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An analysis of job advertisements for software engineering employability skills and knowledge: Jordan as a case study

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Abstract

Well prepared software engineering (SE) graduates for job markets is a big challenge for employers and industry. This challenge has been raised due to the lack of the required knowledge and skills. For instance, some of the graduates are technically strong but lack of communication and/or English language skills and vice versa. Therefore, software engineering graduate's knowledge and skills have a direct impact on their job opportunity. Thus, universities should provide SE graduates with the required knowledge and skills that actually in demand by employment agencies and software industries. This study investigates the gaps between universities course syllabus and employment agencies through job advertisements analysis in Jordan as a first stage of this research. The collected job advertisements (178 job advertisement) are analyzed based on a search strategy in order to acquire the most important hard and soft skills required by industry. The findings of the study indicated that work experience and English language proficiency are the most occurred skills from both types of skills. In addition, knowledge gap of other hard and soft skills is discovered which might help in providing graduates with the required skills and minimizing the gap between the graduates and employers.

Keywords: Employability, Hard skills, Jordan, Software engineering, Soft skills

1. Introduction

When SE students graduate from their university, they may lack of preparation for future career in the software industry [1]. This lack is due to lack of knowledge, soft and hard skills and SE main concepts that are considered as promising for finding a job opportunity. Fresh graduates frequently face troubles in their first job due to a gap between the skills they gain and industry expectations which might prevent them from obtaining a job. SE graduates always lack of preparation in terms of knowledge and different skills for building up a successful software system. This lack of preparation causes graduates to struggle in their workforce, which creates a gap between the students' knowledge and the expectations of the industry. Today, software engineering (SE) graduates' knowledge and skills are considered as an integral part for employability that requires graduates to have an up-to-date university taught courses on the one hand. The positive relationships between higher education institutions that provide outputs to the requirements of the industry lead to suggestions for the required different types of skills in order to increase the employability on the other hand [2]. However, teaching and training quality for SE students has a direct impact on the quality of workforce that has an important effect on employability. Most of the graduates are not well prepared for their future careers in the software industry due to the shortages in the required knowledge and skills to fit the industry needs and modules curricula that identify the intended learning outcomes (ILOs). However, employment process requires that graduates should have a set of skills and understanding of their program to fit the industry needs and requirements. Therefore, educating SE students to fit industry needs is a crucial challenge that requires a good knowledge of SE importance in the IT world. To identify key knowledge and skills, SE graduates should be in possession upon entering the industry workforce. Several studies investigated the gaps between IT graduates and

industry expectations in terms of the expected soft and hard skills from the graduates. Miller et al., conducted a study for interviewing IT professionals and they asked about the most important competencies for interviewees. Theses competencies were software abstraction, domain knowledge, problem solving and team work experience [3]. McGill et al., investigated the gap in the game development industry and the academic programs through surveying a number of game development professionals and university professors who are teaching game development program. The results of the study indicated that hard skills have bigger impact than academia on such industry [4].

This study aims to investigate: What do firms look for in SE graduates in Jordan? What kind of skills required in the Jordanian students? If those two questions answered, a big challenge will be solved for both graduates and firms. Most of the employers locally and globally require graduates with high level of skills and knowledge to recruit. [5] classifies the software engineering to technical such computer programming and coding and soft skills that Lippman LH, Ryberg R, and Moore KA defined as: “The competencies, behaviors, attitudes, and personal qualities that enable people to effectively navigate their environment, work well with others, perform well, and achieve their goals” [6]. In addition, soft-skills are considered as self-skills that refer to personal character skills such as individual learning, team performance, and client relations. Many researchers argue that most of the graduating students from universities lack of knowledge and soft-skills required for the industry to begin a job. In Jordan, there is an exuberance proof of the high number of graduates unemployed due to the lack of the required skills and knowledge [7-9]. For instance, the number of the graduates for the year 2017/2018 was 56,466 graduates from the Jordanian universities. According to the department of statistics unemployment report in the second quarter of 2019, the unemployed graduates were 19.2 % and 18.7 % in the second quarter of 2018 representing an increase by 0.5% in the second quarter of 2019 [10]. This high percentage of unemployed graduates represents a potential inconsistency between the required knowledge and skills and the industry needs. This study is structured as follows: First, a review of the existing literature on the required hard and soft skills and the methods that been used for job search through advertisements and analysis. Next, study methodology and material are discussed. Then, presenting study results and discussions of the collected and analyzed data. Finally, study limitations and conclusions were presented.

2. Materials and methods

This section explains the investigation approach to collect and gather data for current software engineering job advertisements that targeted by software engineering graduate students in Jordan. To classify the jobs advertisements, we assign job advertisements for 2019. This research conducted a guideline produced by [11] to conduct out the material and methods. Regarding a classifications approach in this research, we conducted [5] research result from their study of "Gap Between the Software Industry and the Software Engineering Education" that classifies the software engineering to technical and soft skills. Regarding data visualisation, tables and graphs are used. Based on [5] we have combined structures to describe gathered data of this work that are valuable to software engineering education.

2.1 Search strategy

We have designed our search strategy procedures based on different steps; first, choosing famous list of keywords from software engineering jobs. Second, classifying the investigation scope. The early conducted jobs by search engines is specified in the outstanding keywords list as shown in Figure 1.

(“Software engineering jobs” or “software engineer” or “software tester” or “Software QA” or “Software development”)” or (“Application Development”) or (“programmers” or “Modelling” or "Developers")

Figure 1 Keywords for job advertisements search.

2.2 Data extraction and synthesis

Based on [5,11], we constructed the data extraction and combination using the classification structure. The subsequent actions that been used to classify the study are: required technical and soft skills. These actions are helped in determining whether or not utilized or related with or concerted on software engineering graduate students.

3. Results and discussion

This section demonstrates the classifications of job advertisements collected from advertisement websites in Jordan as mentioned before. These classifications classify the required skills level in the job advertisements from fresh graduate level to professional level. During 2019, there were (378) job advertisements have been chosen from different job advertisement websites in order to be analyzed. Furthermore, the investigation classification scope of advertisements based on the required technical and soft skills used for the analysis process.

3.1 Advertisement country

The collected data in this study are from online job advertisement websites in Jordan. These job websites include akhtaboot.com, Bayt.com, Indeed.com, injaz.com.jo and other websites.

3.2 Job advertisements profile

A total of 178 job advertisement were considered for the analysis from the information technology industry, specifically, software engineering. After analyzing the chosen job ads, it has been found that, graduate degree is one of the most required requirements for the position to fill. Table 1 shows the qualifications and their manifestation in job ads, respectively.

Table 1 Job entry qualifications for graduates.

Rank	Qualification	Manifestation
1	B.S.	122
2	Diploma	41
3	M.S.\Ph.D.	15

As shown in Table 1, B.S. degree was the dominant degree with 122 occurrences in the analysed job advertisements followed by diploma degree with 41 occurrences and 15 occurrences for the degree of master and Ph.D.; The three degrees are considered as the prerequisite for any job. While, the high demand for the B.S. graduates does not mean that graduates with B.S. are the most desirable. The experience, technical skills, soft skills regardless the qualification could increase the chance of the graduates to get employed.

However, most of the advertisements were not concentrating on the graduates' grade point average (GPA), rather they were concentrating on the skills of the graduates and the university they got their degree from. In Jordan, employers are concentrating on the graduate university and its reputation because some universities do not accept students with low GPA in the second secondary school. Ministry of higher education (MOHE) in Jordan specify the lowest GPA for the second secondary school students to be able to study in the universities. Also, MOHE specify the university and the speciality of second secondary school students depending on their GPA. Thus, employers prefer to employ students with high GPA and a good reputation university; this is because employers expect those graduates got the required skills for the industry [10].

3.3 Technical skills

According to the collected job advertisements, there was a focus on a number of the desired technical skills from the industry side for "software engineer" positions. These skills are shown in Figure 2.

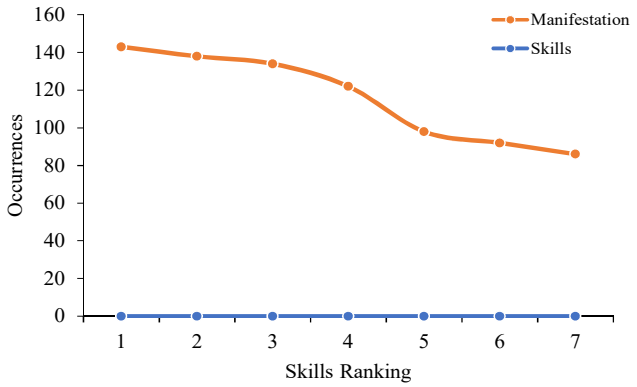

Figure 2 Hard skills required by employers.

Figure 2 shows the most common required hard skills by industry and their occurrences, respectively. Most of job advertisements were asking for the listed technical skills because they are considered as the basics of SE graduates. Therefore, 143 out of 178 of the advertisements were asking for work experience for the position of SE while 35 advertisements did not. The required work experience in the most of the advertisements were ranging from 1-5 years, while other advertisements were looking for fresh graduates. Programming languages occurred in 138 advertisements and most of the employers were asking for at least one or two programming languages such as java/java script, ASP.net, Python, object oriented, and my SQL. Requirement engineering occurred in 134 advertisements, which was the third most required hard skill by employers due to its importance in SE. software testing occurred in 122 advertisements, which was the fourth most required hard skill by employers because it is considered as one of the important skills that the software engineer should have. Software design skill occurred in 98 advertisements, and finally 92 occurrences for system analysis skill and 86 for project management. Also, employers were asking in their advertisements for a specific degree and experience. However, some of the advertisements were asking for fresh graduates with no experience, but with some of the listed hard skills. Table 2 shows 6 aspects of the technical skills required by employers and their manifestations in the analysed ads. These aspects are sorted from the highest manifestation to the lowest in the ads.

Table 2 Hard skills required by employers.

Rank	Skills	Manifestation
1	Programming	138
2	Requirement Engineering	134
3	Software Testing	122
4	Software Design	98
5	System Analysis	92
6	Project Management	86

Table 2 shows 6 aspects of the technical skills required by employers and their manifestations in the analyzed ads. These aspects are sorted from the highest manifestation to the lowest in the ads.

3.4 Soft-Skills

According to the collected job advertisements and the reviewed literature, the study formulates a number of the required soft-skills for the position of "software engineer" in Jordan. These skills are shown in Figure 3.

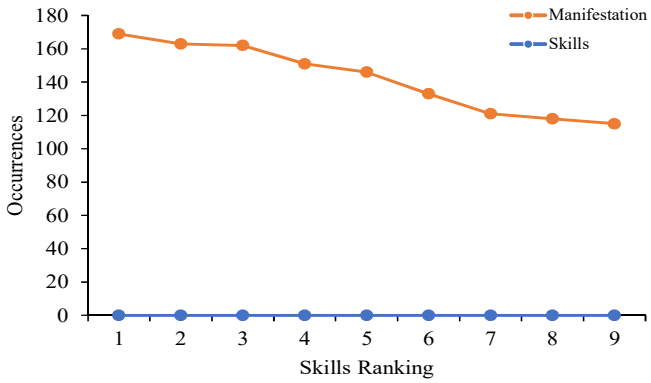

Figure 3 Soft skills required by employers.

Figure 3 shows the most common required soft-skills by industry and their occurrences, respectively. English language proficiency is the most required skill for the industry which occurred in 169 advertisements. Most of job advertisements assert this skill because English language is the standard language for software development. Also, interpersonal skills occurred in 163 advertisements, problem solving occurred in 162 advertisements, creativity occurred in 151 advertisements, self-learning occurred in 146 advertisements, critical thinking occurred in 133 skills, curiosity occurred in 121 advertisements, organisational skills occurred in 118 skills and finally team work occurred in 115 advertisements. However, all the stated soft-skills in table 2 are considered as important requirements in the software industry [12-16]. Therefore, a few studies investigated the

relationship between soft and hard skills and the software industry. [17-19] considered both types of skills related to each other in the software industry because it requires the human factor that is a critical factor for the development process [20]. Software industry should pay attention to the relationship between both kinds of skills due to the development stages of software and the required skills for each stage. English language proficiency, and interpersonal and communication skills are considered as the most important skills of the requirement engineer because he/she interacts with different software stakeholders from different backgrounds to collect the software requirements [21].

Thus, English language, and interpersonal and communication skills are the prerequisite of SE position that contributes to the success the software engineer. Also, software testing was an important skill for the position of SE which requires the software tester to be creative and have the ability of problem solving. In addition, software tester should have a good communication and interpersonal skills to be good team player and avoid conflicts with other team members [14,16,22,23]. Furthermore, Brown et al. (2014) suggests that Jordanian students are lacking for both academic focus and soft skills that are considered important for work. Software design is one of the most complex and important stage of software development that is considered as prerequisite of the development stage and yields the whole architecture of the software and specify its quality attributes. Therefore, software designer needs to have enough experience in a wide range of tasks such as prototyping, test cases and their procedures, and software analysis.

Thus, Software design skill requires work experience, good communication and interpersonal skills, creativity, problem solving, self-learning, organizational skills, curiosity, critical thinking, and good teamwork player [20]. Programming is the process of translating the software design into an executable program without any mistakes [12,20]. This stage of software development requires an open-minded person who can think logically and fix code bugs and errors. The programming skill requires the programmer to be self-learning and creative, good teamwork player, good communication and interpersonal skills, problem solving, curious and should have good organizational skills [23]. System analysis skill involves decomposing the system into a number of modules, specify the essential features of each module, and create the abstract application model for the system [22].

Therefore, system analyst should have interpersonal and communication skills, organizational skills, creativity, problem solving, critical thinking, and team work skills. Finally, Project management skill is important because it requires a comprehensive knowledge for the project requirements, objectives, quality attributes, budget and delivery time. Therefore, the person who should be able to manage software projects should have work experience, strong communication and interpersonal skills, problems solving skills, critical thinking, creativity, organizational skills, curiosity, and team leadership skills [12,13,20]. Table 3 shows 9 aspects of the soft skills required by employers and their manifestations in the analysed ads. These aspects are sorted from the highest manifestation to the lowest in the ads.

Table 3 Soft skills required by employers.

Rank	Skills	Manifestation
1	English language proficiency	169
2	Interpersonal/communication skills	163
3	Problem solving	162
4	Creativity	151
5	Self-learning	146
6	Critical thinking	133
7	Curiosity	121
8	Organizational skills	118
9	Team work	115

Table 3 shows 9 aspects of the soft skills required by employers and their manifestations in the analyzed ads. These aspects are sorted from the highest manifestation to the lowest in the ads.

4. Conclusion

The findings presented in this study show the most important hard and soft skills required in the Jordanian graduate students to get employed. As seen in the results of the collected job advertisements, the hard skill that occurred more than other skills is ‘work experience’. This is because of Jordanian IT companies prefer to get professional workers with a good knowledge rather than getting fresh graduates and train them from the scratch and spend time and money. In addition to the importance of other skills that require experience to minimize the gap between the education system in the universities and the industry.

The authors got benefited from the findings of this study through finding new ways for enhancing graduates with the required skills by the industry in order to minimize the gap between them. This study review helped in

identifying the most important SE topics and the ways that could be used to help graduate students to learn these skills. In addition, knowledge gaps in the most important skills such as software design, testing, analysis and project management are discovered. Thus, these important skills are under consideration which aligned with the way of teaching university courses to reduce the knowledge gap. The findings also show the most important soft skills and their occurrences in the collected advertisements. The most important skill was 'English language proficiency' to the least importance 'Team work'. Most of the presented findings of the soft-skills in this study are considered as important as in other studies which could help other educators and industry managers improve their education system and strengthen the criteria of selecting graduates in the SE industry. Based on the presented findings in this study, the future work aims to identify the best methods used in the peer-review, and keywords list to prioritize soft and hard skills identified in this work. In addition, aligning university courses and industry requirements to reduce the knowledge gap of the most important SE skills could be done by mandating university graduates to get practical training of such kind of skills.

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