the aspirations of the students. One good way of equipping engineering graduates with these capabilities is by designing different courses that meet both the employers' expectations and the needs of the students. This is possible by effectively connecting and incorporating the fundamental employability skills and the intricacies of the engineering practice into the current curriculum being used at the institutions of learning (Heimler, 2010). This corroborated the work of Moreno, Segura & Dominguez, (2012) where engineering professors and engineering professionals were examined on the link between the capabilities of recent graduates and task requirements that the job demanded. It is generally believed by practicing engineers that individual graduate solely, to a large extent, responsible for managing and developing his employability skills. However, such individual learning must be relevant to the professional aspirations of that individual. It must also correspond to the level of academic level pursued or to be achieved by such individual (Lyon & Bernent, 2001).

Jorgensen (2004) and Nilsson (2007) both agree that the specifics and details of a practice can be learned at work, that it may not be possible for institutions of higher education to train graduates on the direct specifics needed in practice. In addition to this, different employers want different competencies in different fields, and the current form of educational courses most likely makes the competencies they offer less (and in some cases more) applicable in certain fields (Hesketh, 2000). Work tasks are continually changing too, as a result of external factors this makes it difficult to evaluate the employability of graduates objectively especially to a particular job's requirement (Nilsson, 2007).

2.2.2 Education and Employability Skill

Higher education institutions since inception have been contributing in no small measure to the development and enhancement of the employability of graduates. Higher Institution of learning has been defined as a place where students must not only learn to know, but also learn to apply and exercise those skills that have been learnt (Mulder, Weigel, & Collins, 2007). Baker (2009) termed formal education as an instrument for the building and refinement of various competencies and capacities in a bid to foster employability. The diverging, emerging and evolving technology is swelling up at a vast pace too distant for academic institutions to keep abreast and cope with. The changing, evolving and emerging nature of work has been pressurizing and shaking the level of competencies and capacities and employability issue is continually threatened Barnett (2004), Sin, Tavares & Amaral (2017) considered education as a germane factor and indicator for personal attainment, self-esteem, development leading to the promotion of human right toward fostering citizenship and adequate equipping of graduates for employment.

Ebenuwa-Okoh (2010) looked into how self-efficacy, attitude, and student engagement could influence affective learning characteristics and academic achievement among engineering students and reported a statistically significant positive correlation among the selected psychological variables and academic achievement scores. These adaptive and transferable skills will ensure that the students are well adapted to whatever career they find themselves.

Blom & Saeki (2011) has suggested that learning and teaching programs in curricula be assessed and reassessed in a bid to incorporate additional thinking skills like memorizing and understanding; as well as further advanced skills, like analyzing, solving engineering problems and creative thinking.

McQuaid & Lindsay (2005) and Cranmer (2006) at separate studies have described employability skills as values that accompany the demonstration of a set of competency or ability developed or gained through a well-developed curriculum from training or education or instruction or both dependently, simultaneously or independently. An example of certain European policies such as the Bologna process has been reported to have imparted the employability tendency of many graduates by ensuring graduates' preparedness for the dynamic labour market.

Scott & Yates (2002) conducted a study on how to use successful graduates' skills set as a yardstick for improving the quality of the undergraduate engineering programs. Graduates from five engineering fields of electrical, civil, mechanical, telecommunication and environmental were used to verify whether technical expertise and emotional intelligence are necessary for successful practice. The outcome culminated in the conclusion that technical expertise is indeed necessary as well as the

emotional intelligence and suggested that course designers should always revitalize the curriculum in a way that learning opportunities in the technical expertise can be enhanced. It has been affirmed that indeed technical background, problem-solving skills, formal communication skills and life-long learning abilities were all necessary skills required by graduates to be successful in their career.

Kazilan, Hamzah, & Bakar (2009) studied employability skills of students of vocational and technical training institutes and reported that personal quality skills, interpersonal skills and thinking skills are considered as mostly essential before resource/capability skills, technology skills, and information skills. Personal qualities comprises of attriributes like responsibility, sociability, self-confidence, honesty, self-management, efficient and punctual, self-directed/self-control, flexible and adaptable good working attitude. These are always considered first before other skills.

The employability and skill set required by engineering graduates as identified by Mulder, Weigel & Collins (2007) were broadly classified as soft skills and professional skills. Soft skills include core employability skills (such as integrity, teamwork, self-discipline, reliability, flexibility, empathy, and willingness to learn) and professional skills are those regarded as communication skills (basic computer skills, written, oral, verbal, technical skills, experimental/data analysis and reading). As well as cognitive skills that have been registered with engineering professions, such as knowledge to apply basic engineering concepts, designing, conducting and interpreting various experiments, just to mention a few. Despite their findings which indicated a huge gap in the professional skill, soft kills are regarded as the most important skills sought after by the employers.

A study of Buyuryan and Kiassat (2017) into the assessment of Industrial Engineering (IE) curriculum had already discovered that the IE program curriculum was designed inclusively on the fundamentals of engineering and industrial engineering training that satisfied the requirements of the Accreditation Board for Engineering and Technology (ABET).

2.3 Work Integrated Learning (WIL)

WIL another term similar to work-based learning in literature is the kind of program that offers the flexibility to combine classroom curricula with workplace practice. It is also a curriculum policy that allows for the incorporation of authentic workplace experiences into the curricula (Collis, 2010).

WIL is different from work-based learning primarily because work-based learning occurs through traineeships and internships with a robust emphasis on acquiring instructive work experience, although it may also occur via formal teaching that has a tilt towards work (Atkinson, 2016). Basically, work-based learning takes place in a work-place by being a part of practices and processes at work while work-integrated learning occurs in the classroom and it entails activities and events where the concept of formal learning is adjusted to the workplace by designing special curriculum, pedagogical practices and active student involvement. A strong focus on WIL in universities and colleges is evolving; it highlights purposefully incorporating experiences of students at work into academic programs. The WIL program included in the courses students take is characterized by effectively identifying and incorporating the requirements of the industry with the expectations of the employer and graduates into the curriculum. The curriculum is made up of work components. Experts within the industry also contribute to the design of the curriculum and offer

places for the students to have valuable work experience. WIL programs effectively rise the enthusiasm to learn and an enhanced classroom performance. Personally, WIL contributes a great boost of employability skills, such as initiative, teamwork, and communication. Increased chances of getting jobs with higher salaries and overall better employment opportunities are some of WIL's career benefits. Better competence in technical skills and knowledge, being mindful of the role work values play, and workplace performance and ethics are also some of the workplace benefits of WIL. WIL also shows incorporated education program best practice by the designing of the program's format with the aim to develop the learning of students and reflect workplace experience, proper alignment with studies of the students, good supervision from both the workplace and the academic institution, effective monitoring mechanisms grafted into the structuring of the program for real feedback from employers and students, having an approach to the partnership (amongst employers, students, and the universities) to student learning. Remarkably, a few universities have proceeded to create simulated environments which reflect actual workplace situations and settings because there can be huge challenges in finding employers who are enthusiastic about taking in WIL students (Atkinson, 2016).

2.4 Curriculum Gap

There exists a great disparity between the knowledge imparted through curriculum and those required on the job (Lesgold, Feuer, & Black, 1997). Harvey (2003) observed that competency is a major issue of concern and suggested that emphasis should be focused on the necessity to develop enough adequate competencies to support the successful transition to the labor market and those needed to transfer within and between different job functions through a well thought-out curriculum. Hence, continuous curriculum design, appraisal and development are germane toward

bridging this gap. This includes constant reviews and revitalization of aspects of the curriculum to keep it in tandem with the labour market's demand. All hands must be on the deck, especially those of the regulatory boards responsible for the accreditation of higher education institutions and the respective professional bodies. Therefore, curriculum improvement and redesigning should be an adequate solution to the skill-deficient issues that is now raping graduates of the opportunity to be employed and retain the employment (Cranmer, 2006; Yorke, 2010).

Whereas, Riebe et al., (2010) and Pegg et al., (2012) suggested techniques based on group-projects, active learning, simulations and role-plays. These kind of learning are those described by Lester & Costley (2010) as issue-based in that such learning need to be targeted toward tackling particular work related issues. It unlikely that these kinds of learning can be conducted or gained within the walls of any university or college.

Further studies have been carried out Rizwan et al. (2018) on the gap perceived between employers and engineering graduates about employability skills using a questionnaire modified from the Secretary's Commission on Achieving Necessary Skills (SCANS) which are made out of 36 questions classified into eight sections. They concluded that employers now tend to adduce more credence and importance to specialized skills set such as creativity, communication, interpersonal, decision making and problem-solving. Hence, they show a strong correlation between students' adequate skills set (employability skills) and their level of competency on the job. On the other hand, students always feel that the level of their technical skills should be well enough to secure them a job and also gives them the required propensity to be effective and efficient on the job.

A mismatch within those employability skills that are really germane for the emerging job market, those that should be curriculum-focused, and those graduates that actually need more training was studied and the conclusion was that structuring and deciphering stakeholders' perceptions about various employability skills will enable Institutions to equip their graduates with the requisite employability skills necessary to satisfy the vast changing demands of the industry (Shivoro, Shalyefu, & Kadhila, 2018). Consequently, this has placed a considerable necessity and onus on institutions to revamp their curriculum in order to keep abreast of the adequate skills demand of the industry.

2.5 Cognitive Ability Tests, Employee Selection and Job Performance

Schmidt & Hunter (1986), cognitive or mental ability called an inevitable determining indicator of performance in an employment and employability. General Mental Ability (GMA) tests have been developed and employed in the selection of employees by many organizations in the past decades; this have shown positive correlation between Cognitive Ability Tests (CAT) and performance (Outtz, 2002). However, fears have been reportedin the racial variances tendency of CAT.

Majorly, GMA appraises the capacity to learn (Hunter & Schmidt, 1996); although there are many other abilities such as physical, social and psychomotor aside from learning and job effectiveness (Schmidt, 2002). Most often, the rate of retention and its threshold could be examined and determined through some widely reported concepts such as general cognitive ability (GCA), cognitive ability tests (CAT), general mental ability (GMA), just to mention a few. It was reported by Schmidt (2002) that there is a link between GCA and job performance. More often, experience have shown that the level of job performance is a function of the rententability (how

much of what have been learnt that could be steadily recollect and leverage on the job's skill requirements) and its threshold (the amount skills and knowledge gained that is retained that can serve as basis appreciably and adequately enough to meet the minimum job requirements).

As opined by (Outtz, 2002), cognitive ability tests conformed with some attributes and dimensions of the performance of most jobs, and gave a leverage for integrating other predictive tests with the cognitive ability tests to achieve some target ends or to decipher any superficial conclusions. This could be dimensioned as follows (i) cognitive ability tests integrated with the sole aim of reducing some adverse influences while the overall plausibility of the entire system is enhanced, and (ii) alternative integrated cognitive model capable of minimizing the adverse influence and maximally produce effective coefficients that is comparable to cognitive ability tests. This is emphasizing the need to always implement an integrated test. Similar to GCA, many researchers concluded that CAT is also linked and correlated with job performance (Bobko, Roth, & Potosky, 1999).

2.6 Employee Aptitude Survey (EAS)

The EAS, is a kind of GMA test developed for assessing psychomotor, perceptual, cognitive capabilities and those skills that are required for a wide range of jobs; which could be utilized when selecting employees and in the area of career guidance. There are 10 tests in the EAS, the choice of tests is always determined by the user's assessment of the important job specifics once details about the job are available (Ruch, Stang, McKillip, & Dye, 1994).

Chapter 3

MODELS AND METHODS

3.1 Overview

The research methodology that is used in this study is described by this chapter. The idea of this research investigating which employability skills are needed to enhance employability of industrial engineering students at EMU. That is, providing them with an innovative and competitive edge in the market place. Additionally, we would like to assess the progression of students' abilities through academic years. This was carried out via two instruments one by taking the participants' views through administered questionnaires to know the opinions of students, employed alumni, and faculty members. The second instrument was the Employee Aptitude Survey test (EAS) to examine the students' aptitude via computing the Battery and Percentile of students. After that we examined the impact of the academic level and the CGPA of students on the Battery and Percentile.

3.2 Instrumentations

Two instruments are used in this research to collect the data for assessing and investigating the students' abilities and skills as follows;

- Questionnaires
- EAS (Employee Aptitude Survey)

3.2.1 Questionnaires

The study used mixed methods to answer the research questions. Two batches of questionnaires were developed.

A. First Batch of Questionnaire: This instrument was modified from existing researches Heimler (2010) and Cao, Chapman, & DeJaeghere (2011). This batch was prepared to allocate participants' answer on the items of skills from their own perspectives, using a 5-point Likert scale likely responses 1 - Strongly Disagree, 2 - Disagree, 3 -have no idea, 4 - Agree, and 5 - Strongly Agree. This questionnaire included three parts are as follows;

1. Personal Information

Contains demographic questions for participants such as gender, age and the native language is English or not. In addition, the student survey includes the questions as the CGPA, CH i.e. cumulative hours of studies, their score in high school diploma, the date when they got a high school certificate, the type of program they are studying and the ultimate best career in their future plans. On the other hand, the employed alumni students' questionnaire asks the participants the date of graduation, status directly after graduation, and the numbers of jobs they have held since graduation, number of people working in the organization and finally it is asked to describe their current employment situation. The faculty members' survey is focusing on the academic rank, the years of teaching experience, the teaching load (full or part time), their primary area of instruction and lastly the courses that they teach.

2. Skill Assessment

This part of the survey included 36 items/question to evaluate the skills in seven scopes which are basic literacy and numeracy (L&N) skills, critical thinking skills (CT), leadership skills (LS), following management skills (FM), interpersonal skills (IP), information technology skills (IT), work ethic skills (WE) by the side of three attitudes of skills which are skills received or emphasized in the curriculum (SREC),

the skills that required additional training (SRT) for both students and employees, skills needed for job performance (SNJ). The 36 items/questions are divided to assess the skills as follows four questions that measure basic numeracy and literacy skills, five questions that measure critical thinking skills, five questions that measure leadership skills, three questions that measure following management skills, five questions that measure interpersonal skills, six questions that measure knowledge of information technology and eight questions that measure work ethic skills as shown in Table 2 on the next page. The IE department is officially accredited only by the body for engineering education (ABET) which has established 11 programs (a to k) outcomes. For this study, these program outcomes are linked with the 36 items of skills as displayed in Table 3.

3. Open Part

The last part is an open part to write any comments. The students and employed alumni students were asked to specify any weaknesses they have observed in the curriculum or any comments related to IE programs at EMU. Additionally, we asked the faculty members to propose any additional courses or activities that may increase the chance of employment for the IE graduates.

Table 2: 36 items of skills arranged in seven employability skills

Items	Skill Description	Type of skills
I_1	Performing basic mathematical calculations.	Literacy and Numeracy
I_2	Organizing basic ideas and communicating verbally to present a task.	
I_3	Sharing simple opinions, ideas, and letters in the text, such as creating reports, letters, flowcharts and graphs.	
I_4	Ability to interpret and understand the basic printed information in documents, such as schedules graphs, charts, and manuals.	
I_5	Coming up with innovative ideas.	Critical Thinking
I_6	Identifying goals, limitations to generating alternatives and choosing the most appropriate alternative.	
I_7	Recognizing problems and analyzing them.	
I_8	Organizing and processing pictures, symbols, objects, graphs and additional information.	
I_9	Getting and using innovative knowledge and skills from several digital and print sources.	
I_{10}	Identifying a principle or rule at the core of the correlation between two or more objects and applying it when resolving a problem.	
I_{11}	Exerting a high intensity of effort for the objectives accomplishment.	Leadership
I_{12}	Having confidence in one's self and maintaining a positive view of own self.	
$I1_3$	Setting individual goals, monitoring development, and taking responsibility for one's actions.	
I_{14}	Deciding on ethical ways of action.	
I_{15}	Communicating ideas to justify a position and convince others, responsibly challenge existing procedures, and policies.	
I_{16}	Selecting goal-relevant undertakings, prioritizing them, apportioning time, organizing and following agendas.	Following Management
I_{17}	Following or preparing budgets, making forecasts, keeping accounts and making amendments to achieve goals.	
I_{18}	Evaluating skills and allocating tasks accordingly, assessing performance and giving feedback.	
I_{19}	Joining in team efforts.	Interpersonal
I_{20}	Working for helping others to learn.	
I_{21}	Working with individuals from different backgrounds.	
I_{22}	Establishing understanding, adaptability, friendliness, politeness and empathy in a group setting.	
I_{23}	Joining forces with group members to brainstorm, so as to provide solutions to problems.	
I_{24}	Choosing processes, implementations or components, such as computers and allied technological equipment.	Information Technology
I_{25}	Recognizing, or resolving difficulties and problems through tools such as computers and allied technological equipment.	
I_{26}	Identifying the necessity of data, getting data from available sources or generating it, and evaluating its significance and accurateness.	
I_{27}	Organizing, processing, maintaining, and preserving computerized or written records and other kinds of information.	
I_{28}	Using computers to get, arrange, evaluate, analyze and share information, and show some level of skill with typical software.	
I_{29}	Attending the required lectures and events.	Work Ethic
I_{30}	Respecting the laws and regulations within the organization.	
I_{31}	Being prompt for meetings, events and lectures.	
I_{32}	Completing all required assignments without cheating or employing unauthorized means.	
I_{33}	Completing the work on-time and carrying out the tasks promptly.	
I_{34}	Understanding the protocols of the organization and procedures.	
I_{35}	Showing a positive attitude at work.	
I_{36}	Individual dependability and reliability.	

Table 3: Connection between student outcomes (a to k) and 36 skills items

Students Outcomes	36 of Items, Skills
A. Ability to apply knowledge of mathematics, science, and engineering.	I_1, I_6, I_{11}, I_{16}, I_{17}, I_{18}, I_{27}, I_{28}, I_{36}
B. Ability to design and conduct experiments, as well as to analyze and interpret data.	I_6, I_7, I_{10}, I_{11}, I_{16}, I_{18}, I_{24}, I_{26}
C. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	I_5, I_6, I_{11}, I_{12}, I_{13}, I_{16}, I_{17}, I_{18}, I_{19}, I_{36}
D. Ability to function on multidisciplinary teams.	I_{11}, I_{19}, I_{21}, I_{22}, I_{23}
E. Ability to recognize, formulates, and solves engineering problems.	I_6, I_7, I_{10}, I_{11}, I_{13}, I_{15}, I_{16}, I_{24}, I_{25}, I_{26}
F. Ability to understand the professional and ethical responsibility.	I_{12}, I_{14}, I_{16}, I_{22}, I_{27}, I_{29}, I_{30}, I_{31}, I_{32}, I_{33}, I_{34}, I_{35}, I_{36}
G. Ability to communicate effectively.	I_2, I_3, I_4, I_8, I_9, I_{15}, I_{19}, I_{20} I_{22}, I_{23}
H. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	I_{10}, I_{13}, I_{16}, I_{18}, I_{21}, I_{24}, I_{36}
I. The ability for the recognition of the need for, and an ability to engage in life-long learning.	I_5, I_{18}, I_{25}, I_{29}, I_{31}
J. Knowledge of contemporary issues.	I_5, I_9, I_{24}, I_{25}, I_{29}, I_{31}
K. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	I_7, I_{10}, I_{12}, I_{13}, I_{16}, I_{17}, I_{20}, I_{24}, I_{25}, I_{26}, I_{27}, I_{28}

B. Second Batch of Questionnaires: They are used to identify the importance of the 36 skılls' items as related to the subjects of each core course as shown in Appendix B Table 3-B. These items of skills are arranged in rows. But the 42 core courses in columns based on a three-point scale of importance (1- Little, 2- Medium, 3- Intensive). The core courses are distributed across the four academic years as follows;

10 courses in the first year, 14 courses in the second year, 10 courses in the third year and 8 courses in the last year. The score 3 of the instructors (intensive importance) was considered to determine what skills out of the seven employability skills are intensively addressed in each course. The yearly average of the percentages of the IE courses' contents on the skills is calculated by dividing the total number of the intensive important responses of instructors by the total number of core courses in every academic year. The respondents of this survey are only the instructor**s** who are teaching the area of IE core courses at EMU.

3.2.2 Employee Aptitude Survey (EAS) Test

EAS was used for assessing the capabilities of the engineering students that are essential to qualify them as junior engineers. Four tests were selected out of ten as the requirements to determine the students' battery and percentile by using formula (3.1) for appraising their progression between different academic years of study. The tests that were chosen are;

1. Numerical Ability Test (EAS 2): This test is intended to assess the numeral performance through the subtraction, addition, division and multiplication. The examinee solves the problem and selects a response from the five alternatives provided. This test has 75 problems divided into three parts and its duration is 10 minutes.

2. Space Visualization Test (EAS 5): It tests the performance related with space visualization. It is a collaboration of 50-items comprising of images of block piles. Its duration is 5 minutes The examinee indicates for a specific block how many other blocks in the pile it touches.

3. Numerical Reasoning Test (EAS 6): This was designed to measure the aptitude to analyze logical relationships. It includes only 20 number series. Its duration is 5 minutes The examinee selects the next number in the series from five alternatives.

4. Symbolic Reasoning Test (EAS 10): It tests the ability to apply general rules to specific problems and to come up with logical answers. This test comprises of 30 problems each of the issues in this test contains a statement and a deduction. Its duration is 5 minutes.

3.3 Variables

The variables are defined as dependent and independent as listed below.

3.3.1 Questionnaires' Variables

Dependent Variable: The dependent variable is the participants' percentage of agreements regarding each of the attitudes (SRT, SNJ and SREC). It is calculated by dividing the total number of strongly agree and agree points by the total number of participants at each item.

Independent Variables: The independent variables are listed as follows:

1. Students' level: freshman, junior, sophomore, and senior.
2. Participants' group: senior students, employed alumni, and faculty members.
3. Seven Types of employability skills: L&N, CT, LS, IP, IT, FM and WE skills.

3.3.2 EAS's Variables

Dependent Variable: The dependent variables were the students' raw scores at each test and students' percentile.

Independent Variables: The independent variables are listed as follows:

1. Academic years: freshman, junior, sophomore, and senior.

2. CGPA groups: ≤1.99, 2-2.49, 2.5-2.99, 3-3.49, ≥3.5, New students.

3. Age groups: ≤22, 23-25, 26-28, ≥29.

3.4 Samples

The samples that used in this research are defined as following;

3.4.1 Questionnaire 's Sample

Participants of the questionnaire are the students, employed alumni and faculty members of Industrial Engineering (IE) Department at Eastern Mediterranean University (EMU). This university is located in the Turkish Republic of Northern Cyprus in Famagusta city. The number of undergraduate students in IE department during academic year 2016-2017 were 412, While the IE department included only 11 instructors.

3.4.2 Sample of EAS- Test

The sample used for this test was drawn from the undergraduate IE students of the Eastern Meditteranean University during fall and spring semesters 2016-2017 and were carefully chosen from all the academic levels (Freshman, Sophomore, Junior and Senior) of undergraduate students. The students were examined during the class session of Introduction to IE (IENG112), Modeling and Optimization (IENG212), Operations Research – I (IENG313), Fundamentals of Work Study and Ergonoics (IENG301), Production Planning – II (IENG431), Systems Modeling and Simulation (IENG461). The registered students for these courses range from the first semester to the eighth semester.

3.5 Procedures of Gathering Data

3.5.1 Questionnaires' Data Collection

The Permission to use the questionnaires that required to conduct the study were obtained from the ethics committee at EMU see appendix A. To get this permission,

the questionnaire was attached along with the application letter, this letter informs the committee to the purpose and importance/contribution of the study to the body of knowledge. It was also emphasized that the responses to be collected will remain confidential. The results of the study were recorded in a way that no links could be made to trace back to the respondent. All the participants, contributors in this study are only known to the researcher. Questionnaires were created online using https://docs.google.com/forms/u/0/ and then sent to all respondent groups in the period time between fall semester of 2016-2017 and spring semester of 2016-2017. While the second batch of questionnaire was distributed as a hard copy to all instructors who teach core courses of IE curriculum

3.5.2 Gathering Data for EAS Test

The permissions were taken from the instructors to apply the EAS tests on the students during lecture hours. At least 40 minutes is required to complete the four tests, each test takes 5 minutes. The numerical ability test (EAS-2) is in three parts and it requires ten minutes to complete. A 3-5-minute break was allowed in-between the two tests. Instructions on how to complete the tests are written clearly on the front page of the sheet. Additionally, some personal information about the students such as age, CGPA and Cumulative Credit Hours (Cum. CH) relevant to this study were extracted from the student registration database.

- **Scoring Instruction for the Hand-Scored Version**

The designing of the EAS test allows for convenient manual scoring. right and wrong answers are graded by the provided stencils.

- **Raw Scores:** The raw score is defined as the number of questions the student respond to correctly without considering the number of questions on the test or each question point.
- **Calculate the Raw Scores:** First we have to see if there are questions with more than one answer. Any of such test questions should be marked wrong and then the right key is placed. The total number of answer marks that are seen via the holes are the right ones. In similar fashion, the wrong answer key on the answer sheet is put and the numbers of grades visible via the holes are counted, these are the wrong ones after that, the raw score can be calculated using Table4. It should be noted that each test has different scoring formulas.

Table 4: Raw score for each test

Test	Formula
EAS 2	RIGHT S – 1/4 * WRONGS
EAS 5	RIGHT S – 1/5 * WRONGS
EAS 6	RIGHT S – 1/4 * WRONGS
EAS 10	RIGHT S – 1/2 * WRONGS

- **Battery score:** It is calculated by using this formula.

Battery Score = 0.5 (EAS 2) +0.5(EAS 5) +EAS 6 +EAS10. (3.1)

Where EAS 2 is a raw score of numerical ability test;

EAS 5 is a raw score of visualization test;

EAS 6 is a raw score of numerical reasoning test;

EAS 10 is a raw score of symbolic test.

Finally, the percentile for the respective students is determined by using the norm table as described in Table 1-c in appendix C.

3.6 Research Questions

3.6.1 Research Questions for EAS

The following research questions are proposed to evaluate the progression of student's abilities during academic studies:

a) Do academic advancements have any significant effects on students' abilities regarding to numerical ability, space visualization, numerical reasoning, and symbolic reasoning?

b) Which of the students' abilities (numerical ability, space visualization, numerical reasoning, and symbolic reasoning) is affected by these academic levels?

c) Does the age of the students have any significant effect on the students' performance?

d) Is there any correlation between CGPA and percentile?

3.6.2 Research Questions for Questionnaires

The following research questions are proposed to assess the IE students' skills:

a) How do the perceptions of respondents differ regarding skills that require additional training, skills needed in job performance and skills received or emphasized in curriculum?

b) Which of the seven employability skills are highly important based on the attitudes toward the three categories of SRT, SNJ and SREC?

c) Which of the seven employability skills should be the focus and intensively trained in the curriculum of the IE students?

3.7 Hypotheses

Ten hypotheses were generated to answer the research questions of the questionnaire and six hypotheses for EAS- test. Figure 1 and Figure 2 show how these hypotheses were generated.

3.7.1 Hypotheses for Questionnaire

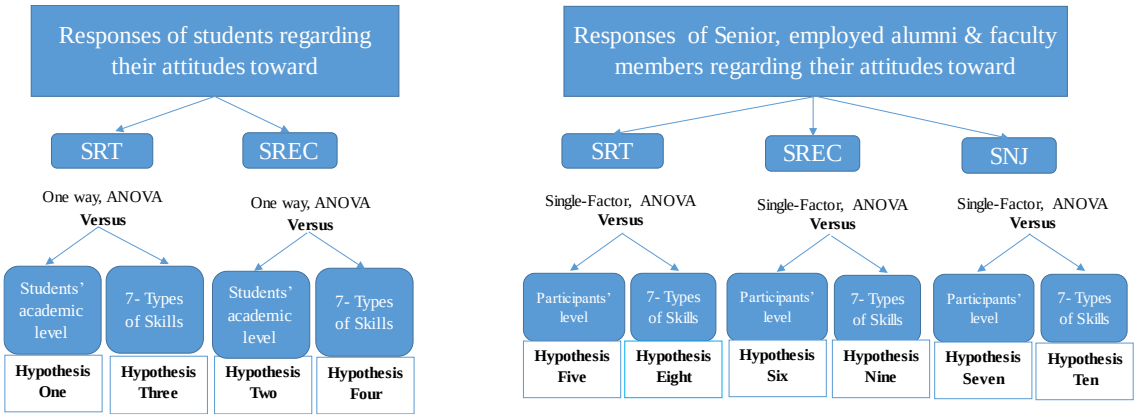

Figure1: Steps to generate ten hypotheses for the questionnaire

Hypothesis One: Is there any significant difference in the mean of students' perceptions (percentages of agreements) between their Academic levels from freshman to senior level regarding their attitudes towards (SRT)?

To evaluate the relationship between the students' responses towards (SRT) versus students' academic levels, the experiment was designed as a single-factor analysis of variance model as follows:

Let Yij: Response of students from all academic levels (freshman, sophomore, junior, senior);

$$Y_{ij}=\mu+\tau_i+\epsilon_{ij} \qquad (3.2)$$

Where:

μ: Grand average of all Yij responses

τ_i: Effects of the i'th treatment of the factor Academic levels (Where i= freshman, sophomore, junior, or senior)

ϵ_{ij} : Random error component

Note: The model used here is a fixed effect model.

H_0: $\tau_{freshman} = \tau_{sophomore} = \tau_{junior} = \tau_{senior}$

H_1: H_0 is not true.

Hypothesis Two: Is there any significant difference in the mean of students' response between different Academic levels regarding the attitudes of SREC? The same one-way analysis of variance model and hypothesis which are used in the previous section (3.2) but the responses here are the attitude of student towards the skills received or emphasized in the curriculum.

Hypothesis Three: Is there any significant difference in the mean of students' response between the types of Seven Employability Skills that were addressed in the curricula of industrial engineering department regarding to their attitudes of SRT?

Let Yij : Response of students regarding each of the seven employability skills (L&N, CT, LS, IT, FM, IP, WE);

$Yij=\mu+ \tau i+\epsilon_{ij}$ for all i and j (3.3)

Where:

μ: Grand average of all responses.

τ_i: Treatment effects for the i'th treatment of the seven employability skills (Where i = L&N, CT, LS, IT, FM, IP, WE).

ϵ_{ij}: Random error component.

Note: the model used here is a fixed effect model.

H_0: $\tau_{L\&C=} \tau_{CT=} \tau_{LS=} \tau_{IT=} \tau_{FM=} \tau_{IP=} \tau_{WE}$

H_1: H_0 is not true.

Hypothesis Four: Is there any significant difference in the mean of students' responses between the types of Seven Employability Skills regarding their attitudes of SREC? The same model used in previous section are used but the response is tested versus SREC.

Let Yij: Response of students regarding each of the seven employability skills (L&N, CT, LS, IT, FM, IP, WE);

$Yij=\mu+ \tau i+\epsilon ij$ for all i and j (3.3)

Where:

μ: Grand average of all responses.

τ_i: Treatment effects for the i'th treatment of the factor the Seven Employability Skills (Where i = L&N, CT, LS, IT, FM, IP, WE).

ϵ_{ij}: Random error component.

Note: the model used here is a fixed effect model.

H_0: $\tau_{L\&C=}$ $\tau_{CT=}$ $\tau_{LS=}$ $\tau_{IT=}$ $\tau_{FM=}$ $\tau_{IP=}$ τ_{WE}

H_1: H_0 is not true.

Hypothesis Five: Is there any significant difference in the mean of participants' response (percentages of agreements) between the senior students, employed alumni and faculty member regarding their attitudes toward skills required additional training SRT? Again one-way analysis of variance model is used here. The model as follows:

$Y_{ij=}\mu_{+} \tau_{i+}\epsilon_{ij}$ (3.4)

Where:

μ is the overall mean response.

τ_i is a fixed effect for the i'th treatment of the factor Academic levels (Where

i=senior students, employed alumni, faculty members),

ϵ_{ij} is a random error component.

H_0: $\tau_{\text{Senior students}} = \tau_{\text{employed alumni}} = \tau_{\text{faculty members}}$

H_1: H_0 is not true.

Hypothesis Six: Is there any significant difference in the mean of participants' response (percentages of agreements) between the senior students, employed alumni and faculty members regarding the attitudes toward SREC? To evaluate the relationship between the participants' responses (SREC) versus participant levels, the same model (3.4) was applied but the response is tested versus SREC**.**

Hypothesis Seven: Is there any significant difference in the mean of participants' response (percentages of agreements) between the senior students, employed alumni and faculty members towards the attitudes of skills that are considered important for job performance (SNJ)? To evaluate the relationship between the participants' responses (SNJ) versus their levels the same model (3.4) was applied but the response is tested versus SNJ.

Hypothesis Eight: Is there any significant difference in the mean of participants' response (percentages of agreements) toward (SRT) between the types of Seven Employability Skills? To determine whether or not the factor has an effect on the participants' responses, the experiment is designed as a single-factor analysis of variance as in model (3.3).

Hypothesis Nine: Is there any significant difference in the mean of participants' response (percentages of agreements) towards (SREC) between the types of Seven Employability Skills? To determine whether or not the factor has an effect on the participants' responses, the experiment is designed as one-way or single-factor analysis of variance as in model (3.3).

Hypothesis Ten: Is there any significant difference in the mean of participants' response (percentages of agreements) towards (SNJ) between the types of Seven Employability Skills? To determine whether or not the factor has an effect on the participants' responses, the experiment is designed as a single-factor analysis of variance as in model (3.3).

3.7.2 Hypotheses for EAS

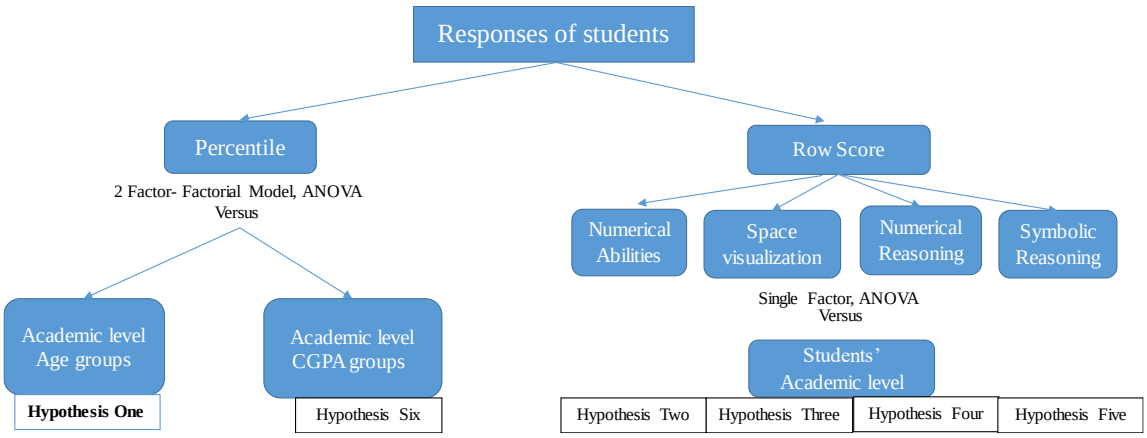

Figure 2: Steps to generate six hypotheses for EAS- Test

Hypothesis One: Is there any significant difference in the participants' mean of percentiles between all Academic years from freshman to senior and for all Ages? To determine whether or not the factors (Academic levels, Ages) have effects on the participants' responses (Mean Percentile), the experiment is designed as a two factors

factorial design with 4 treatments for Academic levels and 4 treatments for Age groups. The model for this experiment is as follows:

$$Y_j=\mu+\tau_i+\beta_j+(\tau\beta)_{ij}+\epsilon_{ij} \quad (3.5)$$

Where:

μ is the overall mean response.

τ_i is a fixed effect for the i'th treatment of the factor Academic levels (Where i= freshman, sophomore, junior, senior),

β_j is a fixed effect for the j'th treatment of the factor Ages groups (Where j= $\leq$22, 23-25, 26-28, $\geq$29)

$(\tau\beta)_{ij}$ is the effect of the interaction between the students' Academic level and Age groups.

ϵ_{ij} is a random error component.

The aim of the study is to test the hypotheses via the following:

1) Equality of students' responses (percentile) regarding their Academic levels:
   a. H_0: $\tau_{\text{freshman}}=\tau_{\text{sophomore}}=\tau_{\text{junior}}=\tau_{\text{senior}}=0$
   b. H_1: Ho is not true.
2) Equality of students' responses (percentile) regarding their Age groups:
   a. H_0: $\beta_{\leq 22}=\beta_{23\text{-}25}=\beta_{26\text{-}28}=\beta_{\geq 29}=0$
   b. H_1: Ho is not true.

Hypothesis Two

Is there any significant difference in the mean of raw scores of numerical abilities between students' Academic levels? To determine whether the factor has an effect on

the participants' responses (Numerical ability', the experiment is designed as one-way or single-factor analysis of variance model as follows:

$$Y_{ij=}\mu_{+}\tau_{i+}\epsilon_{ij} \quad (3.6)$$

Where:

μ is the overall mean response.

τ_i is a fixed effect for the i'th treatment of the factor Academic levels (Where i= freshman, sophomore, junior, senior),

ϵ_{ij} is a random error component.

H_0: $\tau_{\text{freshman}} = \tau_{\text{sophomore}} = \tau_{\text{junior}} = \tau_{\text{senior}} = 0$

$H_{1:}$ H_0 is not true.

Hypothesis Three: Is there any significant difference in the mean of raw scores of space visualization test EAS-5 between students' Academic levels? To determine if there were any differences between the mean of space visualization raw score, the model used is the same as model in (3.6).

Hypothesis Four: Is there any significant difference in the mean of raw scores for numerical reasoning test EAS-6 between Academic levels of students? The same model (3.6) was applied.

Hypothesis Five: Is there any significant difference in the mean of raw scores of symbolic reasoning test EAS-10 between students' Academic levels? The same model (3.6) was applied.

Hypothesis Six: Are there any differences between the mean of students' percentile/aptitude regarding Academic levels and CGPA? To determine whether the factors have effects on the participants' responses, the experiment was designed as 2 factors factorial design where the factors are Academic levels (3 treatments or levels) and CGPA (5 treatments or groups). The model for this experiment is as follows:

$$Y_j=\mu+\tau_i+\beta_j+(\tau\beta)_{ij}+\epsilon_{ij} \quad (3.7)$$

Where:

μ is the overall mean response.

τ_i is a fixed effect for the i'th treatment of the factor Academic levels (Where i= sophomore, junior, senior),

β_j is the fixed effect of the j'th treatment of the factor CGPA groups (Where j is $\leq$1.99, 2-2.49, 2.5-2.99, 3-3.49, $\geq$3.5),

$(\tau\beta)_{ij}$ is the effect of the interaction between the students' Academic levels and CGPA factors.

ϵ_{ij} is a random error component.

The aim of the study is to test the hypotheses via the following:

1) Equality of students' responses regarding Academic levels:

   a. H_0: $\tau_{\text{freshman}} = \tau_{\text{sophomore}} = \tau_{\text{junior}} = \tau_{\text{senior}} = 0$

   $H_{1:}$ $H_{1:}$ H_0 is not true.

2) Equality of students' responses regarding their CGPA groups:

   $H_{0:}$ $\beta_{\leq 1.99} = \beta_{2\text{-}2.49} = \beta_{2.5\text{-}2.99} = \beta_{3\text{-}3.49}$ $\beta_{\geq 3.5} = 0$

   $H_{1:}$ H_0 is not true.

3) Furthermore, we are interested in determining whether academic levels and CGPA groups interact. Thus. We also wish to test

H_0: $(\tau\beta)_{ij} = 0$

$H_{1:}$ H_0 is not true.

3.8 Data Analysis

The procedures used in data analysis are explained in the next sections.

3.8.1 Employee Aptitude Survey (EAS)

All necessary information needed during the research are entered into the EXCEL software file. After which, the number of semesters each student has spent is calculated and the total cumulative credit hours (CUM.CH) are determined and special codes are also given to each student instead of their student numbers to protect their privacies. Codes A to D are assigned to all students starting from academic year 4 (senior students) and ending with first year (freshman students). The excel file is then imported into Minitab 17 (the statistical package used for analysis in this study). The General linear model was applied to evaluate hypothesis one and hypothesis six (particularly, the freshman students is ignored in hypothesis 6). The one- way ANOVA model was applied to analyze the hypotheses from 2 to 5.

3.8.2 Analysis of Questionnaires

The researcher received the responses from the participants using docs.google.com/forms website from which all responses were downloaded into an Excel file, and then analyses were done. The Statistical Package Minitab 17 was used in data analysis. The mean degrees of disagreement or agreement for each question were computed and Cronbach's alpha range of reliability was calculated and reported for all variables.

Chapter 4

FINDINGS AND DESCUSSION

4.1 Overview

This chapter presents a descriptive analysis of the data findings and discussions of these findings that obtained from the analysis of research questions and the hypotheses. The purpose of this study is to evaluate the students' abilities progression during academic years and investigating which skills are needed to enhance the industrial engineering students to give them more chance for employability after graduation. To achieve our purpose, we measured the students' abilities by EAS test. Additionally, the perceptions of students, employed alumni and faculty members were measured through the questionnaires to assess the degree to which the employability skills should be considered, as skills required additional training. In this regard, the extent to which those skills are integrated in the curriculum and the importance of employability skills in job performance were analyzed. Therefore, the employability skills that need to be enhanced in the IE curriculum are determined.

4.2 Descriptive Analysis Data for EAS Test

ANOVA assumption were checked by residual analysis. The residuals were found as normally and distributed with mean zero and constant variance as shown in Figure3 below and Figures 1-c to 4-c in Appendix C. ANOVA models are used with type I Error $\alpha = 5\%$ is used for the data analysis.

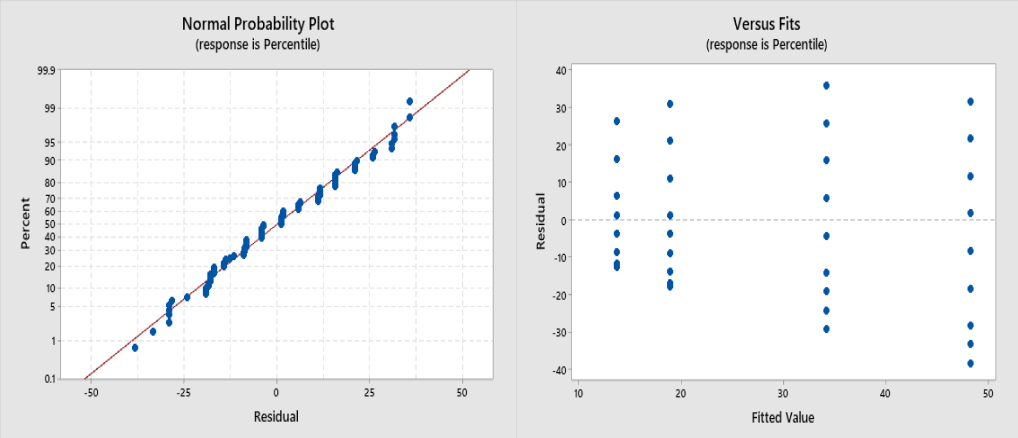

Figure 3: Residual plots for 106 students' percentile versus academic levels

The sample of this test is made up of 106 undergraduates, their ages ranged from 19 to 30 years old. Table 5 shows the frequencies and percentages for students' gender and ages. The distribution of the participants is as follows 30 (28.3%) females and 76 (71.69%) males. Only 2 (1.88%) students were older than 28 years and 52 students with ages between 23-25 (49.06%). Additionally, this table reports the mean, standard deviation, maximum and minimum values of students' percentile. The table shows that the highest percentile is 80. As listed in Table (C-2) Appendix (C) this value was recorded by the students A1, A14 and A16. Those students have CGPA 3.6, 3.88 and 3.26 with the total cumulative credit hours 164, 133 and 132 credits respectively.

Table 5: Descriptive statistics for undergraduate students

Variables		Count	% students	Mean	St.Dev	Min	Max
Gender	F	30.00	28.30	37.90	22.31	2.00	80.00
	M	76.00	71.70	28.39	19.97	1.00	80.00
Age	<=22	45.00	42.45	29.80	19.87	1.00	60.00
	23-25	52.00	49.06	33.21	22.91	1.00	80.00
	26-28	7.00	6.60	26.43	11.44	15.00	40.00
	>=29	2.00	1.89	21.0	26.9	2.00	40.00
Academic year	Freshman	13.00	12.26	13.69	11.52	1.00	40.00
	Sophomore	29.00	27.35	18.86	16.12	1.00	50.00
	Junior	37.00	34.90	34.19	18.20	5.00	70.00
	Senior	27.00	25.47	48.33	18.45	10.00	80.00
CGPA	<=1.99	29.00	27.36	11.62	10.82	1.00	40.00
	2-2.49	24.00	22.64	27.50	14.89	5.00	60.00
	2.5-2.99	17.00	16.04	36.76	16.48	15.00	70.00
	3-3.49	16.00	15.09	48.75	12.04	30.00	80.00
	>=3.5	15.00	14.15	56.00	13.52	30.00	80.00
	New student	5.00	4.72	10.60	12.18	1.00	30.00

As reported in table above, 29(or 27.35%) of students have CGPA less than 2, 24 (or 22.64%) of the students have CGPA between 2-2.49, while 15 (or 14.25%) students have CGPAs greater than 3.5. Only 5 (or 4.7%) students were new students with no CGPA recorded yet. For academic level the sample includes (13 students) 12.26% of freshman level, (29 students) 27.35% of sophomore level, (37 students) 34.9% of junior level and (27 students) 25.47% of senior level. The highest number of students' participants were in the junior level with percent 37%.

4.3 Findings of EAS -Test

The findings from testing of the six EAS hypotheses are illustrated in the following sections.

4.3.1 Hypotheses of EAS- Test

Hypothesis One: Is there any significant difference in the participant mean of percentiles between all Academic years from freshman to senior and for all Ages? From table 6, the P-value exposes that there is a significant difference between students' percentile and

academic level (p-value=0) and (the observed power of the test =1). Hence, the null hypothesis is rejected. Therefore, we can conclude that student's percentile is affected by academic levels. However, students' ages do not have any significant effect on their percentile (p-value = 0.07) and (the observed power of the test = 0.584); Consequently, we fail to reject the null hypothesis. This implies that age would not really influence the estimated percentiles.

Table 6: Analysis of variance for percentile versus academic and age

Factor	Type	Levels	Values
Academic year	fixed	4	Freshman, Junior, Sophomore, Senior
Age	fixed	4	<=22, 23-25, 26-28, >=29

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**	**Power of test**
Academic year	3	16654.3	18023.7	6007.9	21.54	0.000	1.00
Age	3	2034.0	2034.0	678.0	2.43	0.070	0.584
Error	99	27611.9	27611.9	278.9			
Total	105	46300.2					

Multiple comparison test (Fisher test) is carried out to interpret how academic years or levels significantly affect the percentile. The outcome shows the percentiles of students in all academic levels are different significantly. The senior level is significantly different from other levels with the largest mean of percentile 44.9. On the other hand, the lowest percentile value was from first-year students with a mean value of 8.0. Furthermore, based on Fisher test the sample was classified into three groups: group A, including of senior students, B is composed of junior students, and group C is made up of first-year (freshman) and second year (sophomore) students. This indicates the responses of freshman and sophomore are not significantly different. Although, a significant difference exists between fourth and third-year students as shown in Table below.

Table 7: Grouping information of academic years regarding to EAS percentile

Academic year	N	Mean	Grouping
Senior	27	44.9	A
Junior	37	28.5	B
Sophomore	29	11.5	C
Freshman	13	8.0	C

Note: Means that do not share the same alphabets are significantly different (α = 5%).

For evaluating the student's abilities according to the type of EAS tests, four tests from the EAS- test have been selected are numerical ability (EAS-2), space visualization (EAS-5), numerical reasoning (EAS-6), and symbolic reasoning (EAS-10)]. These tests examined whether the students' abilities progress in parallel with academic years or not, by the next hypotheses.

Hypothesis Two: Is there any significant difference in the mean of raw scores of numerical abilities between all students' Academic levels? Figure 4 shows the residual plots of numerical ability test. It shows that the residual analysis is satisfying ANOVA assumptions.

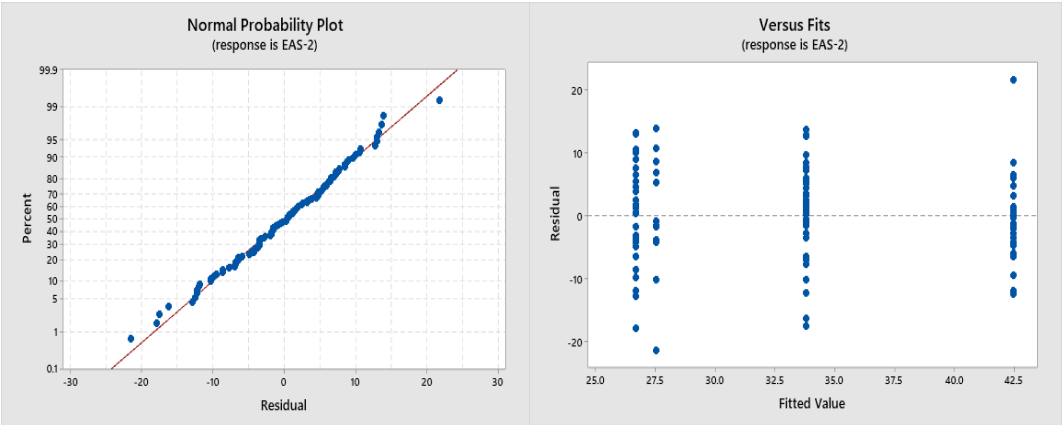

Figure4: Residual plots for numerical ability

Table 8 presents the results of one-way ANOVA for numerical ability versus academic year. The result shows that the (observed power of the test is large = 0.998). Hence the

null hypothesis is rejected and there is a significant difference between students' Raw Score and academic levels (p-value =0.000).

Table 8: One-way ANOVA: numerical ability versus the academic year

Source	DF	SS	MS	F	P	Power of the test
Academic year	3	4001.9	1334.0	20.95	0.000	0.998
Error	102	6494.4	63.7			
Total	105	10496.3				

Fisher test was applied to compare all levels of students at each year and classified them into groups as illustrated in Table 9 below. The rank is from the senior level in group A with the largest mean of raw score 42.5 to freshman level in group C with the smallest value of mean 27.519. The raw score of senior students significantly differ from all other academic levels. These results shows that numerical ability of students does progress with their academic years.

Table 9: Grouping information for numerical ability versus the academic year

Academic year	N	Mean of raw score	Grouping
Senior	27	42.500	A
Junior	37	33.777	B
Sophomore	29	26.672	BC
Freshman	13	27.519	C

Hypothesis Three: Is there any significant difference in the mean of raw scores of space visualization test (EAS-5) between students' Academic levels? The study revealed that there is no significant effect (p = 0.074) between the raw scores of students' abilities over different academic levels. As well as the (observed power of the test = 0.582) as presented in Table 10. Thus the we fail to reject the null hypothesis.

Table 10: One-way ANOVA: space visualization EAS-5 versus academic year

Source	DF	SS	MS	F	P	Power of the test
Academic year	**3**	518.2	172.7	2.39	0.074	0.582
Error	**102**	7387.5	72.4			
Total	**105**	7905.7				

Hypothesis Four: Is there any significant difference in the mean of raw scores for numerical reasoning test (EAS-6) between Academic levels of students? ANOVA test shows that; the academic years have significant effects on students' raw scores of the numerical reasoning (EAS-6) test at (p = 0.008) and (the observed power of the test = 0.840) as displayed in Table 11.

Table 11: One-way ANOVA: numerical reasoning versus academic year

Source	DF	SS	MS	F	P	Power of the test
Academic year	**3**	109.24	36.41	4.15	0.008	0.840
Error	**102**	893.94	8.76			
Total	**105**	1003.18				

Additionally, Fisher test shows that senior students have the highest score and significantly different from sophomore students see Table 12.

Table 12: Grouping information for numerical reasoning versus academic year

Academic year	N	Mean of raw score	Grouping
Senior	27	14.907	A
Junior	37	13.973	AB
Freshman	13	10.654	BC
Sophomore	29	10.552	C

Hypothesis Five: Is there any significant difference in the mean of raw scores of symbolic reasoning test EAS-10 between students' Academic levels? Table 13, indicates that, there is a significant effect of the academic years on the scores of students, (p-value = 0.000) and (the observed power of the test =0.989).

Table 13: One-way ANOVA: symbolic reasoning EAS-10 versus academic year

Source	DF	SS	MS	F	P	Power of the test
Academic year	3	376.8	125.6	7.98	0.000	0.989
Error	102	1605.4	15.7			
Total	105	1982.2				

The multiple comparison (Fisher) test in Table 14 expectedly reveals a higher ability of symbolic reasoning as the academic study progresses. The senior is not significantly different from junior but significantly different from sophomore and freshman.

Table 14: Grouping information for numerical reasoning versus academic year

Academic year	N	Mean of raw score	Grouping
Senior	27	12.120	A
Junior	37	11.385	AB
Sophomore	29	9.733	B
Freshman	13	9.635	AB

Hypothesis Six: Are there any differences between the mean of students' percentile/aptitude regarding Academic levels and CGPA? The interrelationships between the students' percentiles, academic levels and CGPA are also analyzed using 2 factors factorial model. Particularly, the freshman level was ignored because most of the new students (freshman) do not have CGPA. The ANOVA shows that there are significant effects of students' academic years on the percentile scores (p-value = 0.000) and (the observed power of the test = 0.993). Additionally, it can be well said that the mean of students' percentile/aptitude scores regarding the CGPA groups significantly vary (p-value =0.000) and (the observed power =1). However, the interaction between CGPA groups and academic levels does not have any significant effect on the percentile scores of students (p-value = 0.697) with a low power of the test (0.298). Thus we fail to reject the null hypothesis as illustrated in Table 15.

Table 15: General Linear Model percentile versus academic year and CGPA

Factor	Type	Levels	Values
Academic year	fixed	3	Junior, Sophomore, Senior
CGPA	fixed	5	<=1.99, 2-2.49, 2.5-2.99, 3-3.49, >=3.5

Source	DF	Seq SS	Adj SS	Adj MS	F	P	Power test
Academic year	2	12172.1	3547.2	1773.6	11.79	0.000	0.993
CGPA	4	15483.4	12963.1	3240.8	21.54	0.000	1.000
Academic year*CGPA	8	833.6	833.6	104.2	0.69	0.697	0.298
Error	78	11736.1	11736.1	150.5			
Total	92	40225.2					

The interaction plot for percentile versus academic levels and CGPA is shown in Figure 5.

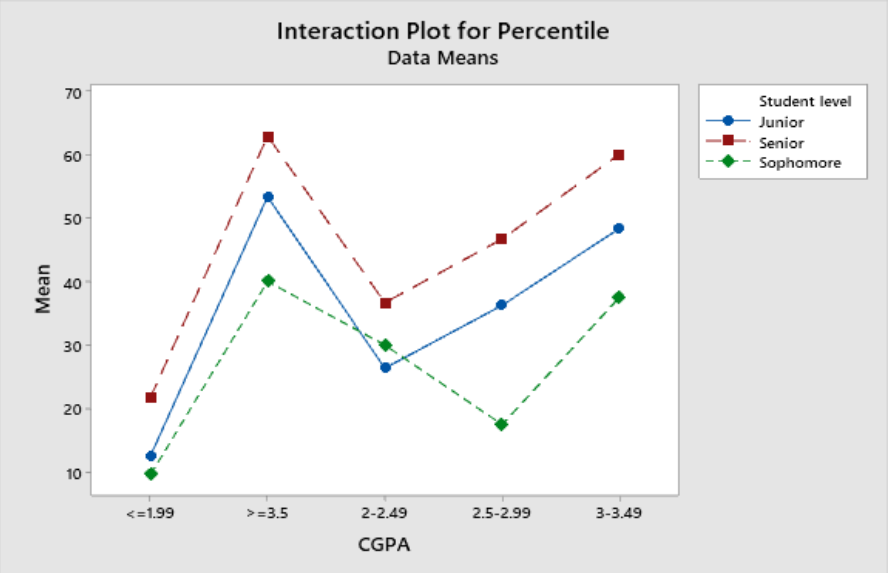

Figure5: Interaction plot for percentile versus academic level and CGPA

4.3.2 Correlation between Academic Years, CGPA and Percentile

Correlation coefficients were computed among the factors (academic years, CGPA) and percentile. According to Cohen (1988), a correlation greater than 0.5 is described as large; 0.5 to 0.3 as moderate, 0.3 to 0.1 as small; and anything smaller than 0.1 is described as being trivial. However, the result in Table 16 illustrates that there is large correlation between CGPA and percentile (r = 0.72) and the correlation coefficient between academic year and percentile is (r = 0.588). On the other hand, the correlation between CGPA and the academic year is moderate with r = 0.531.

Table 16: Correlations between CGPA, academic year and student's percentile

	CGPA	Academic year
Academic year	0.531	
Percentile	0.720	0.588

4.4 Descriptive Data Analysis and Results for Questionnaires

Checking ANOVA assumptions are displayed in Appendix B, Figures 1-B to 8-B. Descriptive statistics, including frequencies and percentages, were run using Minitab Software version 17. To summarize, analyze, organize, and describe the data. The population of this study was approximately 900 people including students, alumni, and faculty. By using the formula (Qualtrics, 2021) to determine the sample size required in this study with a confidence level of 95% and a margin error of 9%, the required sample size is found as 104 participants. However, the survey's questionnaires were received from 109 participants. The sample in this study consists of 26 employed alumni (24.53%), 9 faculty members (8.25%), and 74 (67.89%) students. Table 17 reports the frequencies and percentages reported by all participants. All data which are collected in this part are presented in Tables 1-B and 2-B in Appendix B.

Table 17: Frequency all respondents' gender

Categories	N	Percentage
Gender		
Male	84	77.6
Female	25	22.4

4.4.1 Demographic of Employed Alumni Students

A total of 26 responses of employees who had graduated from Industrial Engineering department at EMU, were collected as shown in Table 18. Their ages range between 21 – 39 years. The majority of the respondents were male (80%). Amongst them 50% had graduated in the academic years 2000-2005. While 15.4% of them during the

academic year 2011-2016. Only 11.5% of them, the English language was their native language. Whereas the others English language was a second language. Among the participants in the alumni student's surveys, only 69.23 of them were signed a job contract after graduation.

Table 18: Demographic data for employed alumni respondents

Categories	N	Percentage
Gender		
Male	21	80.7
Female	5	19.3
Date of graduation		
2000-2005	13	30
2006-2010	9	34.6
2011-2016	4	15.4
Ages		
21-27	5	19.23
28-34	7	26.92
Over 34	14	53.85
Is English your first language?		
Yes	3	11.5
No	23	88.5
Which program did you study?		
Industrial Engineering	26	100
What was your employment status after graduation?		
I signed a job contract.	18	69.23
I was not able to find any job.	8	30.77
How many job(s) have you held since graduation?		
0	1	3.9
1	6	23.07
2	8	30.72
3	5	19.23
4	3	11.54
5 or more	3	11.54
Do you have a job right now?		
Yes	23	88.5
No	3	11.5
How many people in total work for your organization?		
Under 10	2	7.69
10-24	2	7.69
25-99	1	3.85
100-499	9	34.62
500-999	5	19.23
More than 1000	7	26.91
Which one of the following statement best describes your current employment situation?		
I am looking for a job and I am not currently employed	3	11.54
I am employed by a state-owned enterprise	2	7.69
I am employed by an individually/privately-run	3	11.54
I am employed by a party or government organization	13	50
I am employed by a school or research-based institution	3	11.54
I am self-employed and running my own business	2	7.69

4.4.2 Demographic of Faculty Members

Table 19 presents the demographic data of the faculty members; a total 9 responses were collected. From the responses, there were 88.8% male participants and 11.2% female participant, their ages arranged between 30 and 60 years old. For all participants the English language is a second language. Seven instructors are full time and the others are part time. Full time instructors teaching experience ranges from 6 to 44 years.

Table 19: Demographic data for faculty members' respondents (2016-2017)

Categories	N	Percentage
Gender		
Male	8	88.89
Female	1	11.11
Ages		
30-40	3	33.33
41-50	3	33.33
51-60	2	22.22
Over 60	1	11.11
What is your academic rank?		
Lecturer	6	66.67
Associate Professor	2	22.22
Professor	1	11.11
Is English your first language?		
Yes	0	0
No	9	100
Do you teach full-time or part-time?		
Full-Tim	7	77.78
Part-Time	2	22.22
Years of teaching experience		
1-10	5	55.56
11-20	3	33.33
Over20	1	11.11

4.4.3 Demographic of Undergraduates Students

The data recorded in Table 20 illustrates that 74 students participated in the study. In total, 55 male students (74.32%) and 19 female students (25.685), their ages ranged between 17 to 28 years. Fifteen of the students are native English speakers. The largest number of students in the junior level are 30 students (40.54%). Twenty-three students

haven’t decided yet about their career plans. Only 17 have described their ultimate career plans as being employed in the manufacturing sector.

Table 20: Demographic data for students

Categories	N	Percentage
Gender		
Male	55	74.32
Female	19	25.68
Ages		
17-22	51	68.92
23-28	23	31.08
Academic level		
Senior	18	24.3
Junior	30	40.54
Sophomore	11	14.86
Freshman	15	20.3
Is English your first language?		
Yes	15	21
No	59	79
Which of the following describes your ultimate career plans the best?	23	31.08
I have not decided yet	17	22.98
To run my own business	15	20.27
Employment in Manufacturing sector	7	9.46
Employment in Service sector	1	1.35
Employment in Construction sector	5	6.76
Employment in Extraction (Petroleum/Mining/Quarrying)	2	2,7
Employment in Agriculture/Forestry/Animal husbandry	2	2.7
Employment in Non-governmental organizations (NGO)	2	2.7
To be Academician or Scholar		

4.4.4 Descriptive Statistics of Students’ Response

The mean, maximum, minimum and standard deviation of students' responses in each academic year are determined on the basis of both SREC and SRT as shown in Table 21. The maximum value of responses towards skills received and emphasized in curricula (SREC) is recorded by senior students (100%). While, the lowest (25%) value is listed by freshman level. The maximum response value (93%) of students’ attitudes towards skills that require additional training (SRT) is logged by freshman students. Moreover, the minimum response value (17%) is recorded by senior students.

Table 21: Descriptive statistics of students' percentage of agreements

Statistics	Mean		Max		Min		SD	
	SREC	SRT	SREC	SRT	SREC	SRT	SREC	SRT
Freshman	55.14	66.67	94.00	93.00	25.00	27.00	17.32	16.73
Sophomore	62.03	59.17	91.00	91.00	27.00	36.00	15.93	15.97
Junior	84.94	52.89	97.00	80.00	70.00	23.00	05.59	15.69
Senior	86.64	41.61	100.0	72.00	56.00	17.00	10.43	14.73

4.4.5 Students' Responses According to Seven Types of Employability Skills

Table 22 presents the average percentage of students' agreements toward the seven types of employability skills, attitudes towards (SRT & SREC) and the four academic levels. These percentages for SRT are in decreasing order from new students to senior students. The information technology skill recorded the largest percentage, as skills require additional training during the four academic levels. However, the lowest response (50.13%) was recorded by freshman level towards Ethic skills and 45.3%, 38%, 26,3% were recorded by sophomore, junior and senior students respectively regarding Literacy and Numeracy skills. For attitudes towards SREC the students' response was in increasing order from freshman to senior level. The largest average (95.8%) was listed by senior students for Literacy and Numeracy skill while the lowest average (40.0%) was recorded by freshman level towards Leadership skill.

Table 22: Averages percentage of students' agreement

Attitudes	SRT				SREC			
Seven Types of Employability Skills	Freshman	Sophomore	Junior	Senior	Freshman	Sophomore	Junior	Senior
Literacy & Numeracy	56.75	45.30	38.00	26.30	76.75	68.5	91.80	95.80
Critical Thinking	77.67	68.30	48.5	42.50	51.17	59.33	87.20	80.50
Leadership	69.20	54.60	52.80	39.00	40.00	52.80	80.00	77.80
Following Management	82.33	58.00	67.70	68.30	48.00	58.00	81.00	79.70
Interpersonal	60.00	52.80	58.00	46.60	51.60	45.40	85.80	84.20
Information Technology	82.60	80.20	75.40	52.20	51.40	61.80	82.80	89.80
Ethics	50.13	53.40	40.90	30.50	64.00	78.63	85.30	94.40

4.4.6 Descriptive Statistics of Participants' Response

Table 23 presents the mean, maximum, minimum and standard deviation for the responses of groups of senior students, employed alumni, and faculty members regarding their attitudes towards (SREC, SRT and SNJ). The maximum value of responses towards (SERC) is recorded by both senior students and employed alumni (100%). While, the lowest (11.11%) value is listed by faculty members. For respondents' attitude for skills that require additional training the maximum value (77.78%) is logged by faculty members. However, the minimum value (17%) is recorded by senior student. For the term of SNJ the maximum response was recorded by all participants (100%). But the minimum (50%) value recorded by senior students.

Table 23: Descriptive statistic of the responses of employed alumni, faculty & senior

Statistics	**Mean**			**Max**			**Min**			**SD**		
	SREC	**SRT**	**SNJ**	**SREC**	**SRT**	**SNJ**	**SREC**	**SRT**	**SNJ**	**SREC**	**SRT**	**SNJ**
Employed alumni	80.46	52.77	89.87	100.0	73.10	100.0	57.70	7.70	73.10	9.31	15.53	6.17
Faculty member	60.80	59.26	83.34	88.89	77.78	100.0	11.11	22.22	55.56	19.43	13.80	11.73
Senior student	86.64	41.61	87.19	100.0	72.00	100.0	56.00	17.00	50.00	10.43	14.73	12.58

4.4.7 The Responses according to 7 Types of Employability Skills

Table 24 is displaying the participants' average percentages of agreements, which reveals that;

1. For skills needed in job performance, the average of participants' agreement has the highest percentages ranged from 98.0% to77. 8%.

2. Based on skills that require additional training in the following management skill, the largest percentages of the average participants' agreement are 68.3, 66.7 and 74.1% for senior, employed alumni student and faculty members respectively.

3. In terms of all skills received/emphasized in college, the average of percentage agreement for both senior students and employed alumni exceeds (73%). Faculty members agreed with a minimum percentage of agreement of (35.6%) that leadership skills are the least emphasized skill in the curriculum.

Table 24: Senior, employed alumni & faculty members' percentage of agreements

Seven Types of Employability Skills	SNJ			SRT			SREC		
	Senior	**Employed alumni**	**Faculty**	**Senior**	**Employed alumni**	**Faculty**	**Senior**	**Employed alumni**	**Faculty**
Literacy and Numeracy	94.30	94.30	86.10	26.30	31.70	66.70	95.80	88.50	75.00
Critical Thinking	80.30	86.60	87.00	42.50	60.20	50.00	80.50	82.70	50.00
Leadership	77.80	95.40	77.80	39.00	59.20	60.00	77.80	73.10	35.60
Following Management	98.00	92.30	88.90	68.30	66.70	74.10	79.70	76.90	66.70
Interpersonal	85.40	87.70	80.00	46.60	46.90	53.30	84.20	85.40	53.30
Information Technology	93.00	86.90	86.70	52.20	66.10	51.10	89.80	80.00	73.30
Ethics	88.10	89.00	80.60	30.50	43.80	65.30	94.40	77.90	72.20

4.5 Findings of Questionnaires

The findings of questionnaires that were generated to answer the research questions are illustrated in next sections.

4.5.1 Reliability

The research affirmed to do the reliability analysis to determine the cohesion among the items for each attitude. The Cronbach alpha of reliability was calculated and listed for all 36 items of skills for each groups of participants at each of their attitudes (SRT SREC and SNJ). Table 25 presents the factor analysis and showing strongly coherence in the results with Alpha is greater than 90.

Table 25: Cronbach's Alpha for employed alumni, faculty and students

	Employed Alumni			Faculty Members			Students	
Skill Items	SNJ	SRT	SREC	SNJ	SRT	SREC	SRT	SREC
I_1	0.9190	0.9714	0.9496	0.9561	0.9681	0.9481	0.9255	0.9389
I_2	0.9276	0.9712	0.9499	0.9558	0.9687	0.9467	0.9246	0.9378
I_3	0.9239	0.9719	0.9473	0.9576	0.9712	0.9467	0.9249	0.9382
I_4	0.9209	0.9706	0.9498	0.9552	0.9684	0.9467	0.9252	0.9381
I_5	0.9154	0.9690	0.9434	0.9545	0.9717	0.9464	0.9244	0.9382
I_6	0.9167	0.9691	0.9469	0.9548	0.9684	0.9481	0.9240	0.9383
I_7	0.9173	0.9687	0.9473	0.9552	0.9690	0.9484	0.9236	0.9388
I_8	0.9158	0.9687	0.9463	0.9525	0.9681	0.9498	0.9227	0.9387
I_9	0.9172	0.9699	0.9468	0.9557	0.9695	0.9485	0.9249	0.9372
I_{10}	0.9141	0.9688	0.9453	0.9508	0.9696	0.9466	0.9252	0.9381
I_{11}	0.9169	0.9685	0.9461	0.9540	0.9712	0.9479	0.9241	0.9384
I_{12}	0.9199	0.9686	0.9454	0.9525	0.9704	0.9498	0.9246	0.9375
$I1_3$	0.9228	0.9694	0.9467	0.9508	0.9721	0.9491	0.9223	0.9383
I_{14}	0.9199	0.9690	0.9475	0.9592	0.9689	0.9467	0.9242	0.9378
I_{15}	0.9191	0.9685	0.9452	0.9508	0.9735	0.9465	0.9248	0.9379
I_{16}	0.9185	0.9683	0.9442	0.9508	0.9713	0.9475	0.9247	0.9374
I_{17}	0.9135	0.9683	0.9466	0.9515	0.9697	0.9466	0.9245	0.9375
I_{18}	0.9173	0.9682	0.9458	0.9515	0.9697	0.9466	0.9289	0.9383
I_{19}	0.9237	0.969	0.9462	0.9527	0.9679	0.946	0.9237	0.9382
I_{20}	0.9185	0.9689	0.9474	0.9546	0.9734	0.9461	0.9236	0.9379
I_{21}	0.9181	0.9696	0.9452	0.9527	0.9696	0.9474	0.9234	0.9378
I_{22}	0.9175	0.9692	0.9448	0.9527	0.9677	0.9448	0.9233	0.9378
I_{23}	0.9161	0.9685	0.9454	0.9527	0.9677	0.9462	0.9229	0.9387
I_{24}	0.915	0.9688	0.9451	0.9527	0.9688	0.9518	0.9236	0.9374
I_{25}	0.9147	0.9685	0.9462	0.9527	0.9679	0.9467	0.9237	0.9383
I_{26}	0.9142	0.9689	0.9453	0.9527	0.9679	0.9469	0.9239	0.9379
I_{27}	0.9175	0.9684	0.9437	0.9525	0.9682	0.9449	0.9227	0.9382
I_{28}	0.9203	0.9688	0.9447	0.9525	0.9679	0.9467	0.9238	0.9377
I_{29}	0.9209	0.9695	0.9453	0.9546	0.9684	0.9467	0.9249	0.9378
I_{30}	0.915	0.9695	0.9456	0.9546	0.9684	0.9461	0.9246	0.9374
I_{31}	0.9201	0.9688	0.9452	0.9525	0.9717	0.9485	0.9264	0.9386
I_{32}	0.9196	0.9687	0.9436	0.9531	0.9684	0.9463	0.9253	0.9389
I_{33}	0.9169	0.9688	0.9468	0.9536	0.9686	0.9468	0.9225	0.9368
I_{34}	0.9175	0.9689	0.9444	0.9548	0.9702	0.9468	0.9227	0.9389
I_{35}	0.9177	0.9694	0.9446	0.9527	0.9705	0.9485	0.9237	0.9379
I_{36}	0.9152	0.9691	0.9432	0.9527	0.9681	0.9448	0.9237	0.9382

4.5.2 Results of Hypotheses Testing for Questionnaires

ANOVA assumptions were checked to validate the analysis, Figure 6 and Figure.7 shows that ANOVA assumptions are satisfied. Appendix C and Figures 5-c, 12-c show the residual plots for the rest of data contained in the questionnaires.

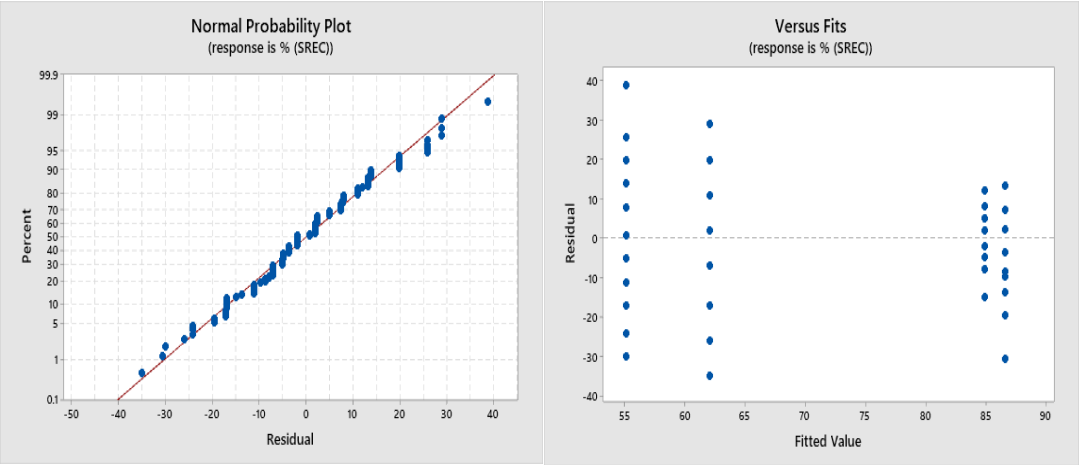

Figure 6: Residual plots for percentge of students' agreement SREC versus academic level

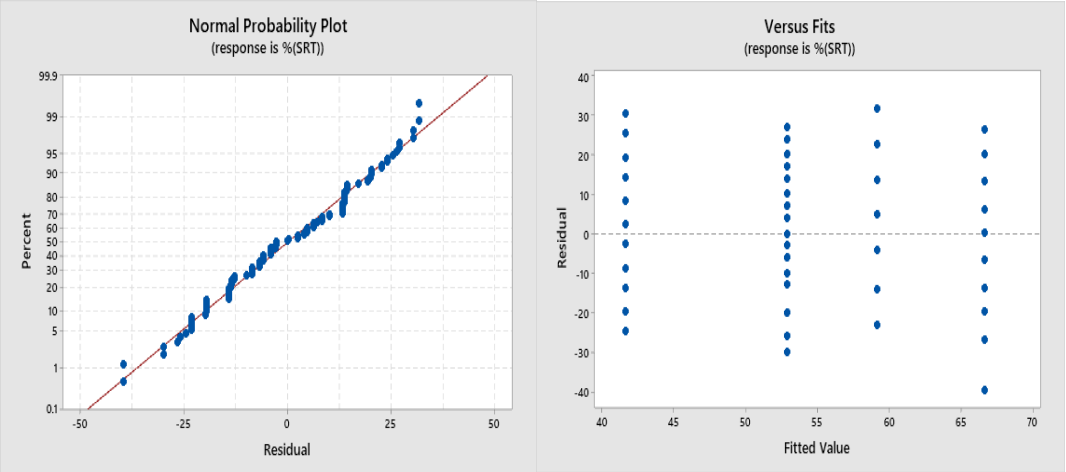

Figure 7: Residual plots for percentge of students' agreement SRT versus academic Levels

Hypothesis One: Is there any significant difference in the mean of students' perceptions (percentages of agreements) between their Academic levels from freshman to senior level regarding their attitudes toward skills that requires additional

training SRT? One-way analysis of variance model was fitted. The results show that, the academic level has a significant effect on the percentage of agreements as listed in Table 26.

Table 26: ANOVA for percentage of agreements SRT versus academic level

Source	DF	SS	MS	F	P	Power of the test
Academic Level	3	12138	4046	16.21	0.000	1.000
Error	140	34939	250			
Total	143	47077				

As illustrated in Table 27, the grouping Information by Fisher test exposes that, freshman level has the largest percentage of agreements as skills requiring more training; but the senior level has the lowest responses.

Table 27: Grouping information for academic level using fisher method

Academic level	Percentage of agreement (SRT)	Grouping
Freshman	66.67	A
Sophomore	59.17	B
Junior	52.89	B
Senior	41.61	C

Hypothesis Two: Is there any significant difference in the mean of students' response between different Academic levels regarding the attitudes of SREC? For skills that are received and emphasized in the curriculum, significant effects exist between student levels and their responses (p=0.00) are observed as illustrated in Table 28.

Table 28: One-way ANOVA: % of agreement SREC versus students level

Source	DF	SS	MS	F	P	Power of the test
Academic Level	3	27556	9185	52.97	0.000	1.000
Error	140	24275	173			
Total	143	51832				

Fisher test revealed that both senior and junior levels are converging in their responses with the largest percentages. Conversely, the sophomore students and freshman students' responses are diverged and they are lower than the advanced academic levels as presented in Table 29.

Table 29: Grouping information for students' level by using fisher method

Academic level	Mean for % of agreements	Grouping
Senior	86.64	A
Junior	84.94	A
Sophomore	62.06	B
Freshman	55.14	C

Hypothesis Three: Is there any significant difference in the mean of students' response between the types of Seven Employability Skills that were addressed in the curricula of industrial engineering department regarding to their attitudes of (SRT)? The relationship between students' responses about their attitudes towards (SRT) and the seven types of employability skills was tested by a one-way ANOVA as shown in Table 30. The results show significant differences between students' responses toward the seven employability skills ($p = 0.00$) and (the observed power of the test =1).

Table 30: ANOVA for students' percentage agreements for SRT

Source	DF	SS	MS	F	P	Power of the test
Seven Employability skills	6	16002	2667	11.76	0.000	1.000
Error	137	31075	227			
Total	143	47077				

As a result, Table 31 arranges these skills in descending order according to the students' percentage agreements.

Table 31: Ranking of seven employability skills regarding the students' response

Seven Types of Employability Skills	Percentage of agreement (SRT)
Information Technology	72.60
Following Management	69.08
Critical thinking	59.25
Interpersonal	54.35
Leadership	53.90
Work Ethics	43.72
Literacy and Numeracy	41.56

Hypothesis Four: Is there any significant difference in the mean of students' responses between the types of Seven Employability Skills regarding their attitudes of SREC? The relationship between students' response regarding the attitude of SREC and the seven types of employability skills are tested by one-way ANOVA as presents in Table 32 and the results show that, there is a significant difference between students' response toward the seven types of skills ($p = 0.002$). and (the observed power of the test =0.950).

Table 32: One-way ANOVA: % of agreement SREC versus type of skills

Source	DF	SS	MS	F	P	Power of the test
Seven Employability Skills	6	7136	1189	3.65	0.002	0.950
Error	137	44696	326			
Total	143	51832				

Table 33 shows the ranking of these skills in descending order according to the mean of students' percentage agreements.

Table 33: Ranking of seven employability skills regarding the students' response

Seven Types of Employability Skills	Percentage of agreement (SREC)
Literacy and Numeracy Skills	86.41
Ethic Skills	81.49
Information Technology Skills	81.05
Following Management Skills	74.42
Interpersonal Skills	74.31
Critical Thinking	71.07
Leadership skill	62.14

Hypothesis Five: Is there any significant difference in the mean of participants' response (percentages of agreements) between the senior students, employed alumni and faculty member regarding their attitudes toward skills required additional training SRT? The results show that the academic levels of participants have a significant effect on their responses (p=0.00) and (the observed power of the test =0.997) as illustrated in Table 34.

Table 34: One-way ANOVA: % of Agreement SRT versus participants' levels

Source	**DF**	**SS**	**MS**	**F**	**P**	**Power of the test**
Participants' Level	2	5738	2869	13.27	0.000	0.997
Error	105	22711	216			
Total	107	28449				

Moreover, the Multiple Comparison test (Fisher method) in Table 35 shows that, the responses of faculty members and employees were converged in the same group A, while the senior students were different from them with the lowest percentage of agreement (41,61%).

Table 35: Grouping Information for participants by using Fisher method

Academic level	Mean of Percentage of agreement	Grouping
EMU faculty member	59.26	A
Employed alumni	52.77	A
Senior students	41.61	B

Hypothesis Six: Is there any significant difference in the mean of participants' response (percentages of agreements) between the senior students, employed alumni and faculty members regarding the attitudes toward SREC? ANOVA analysis discovers that, there is a significant difference between participants' response

regarding their levels (P=0.000). The observed power of the test is equal to 1 as listed in Table 36.

Table 36: ANOVA for participants' response SREC versus Participants 'level

Source	DF	SS	MS	F	P	Power of the test
Participants' Level	2	13102	6551	34.30	0.000	1.000
Error	105	20053	191			
Total	107	33155				

Hypothesis Seven: Is there any significant difference in the mean of participants' response (percentages of agreements) between the senior students, employed alumni and faculty members towards the attitudes of skills that are considered important for job performance (SNJ)? ANOVA analysis discovers that, there is a significant difference between participants' response regarding their levels (P=0.034). The observed power of the test =0.641 as presented in Table 37.

Table 37: One-way ANOVA: % of agreement SNJ versus participants' levels

Source	DF	SS	MS	F	P	Power of the test
Participants' Level	2	777	388	3.49	0.034	0.641
Error	105	11690	111			
Total	107	12467				

The Multiple Comparison test was conducted as shown in Table 38 it shows the employed alumni recorded the highest agreement toward SNJ. The responses of faculty members and employees were spaced and categorized in two different groups A and B, while the responses of senior students were close to both faculty members and employees and classified in Group AB.

Table 38: Grouping information for participant levels regarding SNJ

Academic Levels	Mean	Grouping
Employed alumni	89.87	A
Senior	87.19	AB
EMU faculty member	83.34	B

Hypothesis Eight: Is there any significant difference in the mean of participants' response (percentages of agreements) toward (SRT) between the types of Seven Employability Skills? The results show that the seven types of skills level have significant effect on the percentage of agreements (p=0.002). The observed power of the test is equal to 0.956 as listed in Table 39.

Table 39: One-way ANOVA: % of agreement SRT versus types of skills

Source	**DF**	**SS**	**MS**	**F**	**P**	**Power of test**
Seven types of skills	6	5254	876	3.81	0.002	0.956
Error	101	23195	230			
Total	107	28449				

As a result, the seven skills were arranged in descending order according to the percentage of agreement from the largest percentage 69.69% at Following Management skills to the lowest percentage 41.55 at Literacy and Numeracy skills as shown in Table 40.

Table 40: Ranking skills according to participants' response.

Seven Types of Employability Skills	**Percentage of agreement (SRT)**
Following Management	69.69
Information Technology	56.48
Leadership	52.74
Critical thinking	50.91
Interpersonal	48.95
Work Ethics	46.51
Literacy and Numeracy	41.55

Hypothesis Nine: Is there any significant difference in the mean of participants' response (percentages of agreements) towards (SREC) between the types of Seven Employability Skills? The findings explored that, there is a significant difference between the participants' responses toward the seven types of employability skills regarding SREC (p= 0.003). The observed power of the test is equal to 0.941 as shown below.

Table 41: One-way ANOVA: % of agreement SREC versus type of skills

Source	DF	SS	MS	F	P	Power of the test
Seven Employability Skills	6	5787	965	3.56	0.003	0.941
Error	101	27368	271			
Total	107	33155				

The seven types of skills were arranged in descending order from the largest proportion 86.41% by Literacy and Numeracy Skills to the minimum one 62.14% by Leadership skills as shown in Table 42.

Table 42:Ranking of seven employability skills regarding SREC

Seven Types of Employability Skills	Percentage of agreement (SRT)
Literacy and Numeracy Skills	86.41
Ethic Skills	81.49
Information Technology Skills	81.05
Following Management Skills	74.42
Interpersonal Skills	74.31
Critical Thinking Skills	71.07
Leadership skills	62.14

Hypothesis Ten: Is there any significant difference in the mean of participants' response (percentages of agreements) towards (SNJ) between the types of Seven Employability Skills? The results show that, the types of skills level have not

significant effect on the percentage of agreements p=0.181. The observed power of the test =0.563 as listed in Table 43.

Table 43: One-way ANOVA: % of agreement SNJ versus type of skills

Source	DF	SS	MS	F	P	Power of the test
Seven types of Employability Skills	6	1028	171	1.51	0.181	0.563
Error	101	11438	113			
Total	107	12467				

4.5.3 Common Items of Skills Approved by all Participants

Skills that require additional training are selected in accordance with percentages of agreements that exceed 50% as a common skill between faculty members, senior students and employed alumni. The Venn diagram Figure 8 shows the skills intersections among these groups. Among all respondents, seven items of skills are identified as common: one item belongs to LS skills, three items related with FM, and three items connected to IT skills as described in Table 44.

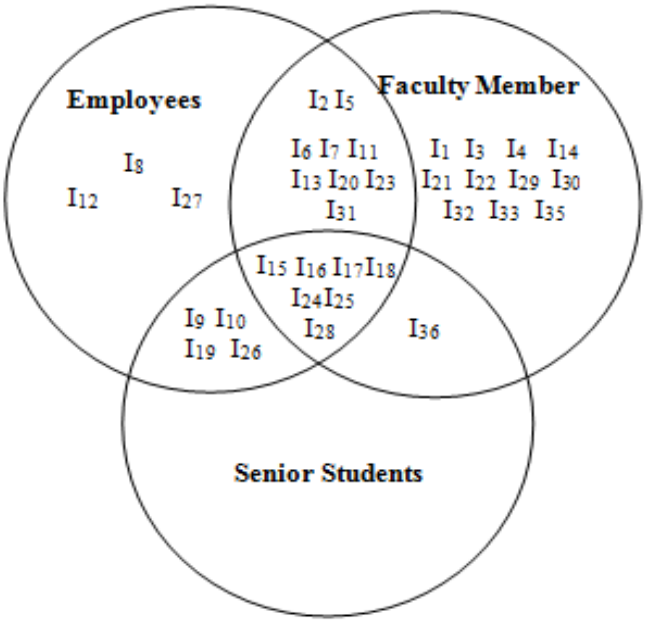

Figure 8: Common skills that required additional training

Table 44: Description of the seven common skill items

Skill items	Skill description	Type of skills	% of Senior	% of Employee	% of Faculty
I_{15}	Communicating ideas to justify a position, and convincing others, responsibly challenge existing procedures and policies.	Leadership	67.00	69.20	66.67
I_{16}	Selecting goal-relevant undertakings, prioritize them, apportion time, organize and follow agendas.	Following Management	72.00	57.70	66.67
I_{17}	Following or preparing budgets, making forecasts, keeping accounts and making amendments to achieve goals.	Following Management	72.00	69.20	77.78
I_{18}	Evaluating skills and allocating tasks accordingly, assessing performance and giving feedback.	Following Management	61.00	73.10	77.78
I_{24}	Choosing processes, implementations or components, such as computers and allied technological equipment.	Information Technology	50.00	73.10	66.67
I_{25}	Recognizing, or resolving difficulties and problems through tools such as computers and allied technological equipment.	Information Technology	61.00	69.20	55.56
I_{28}	Using computers to get, arrange, evaluate, analyze and share information, and show some level of skill with typical software.	Information Technology	50.00	61.50	55.56

4.5.4 Participants Comments

The last part of the first batch of questionnaire is a qualitative research study. It is an open section to recognize the important views of respondents. The findings are summarized and listed as following;

Students' Opinions

- The revision of industrial training days was suggested to make them more than 20 days as this was not sufficient for a proper internship. At least 30 days should be considered.
- The curriculum should bring the student closer to the real life application of engineering.
- The department has to implement partnerships with other universities, not only for exchange programs, but also for dual degree programs as well.
- Students also recommended that time management skills should be taught.
- Instructors should assess students beyond examination grades especially for the graduated students. It is better to assess them in practical areas; making each course to include individual projects that carry considerable points and motivate them to practice real work places cases.

Employees' Comments

- Professional industrial engineering debate should be introduced about real cases not only theoretical and ancient examples.
- They were also recommended that the instructors should encourage more brainstorming.
- Providing work based learning opportunities for the students.
- IE department should work with companies and factories to enable students train in these factories (with simple financial rewards). This can increase the chance of the students to be employed in such factories.

Faculty Members 'Comments

- Some of faculty members suggested teaching organization management or general management principles courses at a premium on the basis that such course focus more on critical thinking skills and leadership.
- Increasing summer training hours to develop the student's employment skills and focus on jobs in companies related to industrial engineering.
- It should be verified that the student is attending the summer training session and she/he will apply all the tasks required of them perfectly. Additionally, there should be contact with the company or institution in which the training is being done. The secret report from the institute or organization is not enough to confirm that. In this way, the student has to work properly and without tampering with the required duties from them.

4.6 Second Batch of Questionnaire

This questionnaire seeks to identify wich of the skills items that are important for IE courses. Table 45 presents the responses of this questionnaire which creates a link between the curriculum of IE at all academic levels and the 36 items of employability skills. The respondents are the faculty members who are teaching the core courses in the IE department. The responses of this questionnaire were transformed to a percent of importance of employability skills inherent in the industrial engineering core courses at every academic year from freshman academic year to senior academic year. The percentage of importance of the following management skill is the lowest in the freshman year. However, this importance is increased in the third and fourth year. In addition, the literacy and numeracy skills have recorded the largest percentage of importance in the senior year followed by IT skill in junior year.

Table 45: Percentages importance of skills in the contents of IE courses

Seven Types of Employability Skills	**Percentage of contents of courses with employability skills**			
	Freshman	**Sophomore**	**Junior**	**Senior**
Literacy and Numeracy	40.00	36.50	33.50	63.50
Critical Thinking	28.17	22.63	38.50	55.50
Leadership	10.00	6.50	21.00	20.50
Following Management	6.00	14.00	39.00	25.50
Interpersonal	6.50	30.00	40.00	36.00
Information Technology	8.00	24.00	60.00	59.50
Ethics	39.00	48.00	59.50	36.00

Table 46 shows the relationship between the common items of skills which are listed in Table 44 and the IE courses at every level of academic years. The objects of table 46 are determined based on the instructors' responses from the second batch of questionnaire which are scored on the intensive importance. Then these responses linked with the common seven items of skills that required additional training. So that, we can suggest the skills needed to be developed in each course from freshman to senior academic year, as listed in next table.

Table 46: Skills' items that require additional training in each course.

Year	Code	Course Name	Items of Skills
Freshman	**MATH151**	Calculus - I	I_{25}
	ENGL191	Communication in English - I	I_{15}
	IENG112	Introduction to IE	I_{17}
	CMPE110	Fundamentals of Computing Prog.	1_{24}, I_{25}
	ENGL 192	Communication in English II	I_{15}
Sophomore	**EENG225**	Fundamentals of Electrical Engineering	I_{24}
	MENG104	Engineering Graphics	I_{24}, I_{25}, I_{28}
	IENG210	Industrial Training I	I_{24}, I_{28}
	ENGL201	Communication Skills	I_{15},I_{18}
	ACCT203	Cost Accounting for Managerial Decision Making	I_{17}
	MGMT201	Principles of Management	I_{16}, I_{18}
	IENG212	Modeling and Optimization	I_{16}, I_{25}
	IENG263	Materials and Manufacturing Processes	I_{25}
Junior	**MATH322**	Probability & Statistical Methods	I_{25}, I_{28}
	IENG355	Ethics in Engineering	I_{15}
	IENG313	Operations Research - I	I_{16}, I_{17}, $I_{24,}$ I_{25}
	IENG323	Engineering Economy	I_{17}, I_{24}
	IENG372	Information Systems and Technology	I_{24}, I_{25}, I_{28}
	IENG 310	Industrial Training II	I_{17}, I_{18}, I_{24}, I_{28}
	IENG301	Fundamentals of Work Study and Ergonomics	I_{16}, I_{18}, I_{24}, I_{25}
	IENG 314	Operations Research - II	I_{16}, I_{17}, I_{24}, I_{25}
	IENG332	Production Planning - I	I_{16},I_{18},I_{24},I_{25}
	IENG385	Statistical Applications in Engineering	I_{24},I_{25}, I_{28}
Senior	**IENG 431**	Production Planning - I,II	I_{17},I_{18}
	IENG 410	Industrial Training III	I_{24}, I_{28}
	IENG441	Facilities Planning and Design	I_{16}, I_{17}, I_{25}
	IENG461	Systems Modeling and Simulation	I_{15}, I_{16}, I_{24}, I_{25}, I_{28}
	IENG490	Introduction to Manufacturing	I_{17}, I_{25}, I_{28}
	IENG484	Quality Engineering	I_{25}, I_{28}
	IENG492	Manufacturing & Service Systems Design Project	I_{18},I_{25},I_{28}
	IENG444	Seminars on Manufacturing & Service Systems	I_{15}

4.7 Discussion and Interpretation

This section argues and interprets the outcomes of this study. The main motive behind conducting this research is to evaluate the IE students' skills and identifying weaknesses in those skills to know the connection between the need for knowledge and employability of IE students. Understanding this connection would assist to bridge the gap between the expectation of both parties (Education and Industry). An analysis

of the hypotheses revealed some notable patterns that may have implications for the skills of students that should be enhanced in the curriculum.

4.7.1 EAS -Test

The results of EAS- Test are:

4.7.1.1 Relationship between Students' Academic Levels

The study investigates the skills retentability of IE students' as they progress academically through the years of studies relative to their ages and CGPA. The findings carry that the abilities of students are improved as the students' advance in their academic studies. This is in agreement with the finding Brockman & Russell (2012) where positive relationship between academic level and the abilities of the students was achieved and reported. As the student progresses in their academic endeavors, they are better equipped with all the required knowledge and skills; thus senior students have superior abilities than junior and freshman students. This is supported by the inferences drawn from (Newton,2000) and (Oblinger, 2005). New students tend to demonstrate certain characteristics that could reduce their performance. They can be disillusioned by the enthusiasm of entering a university, and could engage in some extra curriculum activities that are not related to their studies. Therefore, personal attributes such as culture, age, gender could stand on their ways to understand their courses, just to mention a few. Additionally, aligning with other study (Cassidy, 2007), academic level is of essence in determining students' retentability. Especially for freshman, attrition is as a result of lack in the ability to understand how their personal dimension for learning could influence their capacity for proper adaptation into the university study. This explain how their perception could be translated into knowledge or belief about their external world (Jama, Mapesela, & Beylefeld,, 2008). So called "common ability and capacity" are highly essential tools for all university students to

recognize their limitations in the way of knowledge acquisition, conceptualization, and intuition which are necessary for learning, imbibing and retaining fundamental skills (Larmar & Lodge, 2014).

The study also reveals that no relationship exists between the academic years and space visualization. This result is similar to what was reported Kozhevniko & Thornton (2006) where students' levels of spatial visualization ability were examined based on physics training within the confinement of the microcomputer-based laboratory (MBL). It was reported that in spite of the ability of space visualization to predict students' performance, yet it was not significantly affected by the level of the instructions given to the students. This alludes the reason for as the ineptitude dispositions toward emphasizing this skill in the curriculum.

In terms of numerical ability senior academic level has more retaining ability than the junior, sophomore and freshman. For numerical reasoning, senior students have the higest scores. The results obtained in this study is akin to the results obtained elsewhere James, Conradie, & Browne, (2015) who demonstrated and revealed that literacy mathematics, writing quality and comprehension was used as indicator for success in the skills for Tertary Education Preparotory studies (STEPS) programe. They added that, literacy element is an essential determinant to whether students will complete the program or not.

4.7.1.2 Relationship between Students and Ages

Ages do not have any significant effect on students' percentile according to the EAS tests. Even though, some studies Clark and Ramsay (1990), have been inconsistent with this finding where negative association between age and academic achievement was reported. The reason of this contradicting result I think is due to the fact that the

students age in this study, is between 17 and 30 years old, and does not include a reasonably older student. However, the studies McKenzie and Schweitzer (2001) across ages of the respondents regarding their GPA of both part time and full time students through one-way ANOVA gave no significant difference results. Thereby, this corroborates and gives more credence to this study. On the account Okoh (2010), there can't be a significant difference in academic performance on the basis of age, gender and financial status and advised that counseling should be provided for students of all ages, financial status and gender. Similarly, the results of this research are in-line with Hodges et al. (2013) which reported that age of students has no significant effect on student's academic capabilities. This has casted doubts on the ability of age as a factor to wholly ensure stronger career orientations that can relatively affect the academic capabilities; it also revealed beyond doubt that there is no significant relationship between students' age and their academic ability.

4.7.1.3 Relationship between CGPA, Aptitude and Academic Levels

The research shown, based on EAS tests that there are relationships between CGPA groups, and percentile. In addition there are affairs between percentile and academic levels. It was found as the students advance in their academic years, they acquire more skills and are able to score higher on the percentile of the EAS tests. This can be further expatiated by aligning with many previous studies such as McInnes, James & Hartley, (2000) who indicated that most time freshman lacked confidence, tend to be reluctant socially and alienated. Up to 60% of students that took part in the report of Krause et al. (2005) confirmed that they were either irregularly or never got along to team-work with their colleagues in order to discuss their studies. These traits are capable of adversely affecting their knowledge of how to align themselves with their studies and how to leverage on their personal intelligence and capability when challenged by some

learning problems. This happens due to the fact that the suitability and relevance of some courses toward the students' discipline tend to be higher as the academic level progresses. This stance is also in corroboration with the conclusion of Harvey (2001) that employability is influenced by the courses taken by the student because some courses are active promoters of employability skills. As result, it could be inferred that retainability is higher as the academic level progresses. This is also in consonant with some of the previous studies on the university undergraduate students' attrition (Rose-Adams, Hewitt, & John, 2012) where various ways of improving retention were reported. Finally, this study showed that there is a strong correlation between CGPA grades and the percentile of students. The most of students with high CGPA also have demonstrated high percentile; hence both CGPA and percentile are good determinants of the students' performance.

4.7.2 First Batch of Questionnaires

This questionnaire included 36 items to evaluate the seven types of employability skills according to the participants' responses toward their attitudes (SREC, SRT and SNJ). The results of the first batch of questionnaires are discussed and interpreted as follows;

4.7.2.1 Evaluation the Relationship between Students' Perceptions

An evaluation of the students' perceptions (percentages agreement) regarding two attitudes are skills that require additional training (SRT) and skills that received or emphasized in college courses (SREC). The results show that students' responses are significantly different. The attitude of the senior students regarding SRT exhibited the lowest percentage agreement compared with the remaining academic levels. This result reflects the confidence level of EMU students and its alumni set; they seem well trained and ready for the challenges of the workplace. That was clear in the results of this study where alumni student's surveys, 69.23% of them were signed a job contract

after graduation, and this finding was close to preceding outcomes of the Industrial engineering alumni in EMU, which indicate that about 64.71% obtained a job during six months after graduation, as shown in appendix A. (First employed after graduation). This finding corroborates the previous studies, which indicated that a majority of engineering graduates seemed to have fully imbibed the technical training taught and are always confident that they will perform well as engineers (Martin, Case, & Fraser, 2005). In addition, their responses toward the skills received in college (SREC) is the highest, which reveals that they are learning the most needed skills as stated by their program's objectives and student outcomes (a to k), as envisaged by the Department of Industrial Engineering at EMU. Most of the students agreed that additional training in FM and IT skills are required. The largest percentage of agreement regarding literacy and numeracy skills and work ethic indicates that these skills are well emphasized in the curriculum.

4.7.2.2 Evaluation the Relationship among the Perceptions of Senior, Employed Alumni Students and Faculty Members

As regards to the three attitudes of the groups (senior, employed alumni and faculty members) toward:

1. Skills that required additional training (SRT): The findings reveal that the responses of the faculty members and employed alumni converged to each other. This convergence may be attributed to their vast experience and awareness in evaluating undergraduates' needs for additional training.

2. Skills that received/emphasized in the IE curriculum (SREC): The percentage agreements of senior students and employed alumni students are high and show no significant difference. This finding implies that these seven types of employability skills are received and learned in college. Conversely, the responses of the faculty

members regarding L&N and IT skills are different, which indicates that these skills should be emphasized in the curriculum. This result also reveals the faculty members did not consider emphasizing leadership skills in the curriculum this was obvious from their lowest average percentage score.

3. Skills needed in job performance (SNJ): The participants' responses regarding to the SNJ receive the largest percentage of agreement, which indicates that these seven employability skills are essential for the success of industrial engineers. The highest percentage of agreement is obtained from the responses related to FM and L&N skills, which is consistent with the expectations of many employers. Employers have always maintained that technicians and managers with excellent management skills are scarce, and interpersonal and generic skills are lacking. The majority of salespersons are deficient in communication skills (National_ESS, 2003); some of these sets of skills are necessary for optimum performance in the field of engineering (Kyoung Ro, Lattuca, & Alcott, 2017). In another study Van Dyk (2014), an assessment of the skills requirements of Industrial Engineering graduates in South Africa concluded from the largest agreement of the perceptions of participants that the essential skill items are supply chain management, business process analysis, optimization and management. This conclusion is in tandem with this study because the item of the previously mentioned skills falls under following management and literacy and numeracy refer to Table 2.

4.7.2.3 Skills Need Further Improvement and Development

The study found that leadership, following management and information technology skills as three of the seven employability skills that require additional improvement. Leadership skills are crucial, especially in the areas of goal setting and responsibilities (Farr & Brazil, 2009). The reason for the dearth of leadership skills among engineers

is attributed to the fact that ideas for blending soft and professional skills at all levels for successful job performance are lacking. Thus, engineering students have to be taught inside and outside the classroom, which requires a judicious balance of technical skills and non-technical skills to guarantee an enduring engineering practice. This balance is achievable when the objectives of the curriculum include the development of both professional skills and soft skills. If engineers understand this early in their careers, they would be able to assume leadership roles and seamlessly achieve the transition from project engineer to project manager (Farr & Brazil, 2009). As correctly postulated, an engineering career requires the ability to work in a leadership role within a team; unfortunately, this skill is not particularly developed in the existing curriculum (Martin, Case, & Fraser, 2005).

Management skills also need improvement and should be emphasized in the college curriculum, specifically in the areas of selecting goal-relevant activities, preparing a budget, assessing other skills and distributing duties. Smith (2000) offered suggestions to help students develop these skills. In his study he pointed out the main features of management skills. These features were as follows; established goals, cost, time and performance requirements, multiple resources, one-time activity, and element of risk, temporary activity and process of project life cycle. Therefore, these principles should be embedding in the teaching process.

Information technology skills need to be improved, particularly in the areas of computers, are used to arrange, evaluate, analyze, share information, recognize and resolve problems. Some studies urged the use of the ‘Big 6’ skills method, which the most commonly known and extensively employed approach for training information

technology skills in many high schools, higher institutions, and adult teaching programs (Eisenberg & Doug, 2002).

4.7.3 Discussion the Findings of the Second Batch of Questionnaire

The results of the second batch show that the percentage to emphasis the importance of skills of the Following Management, Information Technology, Interpersonal and Leadership Skills for IE courses is very low in the first and second years but slightly increased in the third and fourth years. This study discovered that Information Systems and Technology (IENG372), which is taught in the third year, is the only course that demonstrated all IT skills set of I_{24}, I_{25} and I_{28}. No special courses intensively focus on all items of FM (I_{16}, I_{18} and I_{17}) and Leadership Skills (I_{15}) in the last two years of study but, appear scanty in certain courses, such as Fundamentals of Work Study and Ergonomics (IENG301), Facilities Planning and Design (IENG441), Systems Modeling and Simulation (IENG461), and Operations Research – II (IENG314). Therefore, IE curriculum should be revitalized to accommodate specialized courses to further enhance these important skills that have been overlooked. Institutions must prioritize the allocation of resources toward the enhancement of employment-oriented training and learning to effectively teach employer-driven courses in the curriculum (Cranmer, 2006). This finding conforms to a report on reinforcing engineering education UNESCO (2010), which expressly stated that the curriculum can be revitalized by emphasizing project and problem-based learning, just-in-time techniques, information and communication experiences and real-time hands-on applications. Institutions have been saddled with the responsibility of enhancing human capital development for improved productivity and economic growth (Ngetich & Moll, 2013). This level of employability skills and experience would positively impact graduates' propensity to secure, manage and retain jobs in the labor market.

However, SCAN (1991) reported that most of the graduates expected that employability skills will be accrued on the job place. Moreover, models that tend to make engineering studies more innovative, relevant, practicable and flexible have to be continuously improved via the faculty curriculum designing process. First, the models have to identify the stakeholders, define and analyze the requirements, conduct preliminary design and create the detailed design. The model must be validated by an advisory board of the University (Meixell, Buyurgan, & Kiassat, 2015).

Chapter 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study provides insight into how the curriculum of an industrial engineering department synergizes with industry practices and requirements. This research unearthed different perceptions and priorities necessary for enhancing employability skills among IE students of Eastern Mediterranean University. A convergence between the attitudes of students and employed alumni in terms of the skills received/emphasized in the curriculum is observed. In addition, convergences between the attitudes of faculty members and employed alumni regarding skills that require additional training are detected. These convergences among faculty members and employed alumni are caused by their diverse experiences.

Using the responses of participants' attitudes provided us the skills prioritization that needed for job performance where the FM skills was the most important one, then the L&N skills, and IT skills for IE graduates to be successful in the workplace. As for the participants' attitudes toward the skills that require additional training the prioritizations were FM skills, IT skills, and LS skills. While the priorities of participants' responses to their attitudes towards the skills that were received/emphasized in IE curriculum were both L&N, ethics and IT skills.

EAS- test study shows that students' percentile is directly proportional to the students' academic level. The average percentile of the students that studied in the fourth year is greater than the rest who studied in the previous academic years. Moreover, both academic years and CGPA have significant effects on the student aptitude and there was a correlation between CGPA and students' percentile. Conversely, ages do not have any significant effect on students' percentile. The study reveals how important it is for academic progression to improve the students' abilities in some skills such as numerical ability, numerical reasoning and symbolic reasoning. Thus, it is demonstrated that graduate students from the industrial engineering department of Eastern Mediterranean University have higher rententability of these skills that are gained from their previous academic years – thus, greater potentials to be employed in the workforce. The outcome of space visualization test indicates student's ability does not improve as the academic level progresses thereby all students irrespective of their academic level possesses this ability in close proximity to each other.

5.2 Recommendations

Based on the findings of the study and on the conclusions presented, the following recommendations are made for research and practice.

5.2.1 Recommendations for Practice

The important points of reccommendtions were summrized as following;

1 Information technology, following management and leadership skills, should be enhanced in the industrial engineering curriculum.

2 The best approach to acquire those skills is to focus on how to pedagogically integrate the existing curriculum with germane employability skills that are in agreement with the expectations and skills demanded by the industry.

3 Faculty members should facilitate work-based learning opportunities for students and motivate them to study with more brainstorming and freedom to spread ideas by creating an educational environment with more competition among students to encourage creativity and innovation.

4 Debating of professional issues of industrial engineering problems about real cases not only theoretical examples.

5 The days of summer training are not sufficient for a proper internship, so it is preferable to increase this period. At least 30 days should be considered.

6 Continuous communication with employers and managers in companies will give a good guidance to instructors for understanding what employers need from IE engineers so, they shall be able to determine the requirements and specifications for the skills of the industrial engineer correctly. This imply that if there are good collaboration among the industry and the academic community in terms of the skills they currently need, the skills that will be needed, and the competency level expected from IE graduates, then the faculty members will be able to develop the IE courses for engineering students to meet the jobs' demands and this will lead to an increase in the number of employable graduates.

Finally, this study can be viewed through the interrelationship between inputs and outputs system of both the educational and industrial institutions to prepare the students for graduation and readiness in labour market. In the educational institution such as engineering faculty, the students are (input), after several processes during the

academic years will become the final products (junior engineers), which are considered (inputs/resources) for the industries. As in any commercial processes, we can consider the educational institution as the supplier (distributor) who must understand what specifications (skills) the customers (industry/employers) require from their new workers (junior engineers) and at what level of quality (capabilities). Therefore, if these groups work as a team, high-quality graduates' skills will be achieved.

5.2.2 Recommendations for Future Research

For future study, some other demographic data such as gender and English language may be considered in the analysis. Also, social, ethnic, and economic aspects of the participants can be incorporated, which may have an impact on their attitudes. This study examined only the attitudes of participants in EMU that is located in North Cyprus. The study could be extended to seek the views of students, faculty members and graduates from other universities, as well as extended to include opinions of employers and managers of the industrial organizations and companies. On the other hand, it is needed to extend this assessment into the remaining six EAS tests. This could include the need to examine and measure how the retained skills can be leveraged on the job and the corresponding efficiency and productivity.

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APPENDICES

Appendix A: Acceptance Letter and Sample Forms of Questionnaires

Acceptance letter from ethics committee

Doğu Akdeniz Üniversitesi
"Uluslararası Kariyer İçin"

Eastern Mediterranean University
"For Your International Career"

P.K.: 99628 Gazimağusa, KUZEY KIBRIS / Famagusta, North Cyprus, via Mersin-10 TURKEY
Tel: (+90) 392 630 1995
Faks/Fax: (+90) 392 630 2919
bayek@emu.edu.tr

Etik Kurulu / Ethics Committee

Reference No: ETK00-2016-0128

28.06.2016

RE: Faeza Saleh A. Dlhin (136116)
Department of Industrial Engineering

To Whom It May Concern,

As part of the 2015-2016 Spring Semester, pertaining to PhD Thesis questionnaires EMU's Scientific Research and Publication Ethics Committee has granted Ms. Faeza Saleh A. Dlhin (136116), from the Department of Industrial Engineering PhD Graduate Program, to pursue with her survey entitled *"Student Skill Assessment With The Purpose To Increase Their Employment Possibilities"*. This decision has been taken by the majority of votes. (Meeting number 2016/29-08)

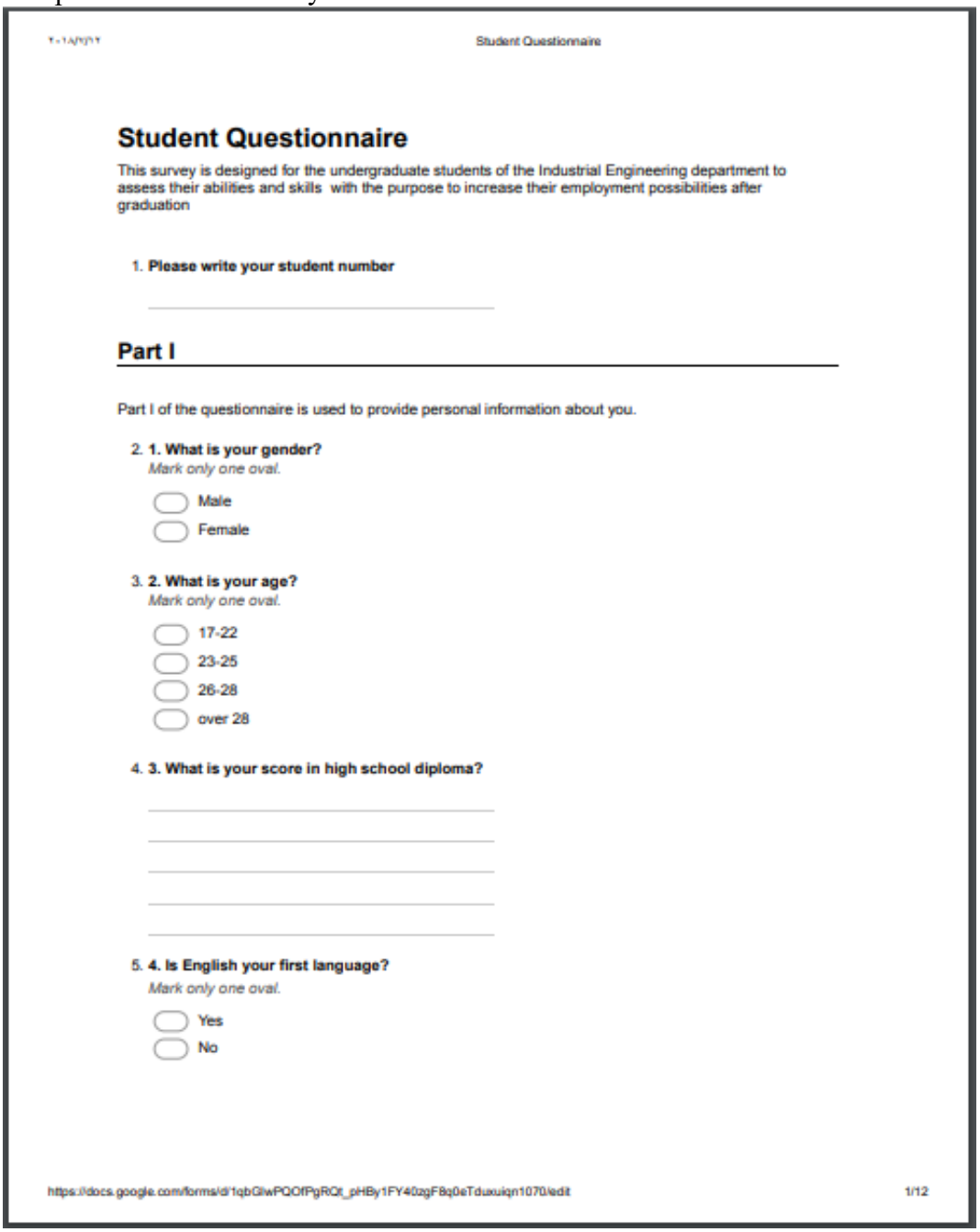
Regards,

Assoc. Prof. Dr. Şükrü Tüzmen
Director of Ethics Commitee

ŞT/sky.

www.emu.edu.tr

Sample of students' survey



Student Questionnaire

This survey is designed for the undergraduate students of the Industrial Engineering department to assess their abilities and skills with the purpose to increase their employment possibilities after graduation

1. **Please write your student number**

Part I

Part I of the questionnaire is used to provide personal information about you.

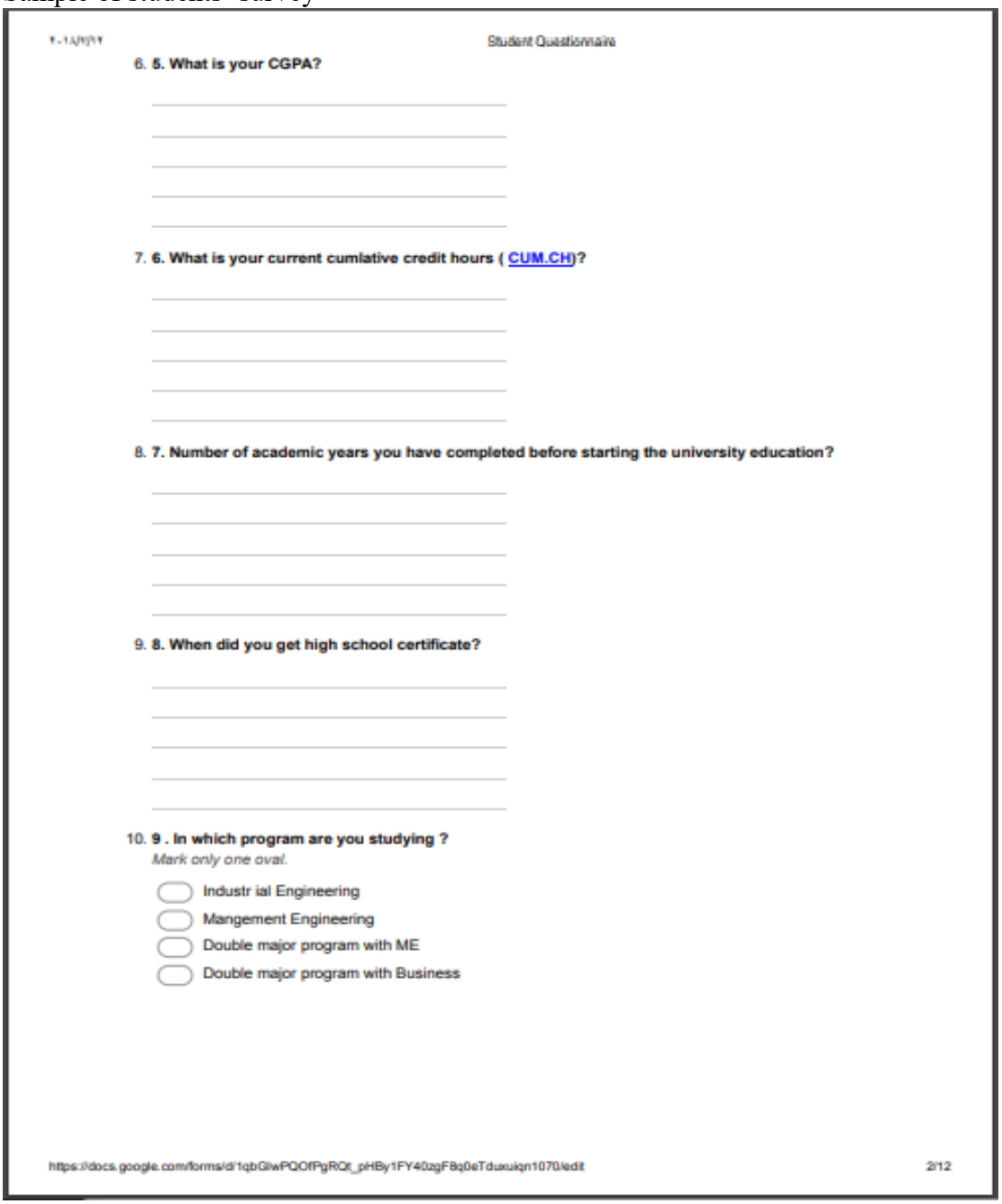
2. **1. What is your gender?**
   Mark only one oval.
   - ◯ Male
   - ◯ Female

3. **2. What is your age?**
   Mark only one oval.
   - ◯ 17-22
   - ◯ 23-25
   - ◯ 26-28
   - ◯ over 28

4. **3. What is your score in high school diploma?**

5. **4. Is English your first language?**
   Mark only one oval.
   - ◯ Yes
   - ◯ No

Sample of students' survey



٢٠١٨/١٢/١٢ Student Questionnaire

6. **5. What is your CGPA?**

7. **6. What is your current cumlative credit hours (CUM.CH)?**

8. **7. Number of academic years you have completed before starting the university education?**

9. **8. When did you get high school certificate?**

10. **9 . In which program are you studying ?**
Mark only one oval.

- Industr ial Engineering
- Mangement Engineering
- Double major program with ME
- Double major program with Business

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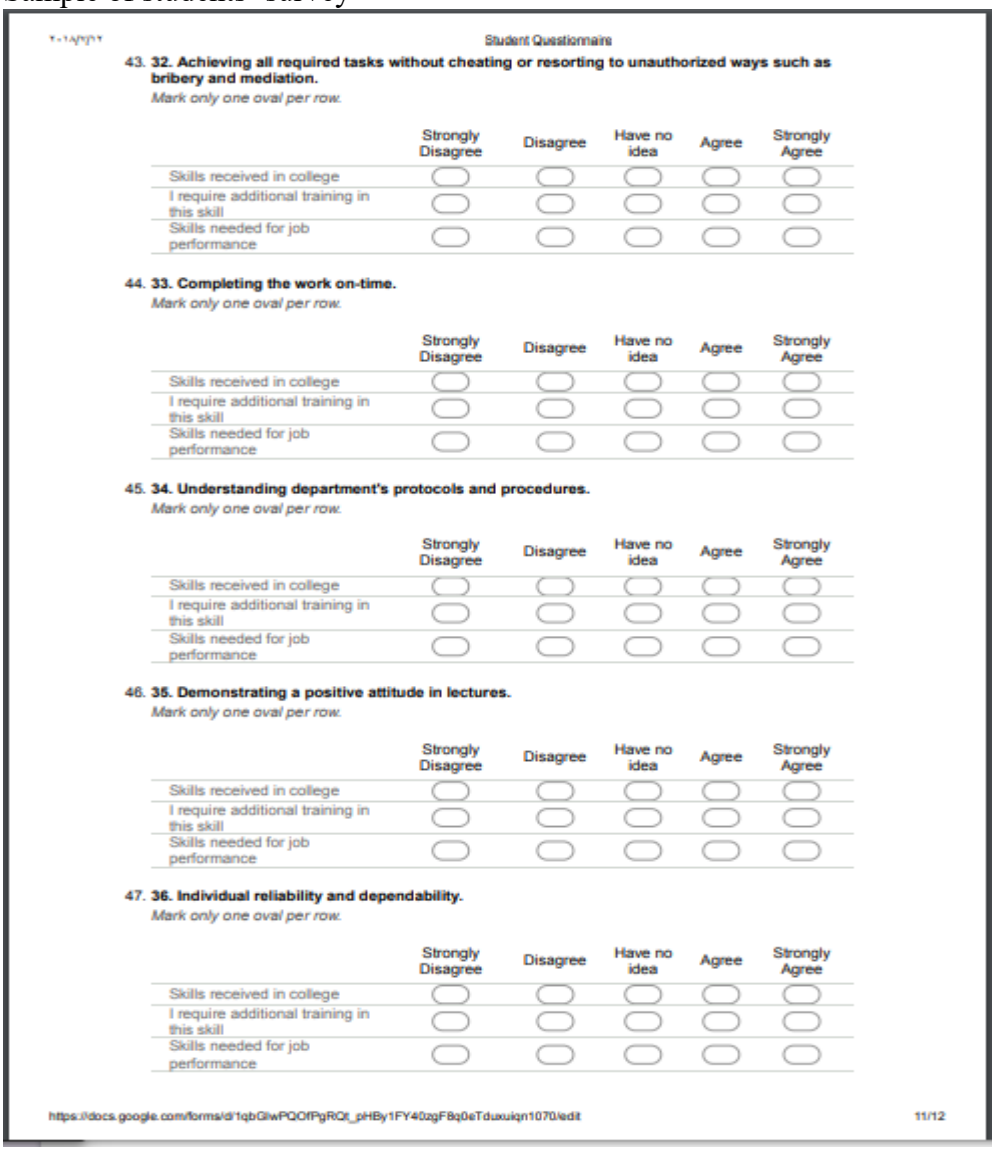
Sample of students' survey



Student Questionnaire

43. **32. Achieving all required tasks without cheating or resorting to unauthorized ways such as bribery and mediation.**
Mark only one oval per row.

	Strongly Disagree	Disagree	Have no idea	Agree	Strongly Agree
Skills received in college					
I require additional training in this skill					
Skills needed for job performance					

44. **33. Completing the work on-time.**
Mark only one oval per row.

	Strongly Disagree	Disagree	Have no idea	Agree	Strongly Agree
Skills received in college					
I require additional training in this skill					
Skills needed for job performance					

45. **34. Understanding department's protocols and procedures.**
Mark only one oval per row.

	Strongly Disagree	Disagree	Have no idea	Agree	Strongly Agree
Skills received in college					
I require additional training in this skill					
Skills needed for job performance					

46. **35. Demonstrating a positive attitude in lectures.**
Mark only one oval per row.

	Strongly Disagree	Disagree	Have no idea	Agree	Strongly Agree
Skills received in college					
I require additional training in this skill					
Skills needed for job performance					

47. **36. Individual reliability and dependability.**
Mark only one oval per row.

	Strongly Disagree	Disagree	Have no idea	Agree	Strongly Agree
Skills received in college					
I require additional training in this skill					
Skills needed for job performance					

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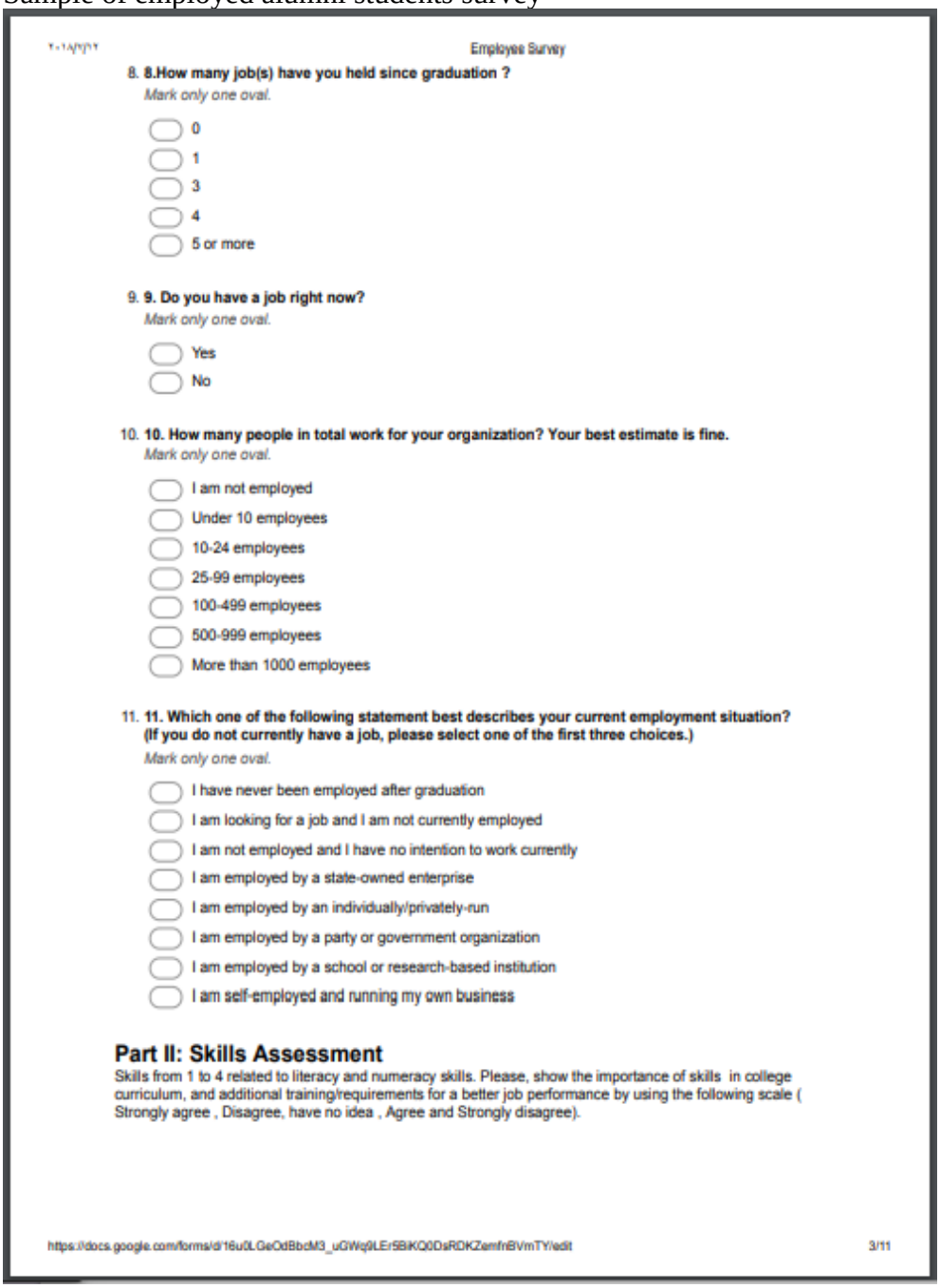
Sample of employed alumni students survey



٢٠١٨/٧/١٢ Employee Survey

8. **8.How many job(s) have you held since graduation ?**
Mark only one oval.

- ◯ 0
- ◯ 1
- ◯ 3
- ◯ 4
- ◯ 5 or more

9. **9. Do you have a job right now?**
Mark only one oval.

- ◯ Yes
- ◯ No

10. **10. How many people in total work for your organization? Your best estimate is fine.**
Mark only one oval.

- ◯ I am not employed
- ◯ Under 10 employees
- ◯ 10-24 employees
- ◯ 25-99 employees
- ◯ 100-499 employees
- ◯ 500-999 employees
- ◯ More than 1000 employees

11. **11. Which one of the following statement best describes your current employment situation? (If you do not currently have a job, please select one of the first three choices.)**
Mark only one oval.

- ◯ I have never been employed after graduation
- ◯ I am looking for a job and I am not currently employed
- ◯ I am not employed and I have no intention to work currently
- ◯ I am employed by a state-owned enterprise
- ◯ I am employed by an individually/privately-run
- ◯ I am employed by a party or government organization
- ◯ I am employed by a school or research-based institution
- ◯ I am self-employed and running my own business

Part II: Skills Assessment

Skills from 1 to 4 related to literacy and numeracy skills. Please, show the importance of skills in college curriculum, and additional training/requirements for a better job performance by using the following scale (Strongly agree , Disagree, have no idea , Agree and Strongly disagree).

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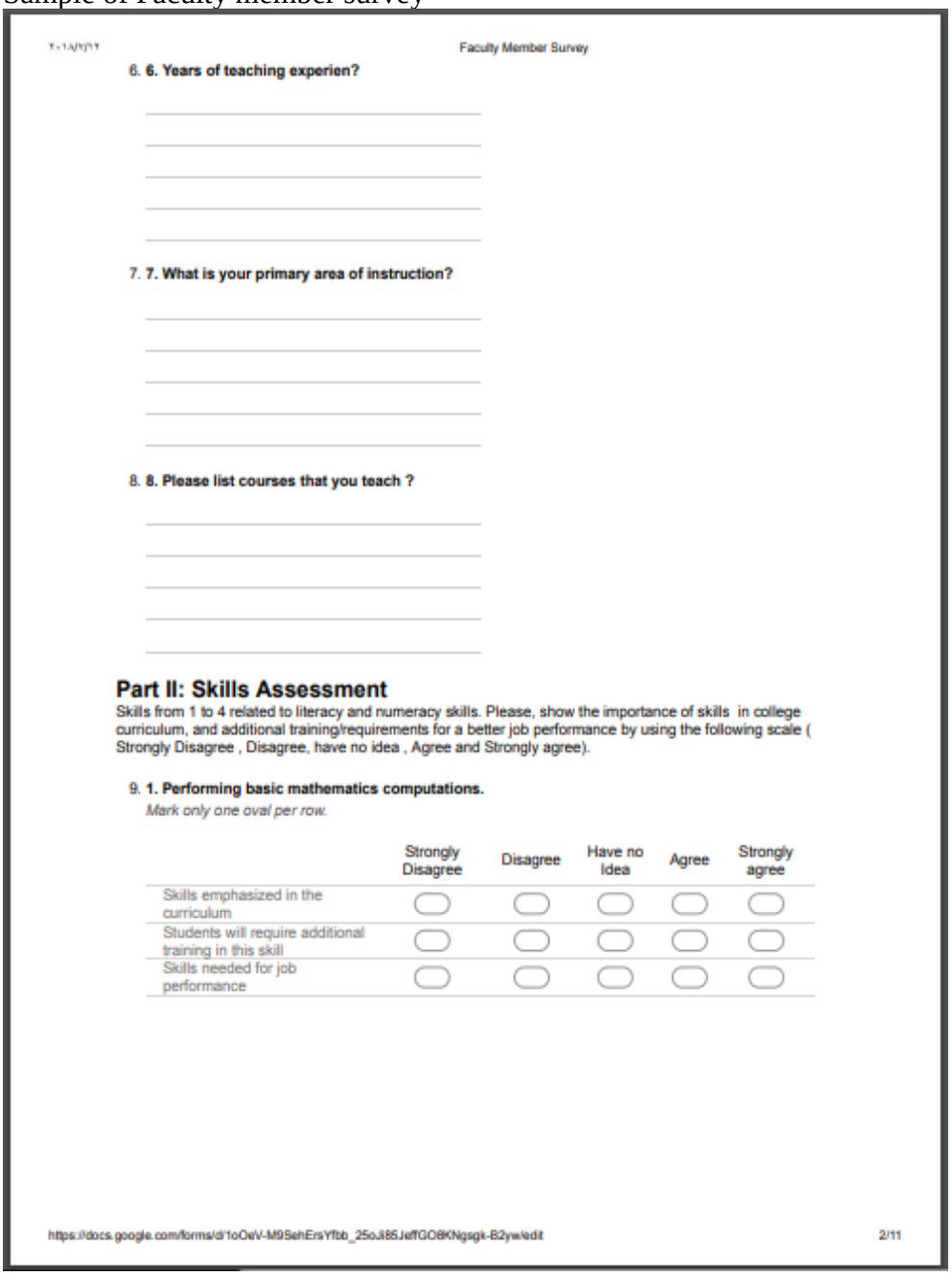
Sample of Faculty member survey



6. **6. Years of teaching experien?**

7. **7. What is your primary area of instruction?**

8. **8. Please list courses that you teach ?**

Part II: Skills Assessment

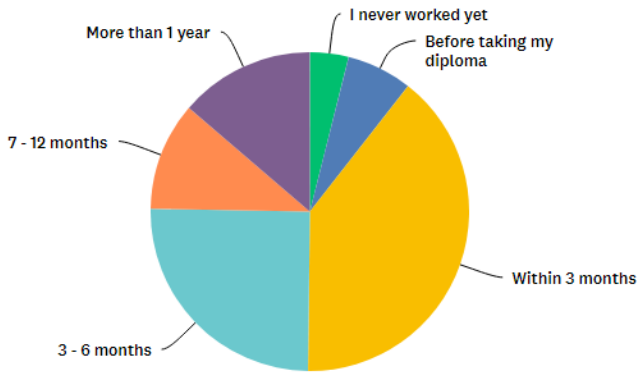
Skills from 1 to 4 related to literacy and numeracy skills. Please, show the importance of skills in college curriculum, and additional training/requirements for a better job performance by using the following scale (Strongly Disagree , Disagree, have no idea , Agree and Strongly agree).

9. **1. Performing basic mathematics computations.**

Mark only one oval per row.

	Strongly Disagree	Disagree	Have no Idea	Agree	Strongly agree
Skills emphasized in the curriculum					
Students will require additional training in this skill					
Skills needed for job performance					

First employed after graduation



ANSWER CHOICES	RESPONSES	
I never worked yet	3.92%	10
Before taking my diploma	6.67%	17
Within 3 months	39.61%	101
3 - 6 months	25.10%	64
7 - 12 months	10.98%	28
More than 1 year	13.73%	35
TOTAL		255

,

Appendix B: Data of Questionnaire

Table 1-B student's response of Questionnaires

Items	Seven Type of Skills	Academic Level	I require additional training in this skill	Skills received in college
			% of Agreement	% of Agreement
I_1	Literacy and Numeracy Skills	Senior	22	100
I_2	Literacy and Numeracy Skills	Senior	22	94
I_3	Literacy and Numeracy Skills	Senior	28	100
I_4	Literacy and Numeracy Skills	Senior	33	89
I_5	Critical Thinking Skills	Senior	33	83
I_6	Critical Thinking Skills	Senior	44	94
I_7	Critical Thinking Skills	Senior	39	78
I_8	Critical Thinking Skills	Senior	33	78
I_9	Critical Thinking Skills	Senior	56	67
I_{10}	Critical Thinking Skills	Senior	50	83
I_{11}	Leadership skills	Senior	39	83
I_{12}	Leadership skills	Senior	33	56
I_{13}	Leadership skills	Senior	28	83
I_{14}	Leadership skills	Senior	28	89
I_{15}	Leadership skills	Senior	67	78
I_{16}	Following Management Skills	Senior	72	77
I_{17}	Following Management Skills	Senior	72	89
I_{18}	Following Management Skills	Senior	61	73
I_{19}	Interpersonal Skills	Senior	56	94
I_{20}	Interpersonal Skills	Senior	50	83
I_{21}	Interpersonal Skills	Senior	39	94
I_{22}	Interpersonal Skills	Senior	44	67
I_{23}	Interpersonal Skills	Senior	44	83
I_{24}	Information Technology Skills	Senior	50	100
I_{25}	Information Technology Skills	Senior	61	94
I_{26}	Information Technology Skills	Senior	56	89
I_{27}	Information Technology Skills	Senior	44	83
I_{28}	Information Technology Skills	Senior	50	83
I_{29}	Ethic Skills	Senior	33	100
I_{30}	Ethic Skills	Senior	17	100
I_{31}	Ethic Skills	Senior	33	89
I_{32}	Ethic Skills	Senior	22	94
I_{33}	Ethic Skills	Senior	22	94
I_{34}	Ethic Skills	Senior	28	89
I_{35}	Ethic Skills	Senior	39	89
I_{36}	Ethic Skills	Senior	50	100
I_1	Literacy and Numeracy Skills	Junior	33	97

I_2	Literacy and Numeracy Skills	Junior	43	93
I_3	Literacy and Numeracy Skills	Junior	33	87
I_4	Literacy and Numeracy Skills	Junior	43	90
I_5	Critical Thinking Skills	Junior	50	87
I_6	Critical Thinking Skills	Junior	47	87
I_7	Critical Thinking Skills	Junior	47	93
I_8	Critical Thinking Skills	Junior	40	93
I_9	Critical Thinking Skills	Junior	67	80
I_{10}	Critical Thinking Skills	Junior	40	83
I_{11}	Leadership skills	Junior	50	83
I_{12}	Leadership skills	Junior	53	77
I_{13}	Leadership skills	Junior	57	87
I_{14}	Leadership skills	Junior	47	70
I_{15}	Leadership skills	Junior	57	83
I_{16}	Following Management Skills	Junior	60	83
I_{17}	Following Management Skills	Junior	63	80
I_{18}	Following Management Skills	Junior	80	80
I_{19}	Interpersonal Skills	Junior	67	90
I_{20}	Interpersonal Skills	Junior	47	90
I_{21}	Interpersonal Skills	Junior	53	83
I_{22}	Interpersonal Skills	Junior	50	83
I_{23}	Interpersonal Skills	Junior	73	83
I_{24}	Information Technology Skills	Junior	77	87
I_{25}	Information Technology Skills	Junior	80	77
I_{26}	Information Technology Skills	Junior	73	80
I_{27}	Information Technology Skills	Junior	70	90
I_{28}	Information Technology Skills	Junior	77	80
I_{29}	Ethic Skills	Junior	23	90
I_{30}	Ethic Skills	Junior	40	87
I_{31}	Ethic Skills	Junior	27	83
I_{32}	Ethic Skills	Junior	23	83
I_{33}	Ethic Skills	Junior	47	93
I_{34}	Ethic Skills	Junior	57	83
I_{35}	Ethic Skills	Junior	63	80
I_{36}	Ethic Skills	Junior	47	83
I_1	Literacy and Numeracy Skills	Sophomore	55	91
I_2	Literacy and Numeracy Skills	Sophomore	36	55
I_3	Literacy and Numeracy Skills	Sophomore	45	64
I_4	Literacy and Numeracy Skills	Sophomore	45	64
I_5	Critical Thinking Skills	Sophomore	73	55
I_6	Critical Thinking Skills	Sophomore	73	55
I_7	Critical Thinking Skills	Sophomore	82	91
I_8	Critical Thinking Skills	Sophomore	45	64
I_9	Critical Thinking Skills	Sophomore	64	36
I_{10}	Critical Thinking Skills	Sophomore	73	55

I_{11}	Leadership skills	Sophomore	64	64
I_{12}	Leadership skills	Sophomore	55	55
I_{13}	Leadership skills	Sophomore	45	45
I_{14}	Leadership skills	Sophomore	36	45
I_{15}	Leadership skills	Sophomore	73	55
I_{16}	Following Management Skills	Sophomore	64	64
I_{17}	Following Management Skills	Sophomore	55	55
I_{18}	Following Management Skills	Sophomore	55	55
I_{19}	Interpersonal Skills	Sophomore	36	55
I_{20}	Interpersonal Skills	Sophomore	55	55
I_{21}	Interpersonal Skills	Sophomore	45	45
I_{22}	Interpersonal Skills	Sophomore	55	45
I_{23}	Interpersonal Skills	Sophomore	73	27
I_{24}	Information Technology Skills	Sophomore	82	82
I_{25}	Information Technology Skills	Sophomore	91	73
I_{26}	Information Technology Skills	Sophomore	73	45
I_{27}	Information Technology Skills	Sophomore	64	45
I_{28}	Information Technology Skills	Sophomore	91	64
I_{29}	Ethic Skills	Sophomore	45	82
I_{30}	Ethic Skills	Sophomore	64	73
I_{31}	Ethic Skills	Sophomore	36	82
I_{32}	Ethic Skills	Sophomore	36	73
I_{33}	Ethic Skills	Sophomore	45	82
I_{34}	Ethic Skills	Sophomore	73	73
I_{35}	Ethic Skills	Sophomore	55	91
I_{36}	Ethic Skills	Sophomore	73	73
I_{1}	Literacy and Numeracy Skills	Freshman	60	94
I_{2}	Literacy and Numeracy Skills	Freshman	60	69
I_{3}	Literacy and Numeracy Skills	Freshman	47	69
I_{4}	Literacy and Numeracy Skills	Freshman	60	75
I_{5}	Critical Thinking Skills	Freshman	73	44
I_{6}	Critical Thinking Skills	Freshman	73	50
I_{7}	Critical Thinking Skills	Freshman	80	69
I_{8}	Critical Thinking Skills	Freshman	80	56
I_{9}	Critical Thinking Skills	Freshman	80	38
I_{10}	Critical Thinking Skills	Freshman	80	50
I_{11}	Leadership skills	Freshman	60	44
I_{12}	Leadership skills	Freshman	60	44
I_{13}	Leadership skills	Freshman	80	31
I_{14}	Leadership skills	Freshman	73	50
I_{15}	Leadership skills	Freshman	73	31
I_{16}	Following Management Skills	Freshman	80	50
I_{17}	Following Management Skills	Freshman	80	44
I_{18}	Following Management Skills	Freshman	87	50
I_{19}	Interpersonal Skills	Freshman	47	63

I_{20}	Interpersonal Skills	Freshman	53	44
I_{21}	Interpersonal Skills	Freshman	53	63
I_{22}	Interpersonal Skills	Freshman	60	25
I_{23}	Interpersonal Skills	Freshman	87	63
I_{24}	Information Technology Skills	Freshman	87	81
I_{25}	Information Technology Skills	Freshman	80	69
I_{26}	Information Technology Skills	Freshman	80	31
I_{27}	Information Technology Skills	Freshman	93	38
I_{28}	Information Technology Skills	Freshman	73	38
I_{29}	Ethic Skills	Freshman	40	81
I_{30}	Ethic Skills	Freshman	60	81
I_{31}	Ethic Skills	Freshman	27	81
I_{32}	Ethic Skills	Freshman	27	50
I_{33}	Ethic Skills	Freshman	80	56
I_{34}	Ethic Skills	Freshman	53	75
I_{35}	Ethic Skills	Freshman	47	44
I_{36}	Ethic Skills	Freshman	67	44

Table 2-B Senior employed alumni and faculty members 'responses

Items	Seven Types of Employability Skills	Levels	Skills needed for job performance	Skills require additional training	Skills received or emphasized in college curriculum
			% of agreement SNJ	% of agreement SRT	% of agreement SREC
Q1	Literacy and Numeracy Skills	Senior	83	22	100
Q2	Literacy and Numeracy Skills	Senior	100	22	94
Q3	Literacy and Numeracy Skills	Senior	100	28	100
Q4	Literacy and Numeracy Skills	Senior	94	33	89
Q5	Critical Thinking Skills	Senior	89	33	83
Q6	Critical Thinking Skills	Senior	83	44	94
Q7	Critical Thinking Skills	Senior	94	39	78
Q8	Critical Thinking Skills	Senior	72	33	78
Q9	Critical Thinking Skills	Senior	72	56	67
Q10	Critical Thinking Skills	Senior	72	50	83
Q11	Leadership skills	Senior	94	39	83
Q12	Leadership skills	Senior	78	33	56
Q13	Leadership skills	Senior	50	28	83
Q14	Leadership skills	Senior	89	28	89
Q15	Leadership skills	Senior	78	67	78
Q16	Following Management Skills	Senior	100	72	77
Q17	Following Management Skills	Senior	94	72	89
Q18	Following Management Skills	Senior	100	61	73
Q19	Interpersonal Skills	Senior	100	56	94
Q20	Interpersonal Skills	Senior	83	50	83
Q21	Interpersonal Skills	Senior	94	39	94
Q22	Interpersonal Skills	Senior	50	44	67
Q23	Interpersonal Skills	Senior	100	44	83
Q24	Information Technology Skills	Senior	94	50	100
Q25	Information Technology Skills	Senior	94	61	94
Q26	Information Technology Skills	Senior	89	56	89
Q27	Information Technology Skills	Senior	94	44	83
Q28	Information Technology Skills	Senior	94	50	83
Q29	Ethic Skills	Senior	78	33	100
Q30	Ethic Skills	Senior	89	17	100
Q31	Ethic Skills	Senior	83	33	89
Q32	Ethic Skills	Senior	94	22	94
Q33	Ethic Skills	Senior	100	22	94
Q34	Ethic Skills	Senior	78	28	89
Q35	Ethic Skills	Senior	89	39	89
Q36	Ethic Skills	Senior	94	50	100
Q1	Literacy and Numeracy Skills	Employee	100	7.7	100

Q2	Literacy and Numeracy Skills	Employee	88.5	73.1	76.9
Q3	Literacy and Numeracy Skills	Employee	88.5	26.9	88.5
Q4	Literacy and Numeracy Skills	Employee	100	19.2	88.5
Q5	Critical Thinking Skills	Employee	88.5	57.7	80.8
Q6	Critical Thinking Skills	Employee	92.3	61.5	80.8
Q7	Critical Thinking Skills	Employee	88.5	69.2	88.5
Q8	Critical Thinking Skills	Employee	73.1	57.7	80.8
Q9	Critical Thinking Skills	Employee	84.6	61.5	80.8
Q10	Critical Thinking Skills	Employee	92.3	53.8	84.6
Q11	Leadership skills	Employee	92.3	50	73.1
Q12	Leadership skills	Employee	96.2	61.5	57.7
Q13	Leadership skills	Employee	100	73.1	80.8
Q14	Leadership skills	Employee	92.3	42.3	92.3
Q15	Leadership skills	Employee	96.2	69.2	61.5
Q16	Following Management Skills	Employee	88.5	57.7	80.8
Q17	Following Management Skills	Employee	88.5	69.2	88.5
Q18	Following Management Skills	Employee	100	73.1	61.5
Q19	Interpersonal Skills	Employee	96.2	53.8	88.5
Q20	Interpersonal Skills	Employee	80.8	50	80.8
Q21	Interpersonal Skills	Employee	88.5	42.3	84.6
Q22	Interpersonal Skills	Employee	92.3	38.5	84.6
Q23	Interpersonal Skills	Employee	80.8	50	88.5
Q24	Information Technology Skills	Employee	84.6	73.1	76.9
Q25	Information Technology Skills	Employee	88.5	69.2	80.8
Q26	Information Technology Skills	Employee	88.5	61.5	84.6
Q27	Information Technology Skills	Employee	88.5	65.4	76.9
Q28	Information Technology Skills	Employee	84.6	61.5	80.8
Q29	Ethic Skills	Employee	88.5	42.3	76.9
Q30	Ethic Skills	Employee	80.8	46.2	88.5
Q31	Ethic Skills	Employee	88.5	53.8	76.9
Q32	Ethic Skills	Employee	88.5	46.2	65.4
Q33	Ethic Skills	Employee	84.6	38.5	92.3
Q34	Ethic Skills	Employee	100	42.3	84.6
Q35	Ethic Skills	Employee	92.3	42.3	69.2
Q36	Ethic Skills	Employee	88.5	38.5	69.2
Q1	Literacy and Numeracy Skills	Faculty	100	66.67	66.67
Q2	Literacy and Numeracy Skills	Faculty	77.78	77.78	66.67
Q3	Literacy and Numeracy Skills	Faculty	77.78	55.56	77.78
Q4	Literacy and Numeracy Skills	Faculty	88.89	66.67	88.89
Q5	Critical Thinking Skills	Faculty	100	66.67	55.56
Q6	Critical Thinking Skills	Faculty	100	66.67	66.67
Q7	Critical Thinking Skills	Faculty	100	66.67	66.67
Q8	Critical Thinking Skills	Faculty	77.78	44.44	44.44
Q9	Critical Thinking Skills	Faculty	55.56	22.22	33.33
Q10	Critical Thinking Skills	Faculty	88.89	33.33	33.33

Q11	Leadership skills	Faculty	88.89	55.56	33.33
Q12	Leadership skills	Faculty	66.67	44.44	11.11
Q13	Leadership skills	Faculty	77.78	77.78	33.33
Q14	Leadership skills	Faculty	66.67	55.56	66.67
Q15	Leadership skills	Faculty	88.89	66.67	33.33
Q16	Following Management Skills	Faculty	88.89	66.67	77.78
Q17	Following Management Skills	Faculty	88.89	77.78	66.67
Q18	Following Management Skills	Faculty	88.89	77.78	55.56
Q19	Interpersonal Skills	Faculty	100	44.44	66.67
Q20	Interpersonal Skills	Faculty	55.56	55.56	22.22
Q21	Interpersonal Skills	Faculty	77.78	55.56	55.56
Q22	Interpersonal Skills	Faculty	88.89	55.56	55.56
Q23	Interpersonal Skills	Faculty	77.78	55.56	66.67
Q24	Information Technology Skills	Faculty	100	66.67	66.67
Q25	Information Technology Skills	Faculty	88.89	55.56	77.78
Q26	Information Technology Skills	Faculty	88.89	33.33	77.78
Q27	Information Technology Skills	Faculty	77.78	44.44	66.67
Q28	Information Technology Skills	Faculty	77.78	55.56	77.78
Q29	Ethic Skills	Faculty	77.78	77.78	88.89
Q30	Ethic Skills	Faculty	66.67	55.56	55.56
Q31	Ethic Skills	Faculty	88.89	66.67	66.67
Q32	Ethic Skills	Faculty	88.89	66.67	88.89
Q33	Ethic Skills	Faculty	88.89	66.67	88.89
Q34	Ethic Skills	Faculty	77.78	44.44	55.56
Q35	Ethic Skills	Faculty	77.78	66.67	66.67
Q36	Ethic Skills	Faculty	77.78	77.78	66.67

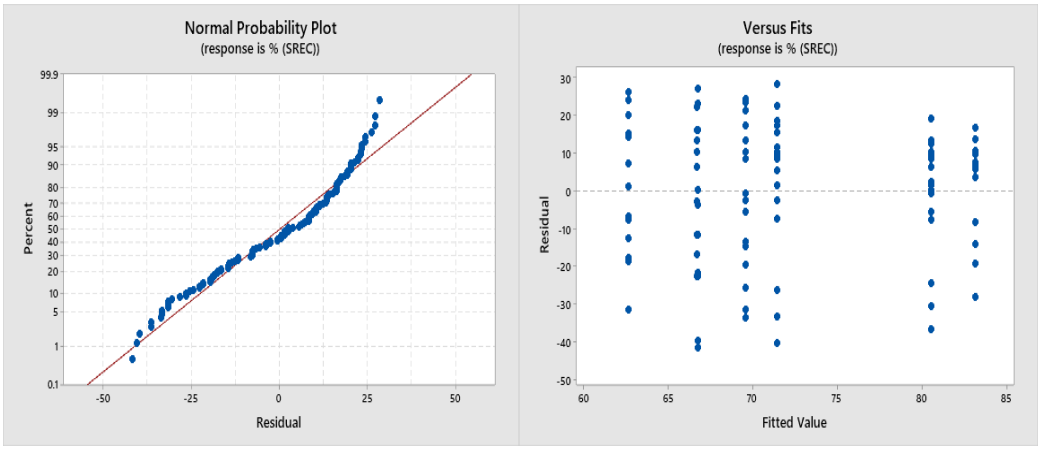


Figure 1-B: Residual Plots for percentge of students' agreement SREC versus seven types of skills

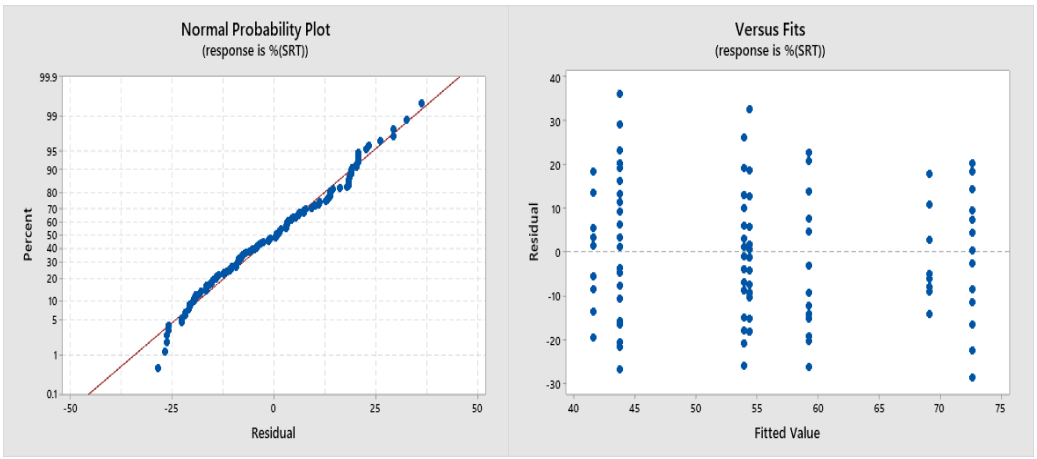


Figure 2-B: Residual Plots for percentge of students' agreement SRT versus seven types of skills

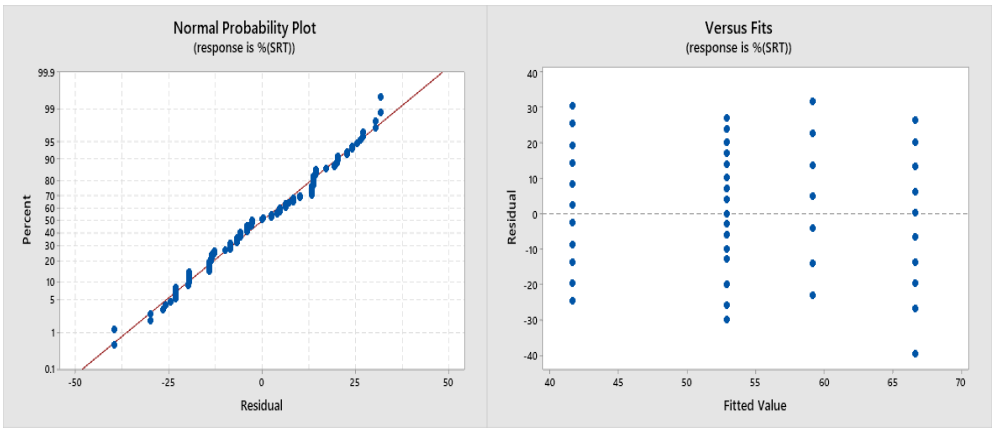


Figure 3-B: Residual Plots for Percentage agreement groups respondents on SRT Versus Participant levels

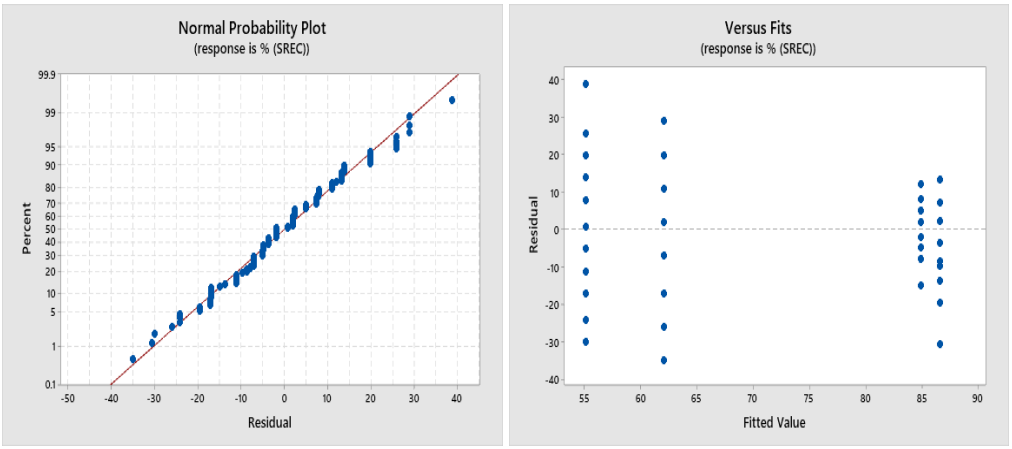


Figure 4-B: Residual plots for percentage agreement groups respondents on SREC versus participant levels

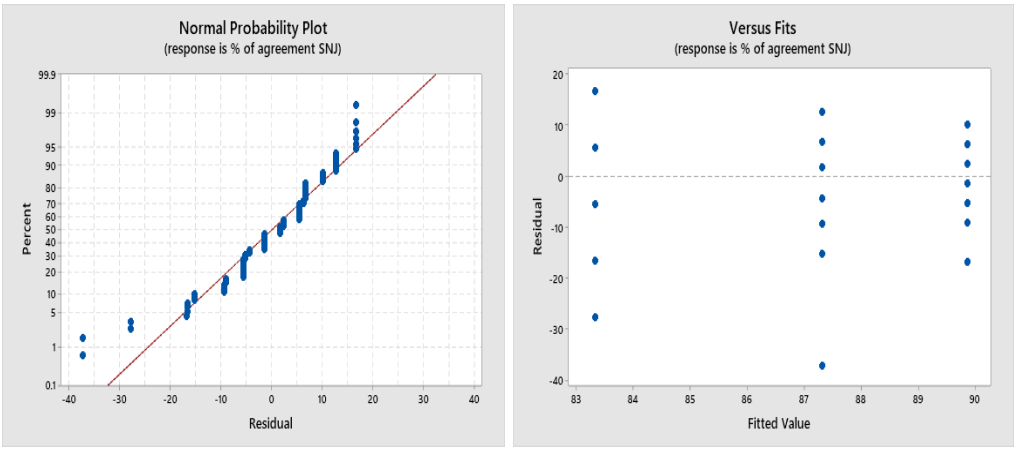


Figure 5-B: Residual Plots for Percentage agreement groups respondents on SNJ Versus Participant levels

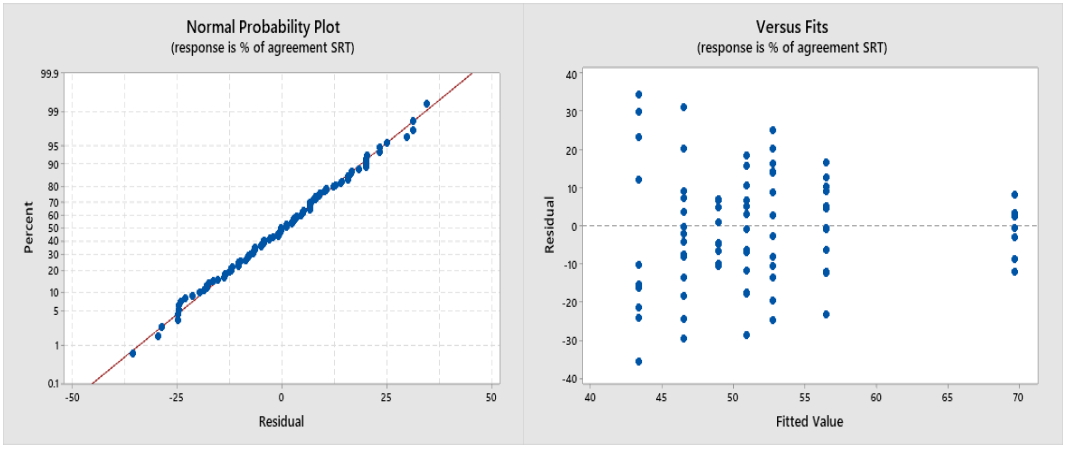


Figure 6-B: Residual Plots for Percentage agreement groups respondents on SRT Versus Seven Types of skills

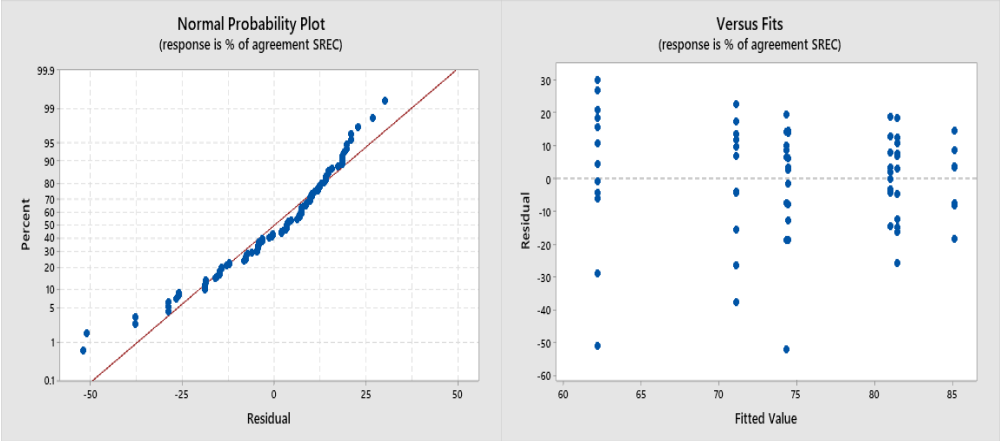


Figure 7-B: Residual Plots for Percentage agreement groups respondents on SREC Versus Seven Types of skills

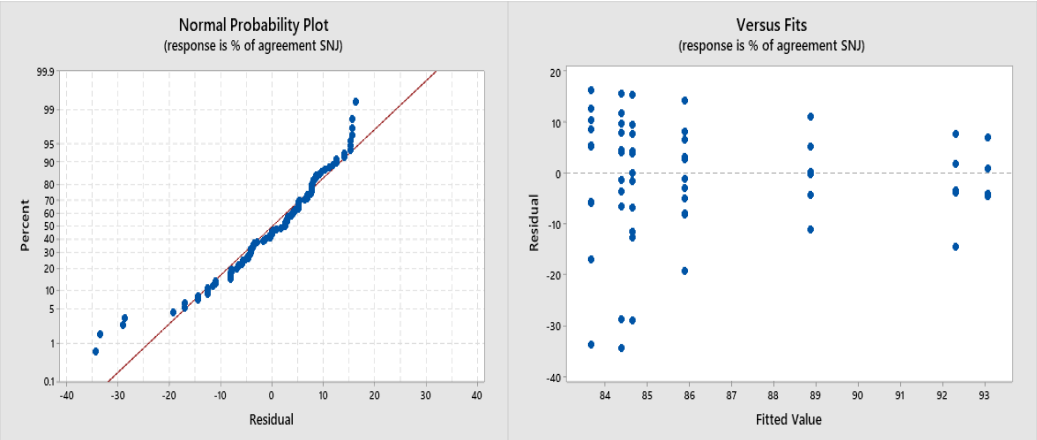


Figure 8-B: Residual Plots for Percentage agreement groups respondents on SNJ Versus Seven Types of skills

Table 3-B: Sample for the Second Batch of Questionnaire to Find Relationship between Skills and Core Courses

	Please, connect the skills which listed below with the courses which you teach them by put (X) in the appropriate cell.																																						
	Course Code		CHEM101	PHYS101	PHYS102	MATH151	MAT 152	MATH163	ENGL191	ENGL 192	CMPE110	MENG104	IENG112	IENG212	IENG263	MATH241	HIST280	TUSL181	MENG231	ECON231	IENG210	ENG 310	ENG 410	MENG244	EENG225	ACCT203	ENGL201	MGMT201	MATH322	IENG301	IENG313	ENG 314	IENG323	IENG385	IENG332	IENG431	IENG372	IENG355	IENG441
Items	description of skill items	Scale: level of importance	General Chemistry	Physics - I	Physics II	Calculus - I	Calculus - II	Discrete Mathematics	Communication in English - I	Communication in English II	Fundamentals of Computing Prog.	Engineering Graphics	Introduction to IE	Modeling and Optimization	Materials and Manufacturing Processes	Linear Algebra & Ordinary Differential Equations	History of Turkish Reforms	History of Turkish Reforms	Engineering Mechanics	Fundamentals of Economics	Industrial Training I	Industrial Training II	Industrial Training III	Fundamentals of Thermodynamics	Fundamentals of Electrical Engineering	Cost Accounting for Managerial Decision Making	Communication Skills	Principles of Management	Probability & Statistical Methods	Fundamentals of Work Study and Ergonomics	Operations Research - I	Operations Research - II	Engineering Economy	Statistical Applications in Engineering	Production Planning - I	Production Planning - I,II	Information Systems and Technology	Ethics in Engineering	Facilities Planning and Design
I_1	Performing basic mathematic computations	1. Little																																					
		2. Medium																																					
		3. Intensive																																					
I_2	Organizing basic ideas and communicating orally to introduce the tasks.	1. Little																																					
		2. Medium																																					
		3. Intensive																																					
I_3	Communicating basic thoughts, ideas, and messages in writing such as create letters, reports, graphs, and flow charts.	1. Little																																					
		2. Medium																																					
		3. Intensive																																					

Appendix C: Data of EAS- Test

Table 1-c: Norms table to determine the percentile for junior engineers

		Numerical Ability	Visual Pursuit	Space Visualization	Numerical Reasoning	Word Fluency	Symbolic Reasoning		
Percentile	**EAS 1**	**EAS 2**	**EAS 3**	**EAS 5**	**EAS 6**	**EAS 8**	**EAS 10**	**Battery**	**Percentile**
99	-	75	28-30	-	17-20	72-75	29-30	95& up	99
98	30	71-74	27	50	16	68-71	26-28	91-94	98
95	28-29	66-70	26	46-49	15	63-67	23-25	85-90	95
90	27	63-65	25	43-45	-	59-62	20-22	80-84	90
85	26	60-62	24	41-42	14	56-58	18-19	77-79	85
80	25	57-59	23	38-40	-	53-55	16-17	73-76	80
70	24	54-56	22	35-37	13	49-52	14-15	69-72	70
60	23	51-53	21	32-34	12	45-48	11-13	64-68	60
50	22	47-50	20	30-31	-	42-44	10	61-63	50
40	21	42-46	19	28-29	11	39-41	9	57-60	40
30	20	37-41	18	27	10	35-38	8	53-56	30
20	19	32-36	-	25-26	9	32-34	7	49-52	20
15	17-18	28-31	17	23-24	8	29-31	6	46-48	15
10	15-16	23-27	16	22	7	25-28	5	42-45	10
5	12-14	16-22	15	19-21	5-6	21-24	3-4	36-41	5
2	9-11	9-15	13-14	17-18	3-4	16-29	2	30-35	2
1	0-8	0-8	0-12	0-16	0-2	0-15	0-1	0-29	1
N	398	354	218	399	392	257	291	-	N
M	21.80	46.10	20	31.9	11.10	43.30	11.60	61.70	M
SD	4.50	15.10	3.20	8.30	3.00	12.30	6.20	15.08	SD

Table C-2: Data of students who participated in EAS. test

Student code	Age	CGPA	R. CGPA	CUM.CH	Year	Gender	EAS-2	EAS-5	EAS-6	EAS-10	Battery	Percentile
A1	23-25	3.6	>=3.5	164	Senior	m	51	29.4	18.75	18	76.95	80
A2	26-28	1.88	<=1.99	147	Senior	f	37.75	28.2	11	13.5	57.48	40
A3	23-25	2.29	2-2.49	145	Senior	f	38.25	12.4	15.5	14	54.83	30
A4	23-25	2.17	2-2.49	145	Senior	f	42.75	26.6	10.75	14.5	59.93	40
A5	23-25	3.38	3-3.49	145	Senior	m	47.25	27.4	14	11.5	62.83	50
A6	23-25	3.57	>=3.5	145	Senior	f	39.75	30.6	8.25	22.5	65.93	60
A7	23-25	2.59	2.5-2.99	145	Senior	f	64.25	24.6	14.5	10	68.93	70
A8	23-25	2.25	2-2.49	145	Senior	m	41	35	9.5	16.5	64	60
A9	23-25	2.25	2-2.49	144	Senior	m	30	36.4	11.75	4.5	49.45	20
A10	<=22	2.69	2.5-2.99	141	Senior	m	43.75	26.6	11.5	16	62.68	50
A11	23-25	2.69	2.5-2.99	140	Senior	m	44	24.6	6.25	17	57.55	40
A12	26-28	2.3	2-2.49	138	Senior	m	43.25	23.25	11	11.5	55.75	30
A13	>=29	2.54	2.5-2.99	135	Senior	m	39	19	14.5	13	56.5	40
A14	23-25	3.88	>=3.5	133	Senior	f	42.25	31.6	17.5	19.5	73.93	80
A15	23-25	2.06	2-2.49	133	Senior	f	36	27.4	9.75	18	59.45	40
A16	23-25	3.26	3-3.49	132	Senior	f	48.5	27.2	13.75	24	75.6	80
A17	23-25	3.85	>=3.5	130	Senior	f	45.75	32.6	13.5	11.5	64.18	60
A18	<=22	3.69	>=3.5	129	Senior	f	47.25	23.25	10.75	16	62	50
A19	<=22	2.7	2.5-2.99	129	Senior	f	36.5	20.6	13.5	15.5	57.55	40
A20	26-28	2.94	2.5-2.99	129	Senior	f	47.25	18.2	10.5	16.5	59.73	40
A21	23-25	3.27	3-3.49	128	Senior	m	49	26	14	16	67.5	60
A22	<=22	3.21	3-3.49	127	Senior	f	33	36.8	12	18	64.9	60
A23	23-25	3.82	>=3.5	120	Senior	m	41.25	24.2	12.75	16	61.48	50
A24	26-28	1.81	<=1.99	119	Senior	f	40.5	15.4	12	7.5	47.45	15
A25	23-25	1.91	<=1.99	113	Senior	m	30.5	15.2	8.25	11.5	42.6	10
A26	<=22	3.07	3-3.49	113	Senior	f	48.75	30.6	8.25	14.5	62.43	50
A27	<=22	3.86	>=3.5	111	Senior	m	39	37.6	13.5	15.5	67.3	60
B1	23-25	3.82	>=3.5	109	Junior	m	46.75	29.4	14	17	69.08	70
B2	23-25	2.53	2.5-2.99	107	Junior	m	32.25	21.4	12	14.5	53.33	30
B3	23-25	2.41	2-2.49	107	Junior	m	39.25	19.4	9.5	16.5	55.33	30
B4	<=22	2.49	2-2.49	103	Junior	f	41	16.8	18	15	61.9	50
B5	23-25	2.31	2-2.49	103	Junior	m	27.25	22.6	9.25	13	47.18	15
B6	23-25	2.5	2.5-2.99	101	Junior	m	37	46.4	12.75	17	71.45	70
B7	23-25	3.42	3-3.49	99	Junior	m	46.5	28.2	12.75	12.5	62.6	50
B8	23-25	3.51	>=3.5	99	Junior	f	39	23	14	17	62	50
B9	<=22	2.32	2-2.49	99	Junior	m	26	38.6	13	10.5	55.8	30

Table C-2: Continued…

Student code	Age	CGPA	R. CGPA	CUM.CH	Year	Gender	EAS-2	EAS-5	EAS-6	EAS-10	Battery	Percentile
B10	23-25	3.33	3-3.49	99	Junior	m	47.5	28.4	12.5	13	63.45	50
B11	<=22	3.45	3-3.49	98	Junior	m	42.25	27.8	16.25	14.5	65.78	60
B12	23-25	2.26	2-2.49	98	Junior	m	27	28.6	10.5	16.5	54.8	30
B13	23-25	1.82	<=1.99	98	Junior	m	30.25	20.6	9.75	9	44.18	10
B14	<=22	3.49	3-3.49	98	Junior	m	41.5	27.8	14.75	13.5	62.9	50
B15	23-25	2.7	2.5-2.99	98	Junior	f	34	15.8	7	16.5	48.4	20
B16	23-25	2.72	2.5-2.99	97	Junior	f	34.25	27	10.75	18.5	59.88	40
B17	<=22	2.82	2.5-2.99	97	Junior	m	32.75	26.4	11	12.5	53.08	30
B18	<=22	3.57	>=3.5	96	Junior	m	35.75	28.8	10.75	22.5	65.53	60
B19	26-28	2.1	2-2.49	95	Junior	m	21.5	39.2	10.75	13.5	54.6	30
B20	23-25	2.41	2-2.49	95	Junior	m	43.5	19.2	12	14.5	57.85	40
B21	<=22	3.63	>=3.5	95	Junior	f	35	18.2	10	19.5	56.1	40
B22	<=22	3.01	3-3.49	92	Junior	f	38.25	26.4	13.25	14.5	60.08	40
B23	23-25	1.87	<=1.99	92	Junior	f	21.5	19.8	10.75	8.5	39.9	5
B24	23-25	2.08	2-2.49	91	Junior	m	34.5	22.2	8.5	10.5	47.35	15
B25	23-25	2.41	2-2.49	89	Junior	m	31	33	9	15	56	30
B26	<=22	3.82	>=3.5	88	Junior	m	41	37.8	10.5	14	63.9	50
B27	23-25	1.8	<=1.99	88	Junior	m	26.75	33.8	15.5	9	54.78	30
B28	<=22	2.83	2.5-2.99	86	Junior	m	39.75	30.4	12	15.5	62.58	50
B29	<=22	2.54	2.5-2.99	85	Junior	m	35.5	14.6	11.5	17.5	54.05	30
B30	23-25	1.81	<=1.99	84	Junior	m	17.5	8.6	7.25	16.5	36.8	5
B31	<=22	3	3-3.49	83	Junior	m	37.25	30.8	9.75	13	56.78	40
B32	<=22	3.61	>=3.5	80	Junior	f	36.25	25.8	14.5	16	61.53	50
B33	26-28	2.01	2-2.49	78	Junior	m	27	33.2	7	9	46.1	15
B34	<=22	2.98	2.5-2.99	78	Junior	m	30.25	26.2	8	15.5	51.73	20
B35	23-25	1.87	<=1.99	77	Junior	m	33.25	13.6	11	16.5	50.93	20
B36	23-25	1.73	<=1.99	76	Junior	f	23.5	24.8	10.75	1.5	36.4	5
B37	23-25	2.05	2-2.49	76	Junior	f	16.25	30	10.75	7.5	41.38	5
C1	23-25	1.97	<=1.99	75	Sophomore	m	20.25	11.4	11.5	3	30.33	2
C2	23-25	1.53	<=1.99	75	Sophomore	m	8.75	7.6	13.25	7.5	28.93	1
C3	23-25	1.94	<=1.99	73	Sophomore	m	36.75	32	12.25	9	55.63	30
C4	<=22	2.25	2-2.49	71	Sophomore	f	23	23.8	9.5	10.5	43.4	10
C5	23-25	1.79	<=1.99	69	Sophomore	m	21.75	5.2	6.75	9	29.23	2
C6	23-25	2.62	2.5-2.99	65	Sophomore	m	27.25	30.2	5.5	14	48.23	15
C7	<=22	1.92	<=1.99	61	Sophomore	m	18	25.6	6.5	12	40.3	5
C8	<=22	1.89	<=1.99	61	Sophomore	m	39.75	12.6	10	9	45.18	10
C9	23-25	3.92	>=3.5	59	Sophomore	m	37.25	26.8	9.5	10.5	52.03	30
C10	<=22	1.65	<=1.99	57	Sophomore	m	16.75	14.6	5.25	6.5	27.43	1
C11	<=22	1.87	<=1.99	56	Sophomore	m	22.5	4.8	5.5	4	23.15	1
C12	<=22	3.16	3-3.49	55	Sophomore	m	33.25	26.8	11.75	12.5	54.28	30
C13	23-25	3.1	3-3.49	55	Sophomore	m	29.25	32	14.5	13.5	58.63	40
C14	<=22	1.45	<=1.99	55	Sophomore	m	34.25	18.4	15.75	7.5	49.58	20

Table C-2: Continued…

Student code	Age	CGPA	R. CGPA	CUM.CH	Year	Gender	EAS-2	EAS-5	EAS-6	EAS-10	Battery	Percentile
C15	<=22	3.47	3-3.49	47	Sophomore	m	33.25	28.6	11	18	59.93	40
C16	<=22	2.34	2-2.49	46	Sophomore	m	28	36.8	13.5	22.5	68.4	40
C17	<=22	1.9	<=1.99	46	Sophomore	m	18	25.2	15	13.5	50.1	20
C18	<=22	0.39	<=1.99	43	Sophomore	m	23.5	23	9.5	12	44.75	10
C19	23-25	2.02	2-2.49	42	Sophomore	m	32.25	22.8	8.5	14.5	50.53	20
C20	<=22	1.35	<=1.99	41	Sophomore	f	23.25	13	5.5	9.5	33.13	2
C21	<=22	2.06	2-2.49	41	Sophomore	m	40	32.8	13.25	12.5	62.15	50
C22	<=22	1.22	<=1.99	41	Sophomore	f	30.5	16.4	11.25	6	40.7	5
C23	23-25	3.17	3-3.49	40	Sophomore	m	35.75	30.6	10.75	12.5	56.43	40
B38	<=22	2.84	2.5-2.99	40	Sophomore	m	25	39.2	10.25	9.5	51.85	20
C24	23-25	1.45	<=1.99	40	Sophomore	m	14.75	26.6	6	6	32.68	2
C25	<=22	1.91	<=1.99	40	Sophomore	m	13.75	10.5	0.5	6.5	19.13	1
C26	<=22	3.53	>=3.5	39	Sophomore	m	28.5	41.6	11.75	14.5	61.3	50
C27	23-25	1.55	<=1.99	39	Sophomore	m	27	38	5.25	15.5	53.25	30
C28	<=22	2.11	2-2.49	39	Freshman	m	38.25	15.6	9	10	45.93	15
C29	23-25	1.84	<=1.99	39	Sophomore	m	31.25	32.4	12.75	4.5	49.08	20
D1	<=22	1.29	<=1.99	37	Freshman	m	23.75	2	10.75	12.5	36.13	5
D2	23-25	2.1	2-2.49	37	Freshman	m	23.25	27.4	10.5	9	44.83	10
D3	<=22	3.09	3-3.49	37	Freshman	f	41.5	28.8	12.75	10	57.9	40
D4	<=22	2.72	2.5-2.99	36	Freshman	m	32.75	31	8.5	10	50.38	20
D5	<=22	2.36	2-2.49	36	Freshman	m	25.75	18.2	5.5	9.5	36.98	5
D6	<=22	1.3	<=1.99	33	Freshman	m	26.75	25	8.5	10.5	44.88	10
D7	<=22	1.18	<=1.99	32	Freshman	f	34.5	19.6	13.75	10	50.8	20
D8	23-25	0	New	22	Freshman	m	25.75	29	11.75	17.5	56.63	30
D9	>=29	0	New	20	Freshman	m	26	8	7.5	10.5	35	2
D10	23-25	0	New	20	Freshman	m	17.25	19.8	9.25	7.5	35.28	5
D11	<=22	0	New	19	Freshman	m	6	9.2	5.75	13.5	26.85	1
D12	26-28	0	New	19	Freshman	m	36.25	19.8	11.75	8	47.78	15

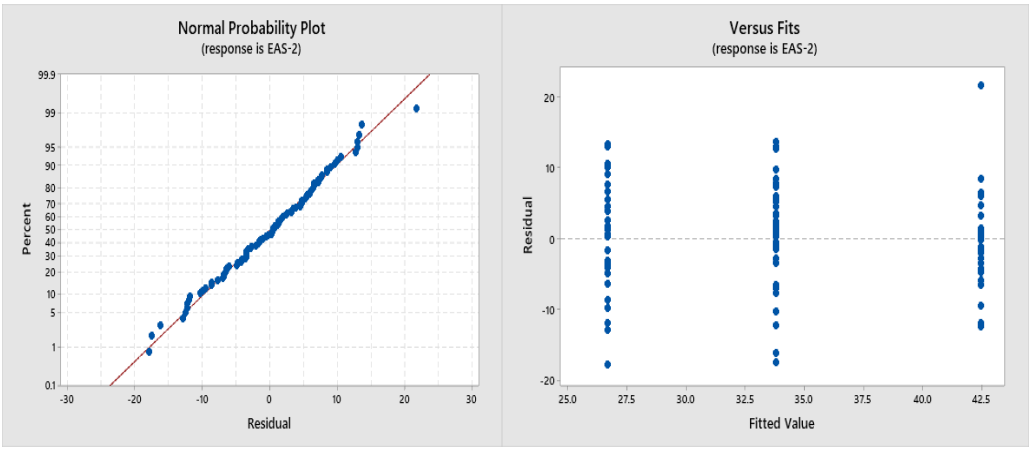


Figure 1-c: Normality assumptions plots for the numerical ability

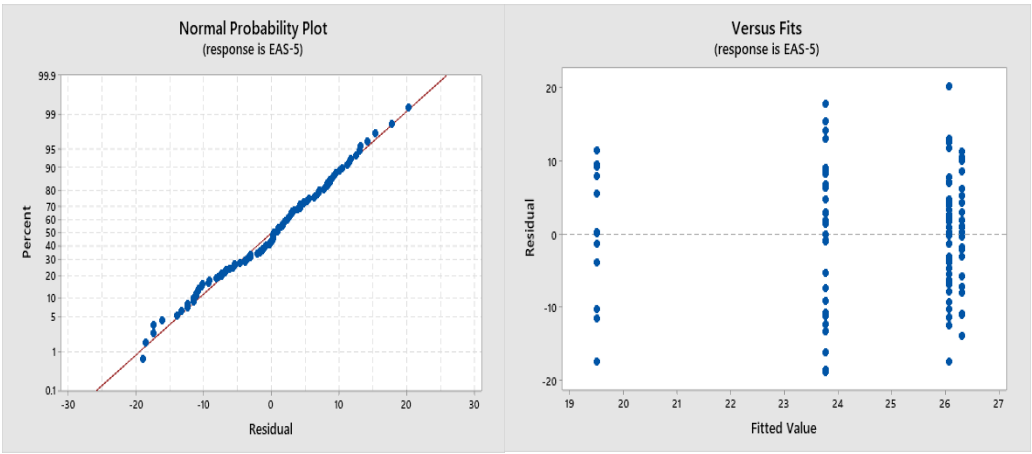


Figure 2-c: Normality assumptions plots for the space visualization

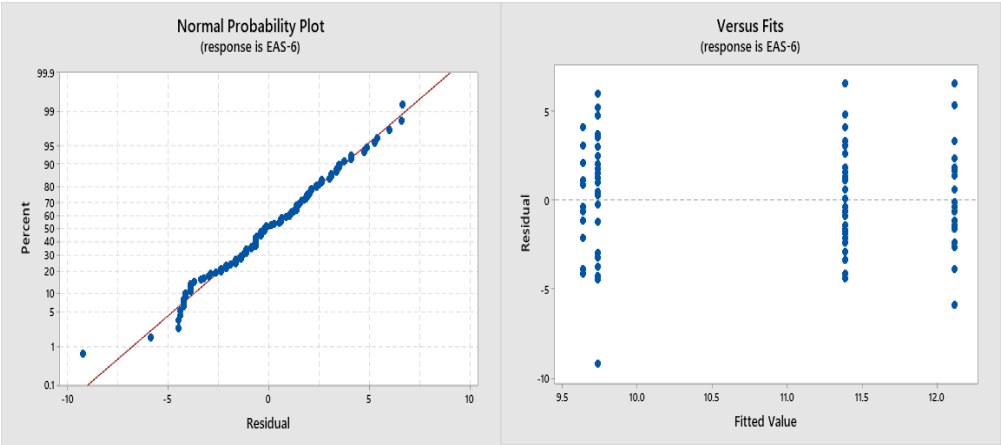


Figure 3-c: Normality assumptions plots for the numerical reasoning

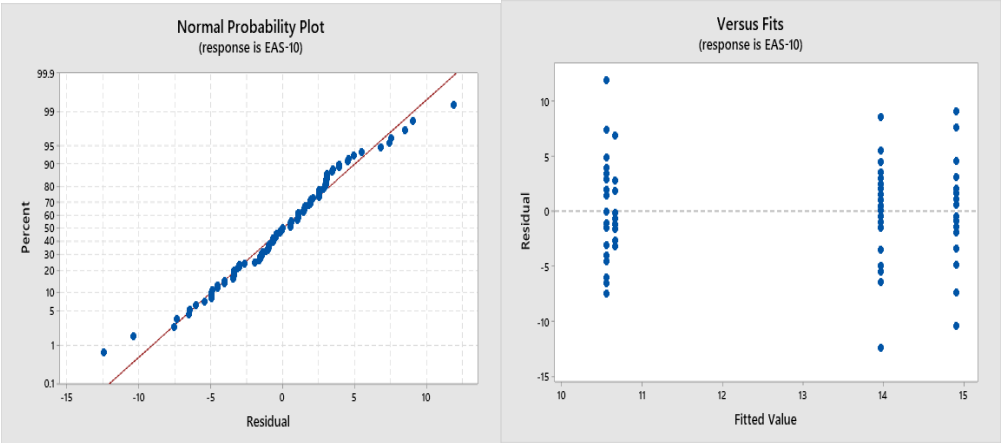


Figure 4-c: Normality assumptions plots for the symbolic reasoning