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RESEARCH ARTICLE

Students' Perceptions of the Skills in the Labor Market in the 4th Industrial Revolution

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ABSTRACT

The Fourth Industrial Revolution will have a crucial impact on the jobs, the types of skills required to cover them, and the role of Higher Education in obtaining these skills. Among the challenges universities are called upon to face is providing students with the necessary employability skills for their future professional careers. This research aims to investigate the perceptions of students at the University of the Aegean and the University of Patras on the employability skills considered necessary in the future labor market. The research was conducted using a questionnaire answered by 392 students from various faculties of the University of the Aegean and the University of Patras. The results show that participants consider hard skills more important (such as Equipment Selection and troubleshooting) than programming and mathematics. They also consider soft skills (such as active listening and critical thinking) to be more important than negotiation, social perceptiveness, and coordination. In terms of their degree and the skills it offers, the majority consider that they have chosen it for a professional career and that it provides them with the necessary skills for the labor market. However, for the next 10–15 years, they do not consider that their degree will be sufficient regarding the skills requirements for their employability.

Keywords: 4IR, employment, skills, university.

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1. Introduction

Tertiary education in the 21st century is a crucial factor in modern societies. Educational institutions operate at a complex time characterized by drastic changes that have taken place with the advent of the 4th Industrial Revolution (4IR). According to Scepanovič (2019), one of the challenges that universities face is how to provide learners with skills and knowledge that will enable them to maintain long-term jobs. At the same time, the industry expects graduates to have an education that aligns with the needs of the labor market. In addition, employability is proving rather difficult as people in the labor market are expected to have skills that can be adapted and have critical and logical thinking.

With the advent of 4IR, it does not mean that the human factor will be set aside. On the contrary, the possibility of strengthening all the skills needed to ensure the smooth integration of people into their workplace should be considered. After all, the concept of the 4IR describes the interconnection of people, objects, and systems through real-time data exchange (Memiş, 2020).

Hill *et al*. (2016) argue that if the necessity of skills is considered, there will be a move towards participatory and self-regulated teaching, learning, and evaluation. These characteristics should exist at all levels and be relevant to all learners in the formal university curriculum (Jones & Pate, 2019). Higher Education institutions have not integrated the development of soft skills in their students effectively and do not prepare them adequately to enter the labor market (Succi & Canovi, 2020). Students' perceptions of the usefulness of their studies and their training in skills acquisition have an impact on their employability and their successful careers. Therefore, the educational program of the universities is a critical factor in building the professional courses of the graduates (Martin *et al*., 2000).

1.1. The Fourth Industrial Revolution and its Impact on the Labor Market

The 4IR is a combination of technologies that shape the connection between physical, electronic, and biological fields. Schwab (2016) pointed out that the advent of the 4IR began in the 21st century because of the progress of the previous three industrial revolutions. However, the 4IR differs from previous industrial revolutions in terms of exponential growth rate and the depth of changes in the world of work. The mobile internet, powerful sensors, artificial intelligence (AI), the automation of production, smart factories, advanced technology systems, the development of new services and products, the Internet of Things (IoT), large data, digital platforms, the 3D printing, the biological technologies, will bring about radical changes at all levels of society and the workplace (Casas i Klett & Howell, 2017). These changes are predicted to eliminate thousands of jobs (Hirschi, 2018). After all, the significant development of artificial intelligence will cause the disappearance of one-third of the current jobs by 2025 (Brougham & Haar, 2017). However, the Cognizant Center (2018) predicts that new jobs will be created in the coming years, increasing the demand for new future skills to satisfy the specific jobs.

The need to strengthen and empower workers with skills for them to respond to the new landscape shaped by the changes in globalization and the advent of the 4IR is very important (Filinis, 2019). This is especially apparent when there is a shortage of skills in the workforce, which has a negative impact on production and employability (Karanikola & Panagiotopoulos, 2018; OECD, 2013). People need to re-examine their current skills and way of thinking to overcome and manage the upcoming changes and develop the required skills that are the main drivers of employability (Boaden, 1997) and future work needs. The conditions for the development and use of innovative skills are steadily increasing due to the rapid development of ICT and its penetration into key areas of business (Bilan *et al*., 2019). Learning a new set of skills is becoming more and more accessible through digital technologies. However, people will also need time and funding to be able to pursue new learning opportunities (Whiting, 2020).

1.2. Employability

The concept of *employability* has been of great interest in the literature for over a century. In one of his studies, Gazier (2001) claimed there are seven versions of employability. The first version became known mainly in the early 1900s with the term "dichotomous employability," which defines the distinction between people who can work and others who cannot work and need rest and help, such as the elderly and people with disabilities. (Small *et al*., 2017). Hillage and Pollard (1998) consider employability as the ability to find employment, maintain employment, and obtain new employment, if necessary. According to Pool and Sewell (2007), employability is a set of skills, knowledge, understanding, and personal characteristics that make a person more likely to choose and secure occupations in which they can be successful. Bridgstock (2009) considers employability as the adequate preparation of workers for the transition to jobs and their preservation, with a range of general and specific discipline skills, but also skills for managing themselves and their careers.

As indicated in the above definitions, the concept of employability has evolved over the years from focusing on the ability to obtain initial employment to focusing on the skills and competencies that enable workers to manage their careers throughout their working life. It is of particular importance to acquire skills in the labor market as an element of recognition and competitiveness. Also, the personality traits of employees are important (Tymon, 2013). However, employability factors either remain largely theoretical or are based on insufficient empirical studies (Wickramasinghe & Perera, 2010). The various conceptual models of employability focused either on the individual's skills or on the outcomes of the employment. Indicatively, Lowden *et al*. (2011) generally define employability as a group of skills, qualities, and characteristics that employers expect from employees. De Vos *et al*. (2011) approach employability in relation to the outcomes of employment by viewing it as the continuous fulfillment, acquisition, or creation of work through the optimal use of skills. Although Hillage and Pollard (1998) also define it in relation to the effects of employment, they define it as the ability to find and maintain work.

In short, there is an inconsistency in the definitions of employability regarding the factors that contribute to people being considered employable than others. Alternatively, Knight and Yorke (2002) argue that cognizance, skills, and beliefs about effectiveness are linked to employability. The employability model of Pool and Sewell (2007) suggests that learning, practice, degree of know-how, general skills, and emotional intelligence are the elements that work together to improve the knowledge of learners for self-effectiveness, self-confidence, and self-esteem, which, in turn, contribute to their perceptions of their employability. Therefore, there isn't a commonly acceptable definition of employability, the approach of which is complex due to the lack of empirical studies that identify or validate the factors of employability (Chhinzer & Russo, 2018).

Fig. 1. Skills and abilities (Source: Manousou, 2017).

1.3. Skills and Abilities

Since the 1990s, there has been a debate between the European Union and the Organization for Economic Reconstruction and Development regarding the terms of competence and skills. In the European Qualifications Framework (European Commission, 2018, p. 18), skills are described as "*cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments)*." In the European Qualifications Framework, the description of competencies refers to responsibility and autonomy (Social Economy Consultant, 2009). Competence is a broader concept than the term *skill* (see Fig. 1) and includes extended capabilities of the individual to be able to use his knowledge and skills in the management of complex situations (Lionarakis, 2005). A combination of knowledge, skills, perceptions, and attitudes combined with the ability to learn how to learn (OECD, 2005).

1.4. Hard and Soft Skills

Skill is defined as the coordination and dexterity needed to perform a task and the ability to be able to use knowledge to complete a task in an efficient and effective manner. Knowledge and skill are interdependent, while skill is related to technical knowledge, that is, what knowledge is put into practice (Orlikowski, 2002). Over the years, the term skill has expanded considerably and has become blurred by the emergence of new categories or sub-categories of skills, such as general, soft, hard, and interpersonal. According to Lloyd and Payne (2009), the more one looks at an activity, the more knowledge, and skills one is likely to discover. Apart from the conceptual ambiguity of the term *skill*, there is potentially a constant emergence of new categories of skills (soft, social, and interactive; Payne, 2000). The emergence and use of the soft skills category meant the separation of skills that were of a cognitive and technical nature and are now referred to as hard technical skills (Moss & Tilly, 2001). Although there is an empirical approach to soft skills based on the analysis of labor requirements (Lloyd & Payne, 2009), the same categories of soft skills may mean different things for the stakeholders (researchers, participants, and policymakers; Touloumakos, 2020). Approaching soft skills through the development of categories based on the actions that need to be performed for tasks and requirements in the workplace brings the acting person to the spotlight, who can interpret them as general qualities that can be acquired and effectively exploited in different environments (Matteson *et al*., 2016; Touloumakos, 2011).

The skills presented on the basis of the achievement index are often referred to as hard skills. According to Muhammad *et al*. (2019), the dominant elements in hard skills are science, technology, and technical skills related to the field of knowledge. All in all, hard skills include technological knowledge and technical skills that are influenced by intelligence and are related to the individual fields of activity in the workplace (Kenayathulla *et al*., 2019). It is the knowledge that can be relatively easily verified (Borrego *et al*., 2019; Wójcik *et al*., 2019), can be identified through technical or practical tests, and can be quantified and acquired through teaching, books, or educational materials. Widoyoko (2009) refers to two categories of hard skills: (a) academic skills, which are related to the ability to search using skills for measuring, interpreting, describing, classifying, analyzing, comparing, differentiating, and drawing conclusions from various concepts, data, and facts related to the subject of research, (b) professional and technical skills that may be presented, recorded and documented.

Soft skills refer to the ability of the individual to relate to other people (interpersonal skills), regulate his behavior (intrapersonal skills), resolve problems, have creativity, cooperation, critical thinking, professionalism, moral integrity, initiative, and facilitate teamwork (extra personal skills) (Borrego *et al*., 2019; Wójcik *et al*., 2019).

Soft skills are more difficult to measure and prove but are valuable and vital to the personal lives and professional careers of employees. Soft skills range from communication to problem-solving and are often related to the way people interact. (Zhang *et al*., 2015). Gray (2016) highlights 10 skills required for future problem-solving, such as critical thinking, originality/creativity, human management, coordination with other individuals, emotional intelligence, crisis and decision-making, service orientation, flexibility in negotiation, and logic. do Rosário Cabrita *et al*. (2020) consider that education in the 4IR (Education 4.0) is related to prosperity in a transformative world by demonstrating creativity, imagination, innovation, and critical thinking. Butler-Adam (2018) argues

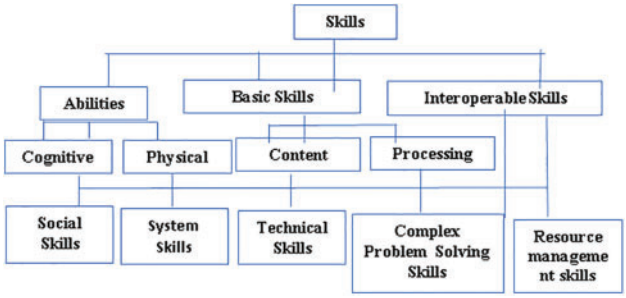

Fig. 2. Basic skills for the 4IR (Source: World Economic Forum, 2016).

that people should have specific skills such as digital literacy and mathematics and an understanding of the operation of the 4IR era in order to be successful as employees or as members of society. Skills that empower people are crucial factors in shaping the 4IR. Battistel *et al*. (2020) state that the prospective employee of 2030 should be able to predict, be communicative, and have digital skills, including marketing and automation of production, in combination with other holistic and interdisciplinary skills. According to Lieu *et al*. (2018), the curriculum in educational institutions plays an important role in the trainees' professional skills. Within the curriculum, courses should be designed in such a way that they clearly communicate the content of the learning to the trainees so that they, in turn, can communicate it later in the workplace (Shaltry, 2020). The World Economic Forum stresses that new training approaches and new training programmes should be used to develop the future workforce to meet the 4IR's requirements (Lieu *et al*., 2018). Graduates should have the basic skills needed to overcome the challenges they may face in the 4IR era (World Economic Forum, 2016). As shown in Fig. 2, abilities are categorized into mental and physical. The basic skills are the combination of content that requires active learning, digital ICT education, reading and writing, active listening, and critical thinking. The interoperable skills are a set of skills that include troubleshooting, resource management, social and technical skills, and system skills. Thus, the curriculum of educational institutions, especially in higher education, should focus on the interdisciplinary approach and the academic and professional development of the trainees. Reshaping the vision for learning, learning soft skills according to the needs of the labor market, and providing interdisciplinary knowledge. Although a significant proportion of employees have a high level of specialization for their work, it falls short of the requirements for the use of soft skills in the workplace (Hou *et al*., 2021).

Hecklau *et al*. (2016) describe the 4IR's potential key skills, starting from the challenges by grouping them into four categories that demonstrate the necessary skills:

1. Economic challenges
   a) Expanding globalization (intercultural skills, language skills, flexibility skills, networking, and process understanding skills),
   b) Increasing the need for innovation (business thinking, creativity, troubleshooting, ability to work in difficult conditions, cutting-edge knowledge, technical skills, research skills, and understanding of the procedures),
   c) Increasing the focus on services (conflict resolution, communication skills, knowledge of achieving a compromise),
   d) Need for collaboration and teamwork (teamwork skills, communication skills, networking skills).
2. Social challenges
   a) Demographic and social changes (ability to transfer knowledge, tolerance to ambiguity, flexibility in time and place of work, leadership skills),
   b) Increased virtual work (flexibility related to time and place of work, technological skills, multimedia skills, and understanding of IT security issues),
   c) Complexity of procedures (technical skills, understanding of procedures, motivation for learning, decision-making capacity, problem-solving capacities, and analytical skills).
3. Technological challenges
   a) Rapid development of technological and data usage (technical skills, analytical capabilities, efficiency in work using data, coding capabilities, understanding of security, and compliance in the IT field),
   b) Teamwork work on platforms (ability to work in groups, virtual communication skills, multimedia skills, understanding of cyber security issues, and cooperation capacity).

4. Environmental challenges
    a) Climate change and scarcity of resources (motivation for environmental protection, creativity, mentality, and development of sustainable solutions),
    b) Political and legal challenges.

The set of skills and competencies or characteristics that constitute employability skills have been the subject of many studies. Martin *et al*. (2008) note that the landscape of employability is complex. The skills required for employability depend on many different factors, such as the type of work, the industrial sector, and the career stage. The necessary skills will tend to change continuously or be replaced by new skills required along with the evolution and development of technologies during the 4IR. Aoun (2017) and Schwab (2016) suggest two key skills that are very important to adapt to an ever-changing workplace: lifelong learning and continuous skills training and upgrading.

1.5. Necessity of Research

Despite the predictions of a rapid and significant change in the future labor market and the skills required, there is relatively little research on students' perceptions and attitudes about the skills they acquire while attending University. The research is mainly limited to exploring the perceptions of Primary or Secondary Education teachers regarding skills. There are few surveys of University students (Anttila *et al*., 2015; Ghee *et al*., 2016; Taylor, 2016; Teng *et al*., 2019; Wesley *et al*., 2017) and even fewer in Greece (Panagiotopoulos *et al*., 2020) and they refer mainly to a category of skills. This research, which explores the perceptions of undergraduate students regarding their skills and future careers in the light of the 4IR and the forthcoming changes in the work sector, aspires to contribute to the understanding of factors that contribute to future employability and to bring benefits to a wide range of stakeholders (students, universities, policymakers).

1.6. Purpose of the Research

The purpose of this investigation is to investigate the perceptions of students of the University of the Aegean and the University of Patras for the skills they deem necessary in the future labor market with the advent of the 4IR.

1.7. Research Questions

1. What are the perceptions of undergraduate students of the University of the Aegean and the University of Patras regarding the hard and soft skills that are considered important for the workforce of the future during the time of the 4IR?
2. What are the ideas of the undergraduate students at the University of Aegean and the University of Patras on the degree and skills acquired for their professional careers based on the requirements of the labor market?
3. Is there a correlation between the perceptions of undergraduate students at the Aegean and Patras University regarding hard and soft skills?
4. Is there a correlation between the perceptions of undergraduate students of the Aegean and Patras regarding the hard and soft skills in the 4IR and the gender and their scientific field?
5. Is there a correlation between the undergraduate students of the University of Aegean and Patras' degrees and the acquisition of skills for their professional careers according to the requirements of the labor market with their gender and scientific field of study?

2. Research Methodology

This investigation took place between February and March 2022 using the quantitative approach method and a questionnaire. For the needs of the research, the Google Forms application was used to create an electronic questionnaire. This application gives the advantage of easy access to recipients, especially during the period of the COVID-19 pandemic, as well as ensuring anonymity and confidentiality to encourage participation in the research (Bryman, 2017). The questionnaire was sent by e-mail to the Secretariats of the University of the Aegean and the University of Patras to promote it via e-mail to the undergraduate students in order for them to complete it. A reference to the purpose of the survey and the use of data solely for research purposes was made in the introductory note when sending the electronic questionnaire.

2.1. Sample

The target population of the survey was the undergraduate students in the faculties of Humanities, Engineering, Mechanical Engineering, Economics, Administration, and Health Sciences of the University of the Aegean and the University of Patras. The sample consists of 392 undergraduate students of the University of the Aegean and Patras using the random sampling method to ensure that the composition of the sample of undergraduate students will be representative in relation to the schools they attend (Babbie, 2015). An effort was made to ensure that the sample size was sufficient to limit the ratio estimation error to a significance level of 95% (Psarou & Zafeiropoulos, 2004).

2.2. Research Tool

The research tool used for this research was based on the Minx research questionnaire (2020), which was based on the skill list of professional information (O*Net) on the basis of the professions for the United States, which is used by the US Bureau of Labor Statistics. The same skills were used in the Humans Wanted report (RBC, 2018) regarding the future of professional skills in the workplace. Certainly, appropriate adjustments were made on the basis of the review of the bibliography and the needs of this study. The questionnaire consists of three sections. The first section contains demographic questions. The second section contains 14 questions about the hard skills and 14 about the soft skills; each one of the questions corresponds to a skill. Participants were asked to respond on a 6-point Likert scale (Strongly disagree, disagree, neither agree nor disagree, agree, strongly agree, I do not know).

The skills that are related to a wide range of jobs were divided into two groups (see Tables I and II):

1. Hard skills: Mathematics, science, material resources management, financial resources management, judgment and decision making, operation analysis, operation and control, programming, troubleshooting, equipment selection, repair, and installation.
2. Soft skills: Active listening, speaking, critical thinking, reading comprehension, monitoring, active learning, complex problem solving, time management, social perceptiveness, coordination, service orientation, negotiation, moral awareness, and cultural agility.

TABLE I: List of Hard Skills

Dimension	Sub-dimension	Hard skill
Basic skills	Mathematics	Using mathematics to solve problems.
	Science	Using scientific rules and methods to solve problems.
Resource management skills	Management of material resources	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.
	Management of financial resources	Determining how money will be spent to get the work done and accounting for these expenditures.
Systems skills	Judgment and decision making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.
Technical skills	Operations analysis	Analyzing needs and product requirements to create a design.
	Operation and control	Controlling operations of equipment or systems.
	Technology design	Generating or adapting equipment and technology to serve user needs.
	Programming	Writing computer programs for various purposes.
	Troubleshooting	Determining causes of operating errors and deciding what to do about it.
	Equipment selection	Determining the kind of tools and equipment needed to do a job.
	Equipment maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.
	Repairing	Repairing machines or systems using the needed tools.
	Installation	Installing equipment, machines, wiring, or programs to meet specifications.

TABLE II: List of Soft Skills

Dimension	Sub-dimension	Soft skill
Basic skills	Active listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
	Speaking	Talking to others to convey information effectively.
	Critical thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems
	Reading comprehension	Understanding written sentences and paragraphs in work related documents.
	Monitoring	Monitoring/assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
	Active learning	Understanding the implications of new information for both current and future problem-solving and decision-making.
Complex problem solving skills	Complex problem solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
Resource management skills	Time management	Managing one's own time and the time of others.
Social skills	Social perceptiveness	Being aware of others' reactions and understanding why they react as they do.
	Coordination	Adjusting actions in relation to others' actions.
	Service orientation	Actively looking for ways to help people.
	Negotiation	Bringing others together and trying to reconcile differences.
Humanics skills	Moral/ethical awareness	Recognizing or engaging with phenomena that questions one's idea of right or wrong, or requires them to justify moral judgements.
	Cultural agility	The ability to build amongst different cultural contexts and norms.

The third section of the questionnaire contains three questions about the degree and labor market of respondents. The answers were on a Likert scale with a range of 1–4 for the first question and 1–3 for the other two questions.

2.3. Credibility and Validity

Regarding the reliability of the present survey, a pilot survey was conducted in order to revise, if needed, the correspondence of some of the questionnaire's sentences. Initially, it was given to 22 students to make comments and remarks on the clarity of the questions and to estimate the time needed for its completion. The feedback helped to make some corrections and improvements for better clarity and understanding of the questions. The internal coherence of the questionnaire is supported by the calculation of Cronbach's Alpha coefficient, which was satisfactory ($0.862 > 0.70$). The nominal validity of the survey was checked based on the matching table of the research tool in the individual dimensions of the skills and the skill groups (hard-soft), the purpose of the research, and the research questions (Bryman, 2017). In terms of ethics, there was an introductory note on the content of the research and its purpose at the beginning of the questionnaire. There was also an explicit assurance that the respondents would voluntarily participate, that confidentiality and anonymity would be ensured, and that the data would be used exclusively for the needs of the investigation.

2.4. Data Analysis

The analysis of the data was done using descriptive and inductive statistics with the application of the IBM SPSS v28 software. The percentages, the frequencies of the mean value, and the standard deviation were calculated and presented in tables and figures. The verification of the regularity of the skills variables was carried out with Kolmogorov-Smirnov and the indicators of curvature and distortion. The results showed that there is a normal distribution of the variables. The Pearson coefficient was used to investigate the correlations between hard and soft skills. To test the correlations of hard and

soft skills and the degree and the labor market with the gender and the scientific field of study of the students, the control of independent T-test samples and the one-factor analysis of variance ANOVA was applied.

3. Results

3.1. Sample Profile

Regarding the demographic characteristics of the 392 participants (see Table III), in terms of gender, the majority (57.1%) are women. Also, 57.7% are related to the positive sciences.

3.2. Hard Skills

Regarding the hard skills that are considered important for the workforce of the future, the analysis of the perceptions of the participating undergraduate students revealed the following (see Table IV):

1. 82.1% to 90.8% agree or strongly agree that the selection of equipment, management of material resources, judgment and decision-making, troubleshooting, operation and control, management of economic resources, science, and operation analysis are very important.
2. 70.9% to 78.1% agree or strongly agree that technology design, equipment maintenance, installation, and repairing skills are significant.
3. 42.9% to 54.6% agree or strongly agree that programming and mathematics are less important.
4. The most important skill is the selection of equipment (90.8%), whereas mathematics is the least important (42.9%).

3.3. Soft Skills

Regarding the soft skills that are considered important for the workforce of the future, the analysis of the perceptions of the participating undergraduate students revealed the following (see Table V):

1. 84.7% to 96.9% agree or strongly agree that active listening, active learning, critical thinking, speaking, reading comprehension, and solving complex problems are very important.
2. 74% to 81.6% agree or strongly agree that monitoring, service orientation, cultural agility, moral awareness, and time management skills are significant.
3. 50.5% to 60.2% agree or strongly agree that negotiation, social perceptiveness, and coordination are less important.
4. The most important skill is active listening (96.9%), whereas coordination is the least important skill (50.5%).

TABLE III: Distribution of the Respondents by Profile Characteristics

Variable	Level	Frequency	Percentage
Gender	Female	224	57.1
	Male	168	42.9
Age	18–19	84	21.4
	20–21	100	25.5
	22–23	84	21.4
	24–25	40	10.3
	26 and above	84	21.4
Scientific field of study	Humanities	148	37.8
	Science and information systems	118	30.1
	Science engineering, Engineering, Administration, and Economics	108	27.6
	Health sciences	18	4.6
Semester of study	Semesters 1–2	70	17.9
	Semesters 3–4	64	16.3
	Semesters 5–6	66	16.8
	Semesters 7–8	108	27.6
	8th	24	21.4

TABLE IV: Descriptive Statistics of the Responses Given for Hard Skills

Hard skills	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I don't know	MV.	SD.
Equipment selection	0%	3.1%	3.6%	60.7%	30.1%	2.6%	4	0.039
	0	12	14	238	118	10		
Management of material resources	0%	2.6%	7.1%	51.5%	36.2	2.6%	4	0.041
	0	10	28	202	142	10		
Judgment and decision making	0%	2%	7.7%	57.1%	30.1%	3.1%	4	0.041
	0	8	30	224	118	12		
Troubleshooting	1%	1.5%	10.2%	54.6%	29.6%	3.1%	4	0.045
	4	6	40	214	116	12		
Operation and control	0.5%	2.6%	9.7%	50%	33.7%	3.6%	4	0.046
	2	10	38	196	132	14		
Management of financial resources	1%	4.6%	8.2%	48.0%	35.7%	2.6%	4	0.048
	4	18	32	188	140	10		
Science	0%	0.5%	15.3%	50.5%	32.7%	1%	4	0.038
	0	2	60	198	128	4		
Operations analysis	0%	3.1%	11.2%	55.6%	26.5%	3.6%	4	0.045
	0	12	44	218	104	14		
Technology design	0%	3.6%	15.8%	51.5%	26.5%	2.6%	4	0.045
	0	14	62	202	104	10		
Equipment maintenance	0.5%	6.1%	14.3%	44.4%	30.1%	4.6%	4	0.054
	2	24	56	174	118	18		
Installation	3.6%	5.6%	11.7%	43.4%	31.1%	4.6%	4	0.059
	14	22	46	170	122	18		
Repairing	4.1%	8.7%	10.7%	41.8%	29.1%	5.6%	4	0.064
	16	34	42	164	114	22		
Programming	4.1%	9.7%	24.5%	38.8%	15.8%	7.1%	4	0.066
	16	38	96	152	62	28		
Mathematics	1.5%	11.7%	40.8%	25%	17.9%	3.1%	4	0.057
	6	46	180	99	40	12		

Note: The ranking of the hard skills was made on the basis of the percentage of the sample agreement in descending order.

3.4. Degree and Labor Market

With regard to the degree and skills, 72.4% of the participants believe that they acquire the necessary skills, 23.4% believe that not at all, or they slightly do, and 4.1% do not know.

For the selection of the degree for the purpose of a professional career, the majority (68.9%) of the participants stated that they chose it in order to pursue a specific career or field of work. It is noteworthy that 21.9% did not choose it for this purpose, while 9.2% were not able to answer.

Regarding the future skills related to the degree, 49.5% state that they acquire the necessary skills to be successful in the workplace for the next 10 to 15 years, 34.7% estimate that they are not given the opportunity to acquire future skills for their job after 10 to 15 years, while 15.8% do not know how to respond (Table VI).

3.5. Relationship Between Hard and Soft Skills

The Pearson coefficient test shows a statistically significant positive correlation between hard skills and soft skills ($r = 0.557$, $p < 0.01$).

3.5.1. Relationship of Hard Skills with Gender and Scientific Field of Study

In order to establish whether there is a statistically significant difference in the perceptions based on gender, information was analyzed using an independent samples t-test. Results of the t-test presented in Table VII, with regard to the descriptors (hard skills in the two categories), showed that men agreed more ($M = 4.17$) than women ($M = 4.04$) that it is important that the workforce have strong labor market skills.

Table VII descriptive Measures for Women's and Men's Hard Skills.

Regarding the relationship between gender and hard skills (Table VIII), there is no equality of dispersions for women and men, as in Levene's Test, $p = 0.021 < 0.05$. Thus, based on the results $t(390) = -2.845$, $p = 0.005 < 0.05$, there is a statistically significant difference, and the null hypothesis is discarded. Therefore, men agreed more than women that it is important for the workforce to have tough skills.

TABLE V: Descriptive Statistics of the Responses Given for Soft Skills

Soft skills	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	I don't know	MV.	SD.
Active listening	0%	0.5%	2.6%	41.3%	55.6%	0%	5	0.029
	0	2	10	162	218	0		
Active learning	0.5%	0.5%	7.7%	58.7%	29.6%	3.1%	4	0.050
	2	2	30	230	116	12		
Critical thinking	0%	0.5%	8.7%	49%	38.8%	3.1%	4	0.036
	0	2	34	192	152	12		
Speaking	0%	0.5%	9.2%	50%	37.2%	3.1%	4	0.036
	0	2	36	196	146	12		
Reading comprehension	0%	0%	11.2%	43.4%	43.9%	1.5%	4	0.035
	0	0	44	170	172	6		
Complex problem solving	0%	0%	12.2%	59.7%	25%	3.1%	4	0.050
	0	0	48	234	98	12		
Monitoring	0%	0.5%	2%	15.3%	45.9%	35.7%	4	0.040
	0	2	8	60	180	140		
Service orientation	0%	0%	15.8%	49.5%	32.1%	2.6%	4	0.034
	0	0	62	194	126	10		
Cultural agility	0.5%	1.5%	11.7%	37.8%	43.9%	4.6%	4	0.043
	2	6	46	148	172	18		
Moral/ethical awareness	2%	1.5%	15.8%	31.6%	45.4%	3.6%	4	0.049
	8	6	62	124	178	14		
Time management	1%	6.6%	17.3%	46.4%	27.6%	1%	4	0.046
	4	26	68	182	108	4		
Negotiation	0%	8.2%	28.1%	36.2%	24%	3.6%	4	0.050
	0	32	110	142	94	14		
Social perceptiveness	0%	7.1%	34.2%	36.7%	15.8%	6.1%	4	0.036
	0	28	134	144	62	24		
Coordination	2%	10.2%	34.2%	39.3%	11.2%	3.1%	4	0.037
	8	40	134	154	44	12		

Note: The ranking of soft skills was made on the basis of the percentage of the sample agreement in descending order.

TABLE VI: Descriptive Statistics for the Responses About Degree and Labor Market

Degree and labor market	Frequency	Percentage
1) Do you personally value your degree and the skills you think you gain from it?		
Not at all	8	2,0
A little	84	21,4
A lot	284	72,4
I don't know	16	4,1
2) Did you choose this degree in order to pursue a particular career or a field of work?		
No	86	21,9
Yes	270	68,9
I don't know	36	9,2
3) Do you believe that you are currently acquiring the necessary skills to be successful in the workforce in the next 10 to 15 years?		
No	136	34,7
Yes	194	49,5
I don't know	62	15,8

TABLE VII: Descriptive Statistics of the Hard Skills in Women and Men

Gender	N	Mean	Std. deviation	Std. error mean
Female	224	4.04	0.554	0.037
Male	168	4.17	0.406	0.031

A one-way ANOVA was conducted to control the difference between the average values of the hard skills between the scientific field categories of the participants. Results presented in Table IX showed $F(3) = 0.461$, $p = 0.710$. Therefore, there is equality through the values of hard skills with the different

TABLE VIII: T-Test Results for the Influence of Gender on Hard Skills

	Levene's test for equality of variances		t	df	Significance	
	F	p			One-sided p	Two-sided p
Equal variances assumed	5.360	0.021	−2.724	390	0.003	0.007
Equal variances not assumed			−2.845	389.798	0.002	0.005

TABLE IX: Analysis of Variation of Hard Skills by Scientific Field of Studies

	Sum of squares	df	Mean square	F	p
Between groups	0.348	3	0.116	0.461	0.710
Within groups	97.507	388	0.251		

scientific fields of study ($p > 0.05$). Thus, the zero assumption that there is no statistically significant difference in the perceptions of hard skills within the scientific field is not rejected.

3.5.2. Correlation of Soft Skills with Gender and Scientific Field of Study

To establish whether there is a difference in the perceptions of the participating students on soft skills based on gender, the data was analyzed using an independent samples t-test. Descriptive statistics presented in Table X showed that women ($M = 4.18$) agreed more than men ($M = 4.12$) that the workforce should have soft skills.

Concerning the relationship of gender with soft skills, there is equality of the dispersions between women and men, as in Levene's Test, $p = 0.364 > 0.05$. Therefore, based on the results in Table XI, $t(390) = 1{,}503$, $p = 0.134 > 0.05$, there is no statistically significant difference, and the null hypothesis is not rejected. Therefore, men and women did not show a statistically significant difference in their perceptions of soft skills.

One-way ANOVA was used to control the difference in the mean values of the soft skills when it comes to the categories of the participants' scientific fields of study. The results presented in Table XII indicated $F(3) = 1.119$, $p = 0.341$, so there is equality by means of soft-skill values with the different scientific fields ($p > 0.05$). Therefore, the null hypothesis that there is no statistically significant difference in the perceptions of soft skills within the scientific field of study is not rejected.

3.5.3. Correlation of Degree and Labor Market with Gender and Scientific Field of Study

To determine whether there is a statistically significant difference in the perceptions of the respondents on the valuation of the diploma and the skills they acquire based on gender, an analysis of the data using an independent samples t-test was carried out. Descriptive statistics presented in Table XIII showed that women ($M = 2.82$) appreciated the degree and skills they acquired more than men ($M = 2.74$).

TABLE X: Descriptive Statistics of the Soft Skills for Scientific Field of Studies in Women and Men

Gender	N	Mean	Std. deviation	Std. error mean
Female	224	4.18	0.405	0.027
Male	168	4.12	0.378	0.029

TABLE XI: T-Test Results for the Influence of Gender on Soft Skills

	Levene's test for equality of variances		t	df	Significance	
	F	p			One-sided p	Two-sided p
Equal variances assumed	0.827	0.364	1.503	390	0.003	0.134
Equal variances not assumed			1.517	371.647	0.002	0.130

TABLE XII: Analysis of Variation of Soft Skills by Scientific Field of Studies

	Sum of squares	df	Mean square	F	p
Between groups	0.522	3	0.174	1.119	0.341
Within groups	60.258	388	0.155		

TABLE XIII: Descriptive Statistics of the Degree and Skills Assessment for Women and Men

Gender	N	Mean	Std. deviation	Std. error mean
Female	224	2.82	0.468	0.031
Male	168	2.74	0.621	0.048

As far as the relationship of gender with the valuation of diplomas and skills (Table XIV) is concerned, for women and men there is no equality of dispersions, as in Levene's Test, $p < 0.001$. Therefore, based on the results $t(390) = 2.643$, $p = 0.146 > 0.05$ there is no statistically significant difference and the null hypothesis is not rejected. Therefore, women and men do not differ statistically significantly in their perceptions of the evaluation of their degree and the skills they acquire from it.

To investigate whether there is a difference between the perceptions of the respondents regarding the selection of their degree and their professional career based on gender, the data was analyzed using an independent samples t-test. The results in Table XV showed that men ($M = 2.02$) chose a specific degree for a specific professional career more than women ($M = 1.86$).

As regards the relationship of gender with the choice of the diploma and professional career (Table XVI), there is equality of dispersions for women and men, as in Levene's Test, the $p = 0.057 > 0.05$. Therefore, based on the results $t(390) = -2.155$, $p = 0.032 < 0.05$, there is a statistically significant difference, and the null hypothesis is discarded. Consequently, men have chosen this degree to a greater degree than women in order to pursue a specific career or field of work.

To test whether there is a statistically significant difference in the perceptions of the participants on the adequacy of the skills they acquire in the workplace for the next 10–15 years, based on gender, the data was analyzed using t-test independent samples. The results in Table XVII showed that women ($M = 1.88$) valued the acquisition of the necessary skills for their success in the labor market after 10–15 years more than men ($M = 1.71$).

As regards the relationship of gender with the competence of the skills for the future labor market (Table XIII), for women and men, there is equality of the dispersions, as in Levene's Test, the $p = 0.066 > 0.05$. Therefore, based on the results $t(390) = 2.438$, $p = 0.015 < 0.05$, there is a statistically significant difference, and the null hypothesis is discarded. Therefore, women value, to a greater extent than men, that they acquire the necessary skills to succeed in the workforce after 10–15 years.

TABLE XIV: T-Test Results for the Influence of Gender on the Assessment of Degree and Skills

	Levene's test for equality of variances		t	df	Significance	
	F	p			One-sided p	Two-sided p
Equal variances assumed	26.723	<0.001	2.694	390	0.004	0.007
Equal variances not assumed			2.643	331.939	0.004	0.009

TABLE XV: Descriptive Statistics of the Degree and Career Selection for Women and Men

Gender	N	Mean	Std. deviation	Std. error mean
Female	224	1.82	0.539	0.036
Male	168	1.94	0.544	0.042

TABLE XVI: T-Test Results for the Influence of Gender on Degree Selection and Career

	Levene's test for equality of variances		t	df	Significance	
	F	p			One-sided p	Two-sided p
Equal variances assumed	3.645	0.057	−2.155	390	0.016	0.032
Equal variances not assumed			−2.152	358.217	0.016	0.032

TABLE XVII: Descriptive Statistics of the Adequacy in the Future Labor Market for Women and Men

Gender	N	Mean	Std. deviation	Std. error mean
Female	224	1.88	0.680	0.045
Male	168	1.71	0.685	0.053

TABLE XVIII: T-Test Results for the Influence of Gender on Adequacy Measures in the Future Labor Market

	Levene's test for equality of variances		t	df	Significance	
	F	p			One-sided p	Two-sided p
Equal variances assumed	3.395	0.066	2.438	0390	0.008	0.015
Equal variances not assumed			2.435	358.415	0.008	0.015

TABLE XIX: Analysis of Variation of Appreciation and Skills by Scientific Field of Studies

	Sum of squares	df	Mean square	F	p
Between groups	1.053	3	0.351	1.206	0.307
Within groups	112.947	388	0.291		

TABLE XX: Analysis of Variation of Degree and Professional Career Choice by Scientific Field of Studies

	Sum of squares	df	Mean square	F	p
Between groups	1.890	3	0.630	2.149	0.094
Within groups	113.732	388	0.293		

TABLE XXI: Skills Adequacy Analysis for the Future Labor Market with the Scientific Field of Study

	Sum of Squares	df	Mean Square	F	p
Between Groups	1.125	3	0.375	0.795	0.497
Within Groups	182.906	388	0.471		

A one-way ANOVA was conducted to control the difference in the mean values for the evaluation of the degree and the acquisition of skills from it between the categories of the scientific field of study of the participants. Results presented in Table XIX indicated $F(3) = 1.206$, $p = 0.304$, so there is equality by means of soft-skill values with the different scientific fields of study ($p > 0.05$). Therefore, we could not reject the null assumption.

A one-way ANOVA was conducted to determine the difference between the mean values of the selection of the specific degree for a professional career between the categories of the participants' scientific fields of study. The results presented in Table XX indicated $F(3) = 1.890$, $p = 0.094$. Therefore, the mean values of soft skills do not differ between scientific fields of study ($p > 0.05$). Consequently, the null hypothesis that there is no statistically significant difference in the perceptions of the selection of this degree for a professional career in the scientific field of study is not rejected.

A one-way ANOVA was used to control the difference between the mean values of the acquisition of skills for the future labor market among the categories of the participants' scientific fields of study. Results presented in Table XXI indicated $F(3) = 0.795$, $p = 0.497$. Therefore, there is equality between the mean values of the acquisition of skills adequacy for the future labor market and the different scientific fields of study ($p > 0.05$). Therefore, the null hypothesis that there is no statistically significant difference in the perceptions of acquiring the necessary skills for their success in the labor market after 10–15 years in the scientific field of study is not rejected.

4. Conclusion

This research has examined undergraduate students' perceptions of the University of the Aegean and the University of Patras on the hard and soft skills deemed necessary in the future labor market in light of the changes and requirements of the 4th Industrial Revolution. Regarding the sample profile, the majority (57.1%) are women, most of whom (68.3%) belong to the age group of 18–23, whereas a smaller part are in the age group of 24 and over. The students that participated came from the faculties of Humanities, Engineering, Mechanical Engineering, Economics, Administration, Informatics, and Information Systems with a proportional representation of 31% (average value), except the faculties of Health Sciences with 4%, 6%. Most students (65.8%) of the sample are in the 5th semester of study or above.

According to undergraduate students, hard skills are important for the labor market. Based on the percentages of their responses, they evaluate as very important (82.1%–90.8%) the skills of Equipment Selection, the Management of Material Resources, Judgement and Decision-making, Troubleshooting, Operation and Control, Management of Financial Resources, Science and Functional Analysis. As

quite important (70.9%–78.1%), they consider the following skills: Technology Design, Equipment Maintenance, Installation, and Repair. They consider the skills of Programming and Mathematics less important (42.9%–54.6%). The findings of a Minx (2020) study of 1,136 students at the University of Dalhousie in Nova Scotia on the skills assessment ranking are quite similar. Also, the results of the Humans Wanted report of the Royal Bank of Canada (RBC, 2018) ranking of skills are relevant, which is based on the Professional Information Skills List (O * Net) based on the professions for the United States and used by the US Bureau of Labor Statistics. However, they differ in the skills related to equipment selection, science, and the management of material resources, for which this investigation has shown that participants consider them very important. At the same time, the Minx survey and the report of the Royal Bank of Canada are presented as less important.

Regarding the perceptions of the interviewed undergraduate students about soft skills as very important (84.7%–96.9%), they consider the skills of active listening, active learning, critical thinking, speaking, reading comprehension, and complex problem-solving. Soft skills (monitoring, service orientation, cultural agility, ethical awareness, and time management) are significant (74%–81.6%). They consider the soft skills (negotiation, social awareness, coordination) less significant (50.5%–60.2%). The findings of the Minx (2020) survey and the skills ranking results of the Humans Wanted report of the Royal Bank of Canada (RBC, 2018) are similar. However, the results of this research regarding the skills (Negotiation, cultural agility, and coordination) are differentiated from the results of the Minx and the Humans Wanted of the Royal Bank of Canada, which are considered more important.

Participants' perceptions of the valuation and classification of the skills generally demonstrate that they agree with the OECD's positions (OECD, 2021). According to the OECD, transversal skills such as solving complex problems, analytical skills, and creativity are key competencies enabling individuals to meet current and future labor market requirements. Furthermore, in its report on skills in the workplace, the World Economic Forum (2020) considers that analytical thinking and innovation, active learning strategies, critical thinking and analysis, troubleshooting, use of technology, monitoring and control, design and programming of technology, are all very important skills.

Regarding the perceptions of the undergraduate students of the University of the Aegean and The University of Patras regarding the degree and the acquisition of skills for their professional career based on the requirements of the labor market, they evaluate positively (72.4%) their degree and the skills they acquire from it. 68,9% of the participants have chosen this degree to pursue a specific career or field of work. However, only 49.5% believe that, based on a degree, they acquire the necessary skills to be successful in the labor market in the next 10 to 15 years. The research findings (Minx, 2020) are similar, according to which students believe that with their degree, they acquire the skills for the labor market and that the choice was made to pursue a specific professional career. On the other hand, findings concerning the degree assessment by the participants in Davidson's (2017) views differ, as he considers that students do not appreciate their degree as much as they should. In addition, the results for the assessments regarding the acquisition of skills in order to be successful in the labor market after 10–15 years differ from those of the Minx research (2020), where 81% of students estimate that they acquire them while in the present research, the rate is 49.5%.

Regarding the correlation between the hard and soft skills of the participants, a statistically significant correlation was recorded between them ($r = 0.557$, $p < 0.001$).

Regarding the correlation between the respondents' perceptions of hard skills and their gender and their science field, it was noted that men agree more (Mean = 4.17) that the workforce ought to have strong labor market skills than women (Mean = 4.04). The views of the respondents on hard skills do not differ statistically significantly based on their scientific field of study. Differentiation of perceptions of tough skills based on gender was also recorded in the Minx (2020) survey, where men consider them more important than women. This finding also aligns with the positions of Wilson *et al*. (2006), who note that a larger proportion of women, compared to men, are employed in jobs using anthropocentric, soft skills.

Regarding the correlation between women's perceptions of soft skills and their scientific field, it was noted that women and men do not differ statistically significantly in their perceptions. The respondents' views on soft skills do not differ statistically significantly based on their scientific field of study.

Concerning the relationship between the perceptions of the undergraduate students of the sample on the degree and the market, based on gender and their science field, it was found that:

a) Women and men do not differ statistically significantly in their perceptions of the value of the license and the skills acquired by it. Also, the respondents' perceptions do not differ based on their scientific field of study.
b) Concerning the choice of a specific degree to pursue a specific career or field of work, men have chosen to a greater extent than women [$t(390) = -2.155$, $p = 0.032 < 0.05$]. The views of the

respondents regarding the choice of their diploma to pursue a professional career or a working sector are not statistically significant based on their scientific field of study.

c) In terms of acquiring the necessary skills for success in the labor market in the next 10 to 15 years, women consider to a greater degree that they acquire them than men [$t(390) = 2.438$, $p = 0.015 < 0.05$]. The participants' scientific field of study does not differentiate their perceptions about the adequacy of the skills they acquire to succeed in the labor market for the next 10–15 years. On the other hand, the survey's findings (Minx, 2020) concerning the valuation of the degree for the skills acquired show that women show a higher degree of appreciation for the value of their diplomas.

5. Limitations of the Research and Suggestions

This research has investigated the perceptions of undergraduate students of the University of the Aegean and the University of Patras on the hard and soft skills they consider relevant and the assessment of their degree in terms of competence and readiness regarding the skills they offer for the future labor market. The findings of the investigation could not be generalized as the research sample is relatively small. It concerns faculties of the University of the Aegean and Patras.

It is proposed that the research be expanded to include students from other universities, University teachers, employers, and institutions from a wide range of private and public sectors. Therefore, a comparative study and evaluation with the findings on the perceptions and attitudes about the skills they consider necessary and important for the labor market could be carried out. Also, skills can be explored by using other research tools, such as interviews and case studies.

This research could help to improve the skills and readiness of students in the demands of the future labor market in light of the 4IR. Higher education professionals and policymakers could define future strategies and policies to improve student readiness and prepare them for future professional skills. At the same time, these findings could help higher education professionals redesign their educational programs and adapt the learning outcomes in order to help students acquire future professional employability skills to respond successfully to the future job market. In such a perspective, there is a need for a systematic investigation into the conceptualization of skills so that there is a coherent and clear understanding of their inclusion in educational programs. However, in addition to bridging the gap in the professional preparation of graduates from Universities, a culture of lifelong learning, practical training, and entrepreneurial attitudes should be fostered.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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