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Bond the Gap between Academic and Industry Requirements for Undergraduate Civil Engineering Students in Iraq

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Abstract. In the last twenty years, civil engineering industry has been improved significantly due to the expanded use of technology and innovations in project management. This progress represented as a challenge to universities to provide competence engineers with the right capabilities to be fit in the new job requirements and able to lead this industry to the new era. As this problem considered a global issue, it has a particular situation in Iraq. This resulted from the sharp change in the Iraqi construction industry after recent political change in 2003. This study aims to investigate the current industry expectation from graduated civil engineers and compare it with actual competences that engineers learned from their study in Iraqi universities. This research implements both a qualitative and quantitative approach to collect valuable and reliable data. This has been achieved by sending an online questionnaire to senior engineers working for both public and private organizations. In addition, another set of questions send to students to evaluate their knowledge to identify the gap. This study identified a considerable gap between current civil engineering education and industry expectation, which mainly resulted in project management skills. This gap needs to be addressed in the near future to make sure that Iraqi civil engineers maintain their chances to get hired from foreign companies and be able to lead the Iraqi construction industry to the global market.

Keywords: Civil, engineering, education, industry, knowledge

1. Introduction

Progressively, Iraqi engineers are facing several kinds of challenges including speedy technological innovation, foreign companies with different responsibilities and the needs to compete globally [1-2]. Therefore, industry, Local authorities and even the central government announced to universities lecturers to review their traditional way of teaching and start to prepare civil engineering students by improving not only technical competencies but also include professional capabilities [3-5]. This trend is a global issue, where most of the recent researches try to identify those competencies that may include: communication skills, business skills, teamwork skills, creativity, lifelong learning skills, and problem-solving skills [3].

Despite the importance of this topic, there are few research and case studies which try to highlight this problem [6-8]. To emphasize this current situation, [9] stated that in 2004 almost a quarter of employers in the USA informed that engineering alumni were less capable in problem-solving and fewer responsive



of organizational contexts and restrictions compare to former students ten years earlier. A third of the university lecturers who educated these students correspondingly described that they were not have sufficient capability in math and science and had not as good as technical skills than their indications [10]. In addition, other research also states that numerous engineering students keep on unreliable about what engineering is and what engineers do, even by the time they graduate [11].

Finally, it very important to explain to students what they may expect in their future career otherwise they will feel that they not prepared to be a civil engineer, which may influence some graduates to abandon civil engineering altogether. The lack of research in this particle field can result in a huge gap between academic requirements that every civil engineering student need to meet to graduate and the actual industry skill requirements. To illustrate this problem, in the USA where the education system has improved significantly, National Science Foundation stated that two years after graduation, 28% of all engineering graduates from the classes of 2008 and 2009 were working in fields not related to engineering, including mathematics and computer science. Therefore, this study aims to identify the current gap between academic and industry requirement for civil engineering students in Iraq. This will start by identifying this requirement first and then evaluate final year civil engineering students just before their graduation ceremony.

2. Academic Requirements

According to the Ministry of higher education and research in Iraq, the civil engineering students must study for four years and at least get 50 of 100 to pass each year and graduate. During these four years, different kind of topics will demonstrate starting from basics in the first two years to the most advanced ones in the fourth year. By investigating the available sources on the internet, which include Iraqi Universities websites, it can be concluded that to get civil engineering bachelor in Iraq you must have at least basic knowledge regarding the topics that listed in the Table (1).

Table 1. Fundamental Academic skills and knowledge for civil engineering students in Iraq.

No	Knowledge and Skills	No	Knowledge and Skills
1	Construction material	9	Math
2	Soil mechanics	10	Steel structure
3	Concrete mixture	11	Estimation
4	Structural analysis and design	12	Surveying
5	Foundation design	13	Traffic management
6	Method of construction	14	Project management
7	Fluid mechanics	15	Water and sewage system
8	Irrigation system	16	Hydraulics

3. Industry Skills

The recent significant developments and innovations in the construction industry produce huge pressure on graduate engineers to be qualified for the new job. In other word, companies start to enhance the requirements list for their new civil engineer vacancies with skills and knowledge beyond just academically needs. Therefore, fresh civil engineers are currently facing challenges, these challenges can be summarised in the list below [12-13]:

- 1- They never heard about these requirements in their academic journey, which can produce frustrated feelings.
- 2- There is a lack of professional bodies that can support them to learn such skills and knowledge inside Iraq.
- 3- This situation can create reluctance of engineers for foreign companies that can increase the number of unemployed numbers of engineers.

For the aforementioned reasons, it is very important to find out what these requirements are and how the university as significant knowledge provider can help to solve the problems and reduce the current gap between the industry and academia.

Profound investigation through literature has been implemented to identify the current industry skills and knowledge that a new civil engineer must have to be qualified for new jobs in an international company. Twenty-two areas of knowledge and skills have been recognized, each area have described briefly in Table (2) [14-20]. Most of aforementioned references' data published by The National Bureau of Economic Research.

Table 2. List of new skills and knowledge required by industry for civil engineers.

No	Knowledge and Skills	Description
1	Business knowledge	Awareness of the organization's business needs
2	Communication skills	Ability to express oneself effectively, in written/oral reports and when working with different groups of people
3	Content knowledge	Understanding of technical content, including engineering, science, and math
4	Context knowledge	Awareness of contextual issues affecting engineering solutions, e.g., safety, finances
5	Creativity skills	Ability to develop original ideas or solutions
6	Documentation skills	Ability to take good notes and keep track of records
7	Equipment/processes knowledge	Understanding of equipment and processes needed to do a job
8	Hands-on skills	Ability to make or build an object using tools/processes
9	Information finding skills	Ability to locate resources and information
10	Leadership skills	Ability to provide direction for a team or project
11	Logic skills	Ability to draw conclusions using reasoning
12	Organizational culture/background knowledge	Understanding the organization's culture and background
13	Organizational hierarchy knowledge	Understanding the organization's labor hierarchy
14	Organizational policies/procedures knowledge	Understanding the organization's policies and procedures
15	Problem-solving skills	Ability to define and solve engineering problems
16	Programming skills	Ability to using analysis and design programme
17	Project management skills	Ability to plan, organize, and manage project resources
18	Self-directed learning skills	Ability to acquire new knowledge and skills on one's own
19	Self-motivation skills	Ability to focus one's energy and effort towards doing one's work, without influence from other people
20	Teamwork skills	Ability to function on teams
21	Time management skills	Ability to manage one's time and meet deliverables in a timely manner
22	Work ethic	Willingness to keep working until the task is finished

4. Methodology

Questionnaires are frequently used techniques in collecting survey data, often numerical, which tends to be easy to observe [21]. Structured questionnaires have been used in this research to collect the data, which is basically to evaluate the current nearly graduate civil engineering students against industry professional expectations regarding different academic and industry skills and knowledge. Each student has been asked to evaluate his knowledge in term of six levels. Level 0 means not exist, level 1 basic knowledge, level 3 intermediate knowledge, level 5 advance knowledge. Two additional levels have

been added between 1, 3, and 5 to give the responder more flexibility to evaluate himself. Civil engineering students at the University of Basra considered as the main sample for this research. In addition, these questionnaires sent to a number of professionals in both public and private organizations using Google Survey Tools. These professionals currently in a position to form the requirements for new civil engineering vacancies. SPSS software has been used to evaluate the responses which not fully complete answers will be neglected.

5. Results

As mentioned previously, our sample fundamentally divided into two main parts. Firstly, the professionals which will be asked to express their expectations from new civil engineers in term of the academic and industrial area of knowledge and skills. Secondly, civil engineering students that in their final year and they will graduate in a few days. They will be requested to assess themselves according to the same criteria that sent previously to the professionals. 90% of the responders did answer all the questions. However, the remaining 10% was neglected where it is not practical to involve them in the analysis.

Before starting to examine the results, it is important to identify their workplace type and its implication on the requirements. From Figure (1), it can be seen that 58% of the responders are working for private companies and the rest work for public companies. This will help to examine the company type on their requirements. To illustrate the gap between the industry expectations and academic current knowledge, the resulted discussed in three subsections as follows:

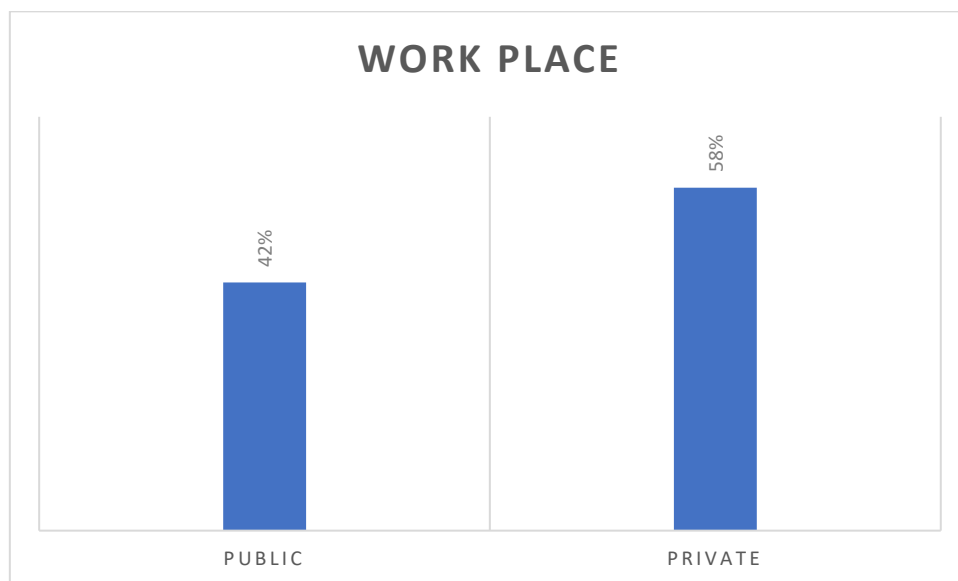


Figure 1. Professional's workplace type.

5.1. Industry knowledge

Before discussing the results, it will be important to identify the differences between skills and knowledge. Knowledge states the level of learning and understanding concepts, principles and information regarding a particular subject(s) by a person through different sources books, media, encyclopedias, academic institutions, and other sources. Skill represents the ability to use that information and applying it in a context. Therefore, a different area of knowledge required by the industry will be discussed first.

Figure (2) represents that generally new civil engineers are falling behind in term of required industry knowledge. This phenomenon can be easy identified in context, content, and business knowledge. The situation is less critical with organizational hierarchy and culture where civil engineers have quite a

good level of knowledge regarding these areas. Industry professional with more 60% state that equipment and process knowledge are important and civil engineers must have at least level 2 of proficiency or more, the current level of this area shows that 50% of the students have no idea about this area or just basic concepts. Only work ethics knowledge area shows a quite good balance between industry requirement and current civil engineers level.

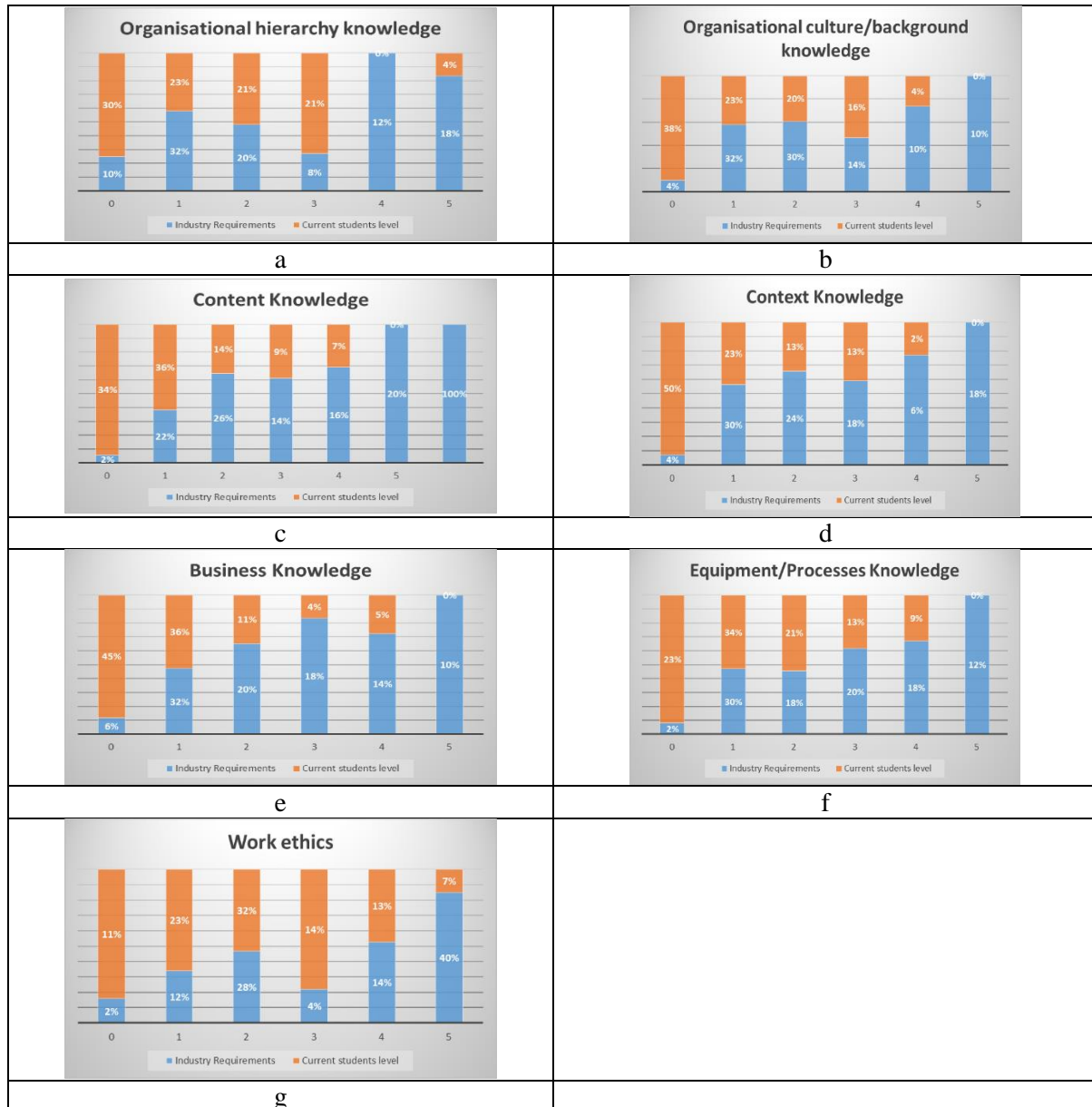


Figure 2. The comparison between student level and required level by professional regarding different areas of knowledge.

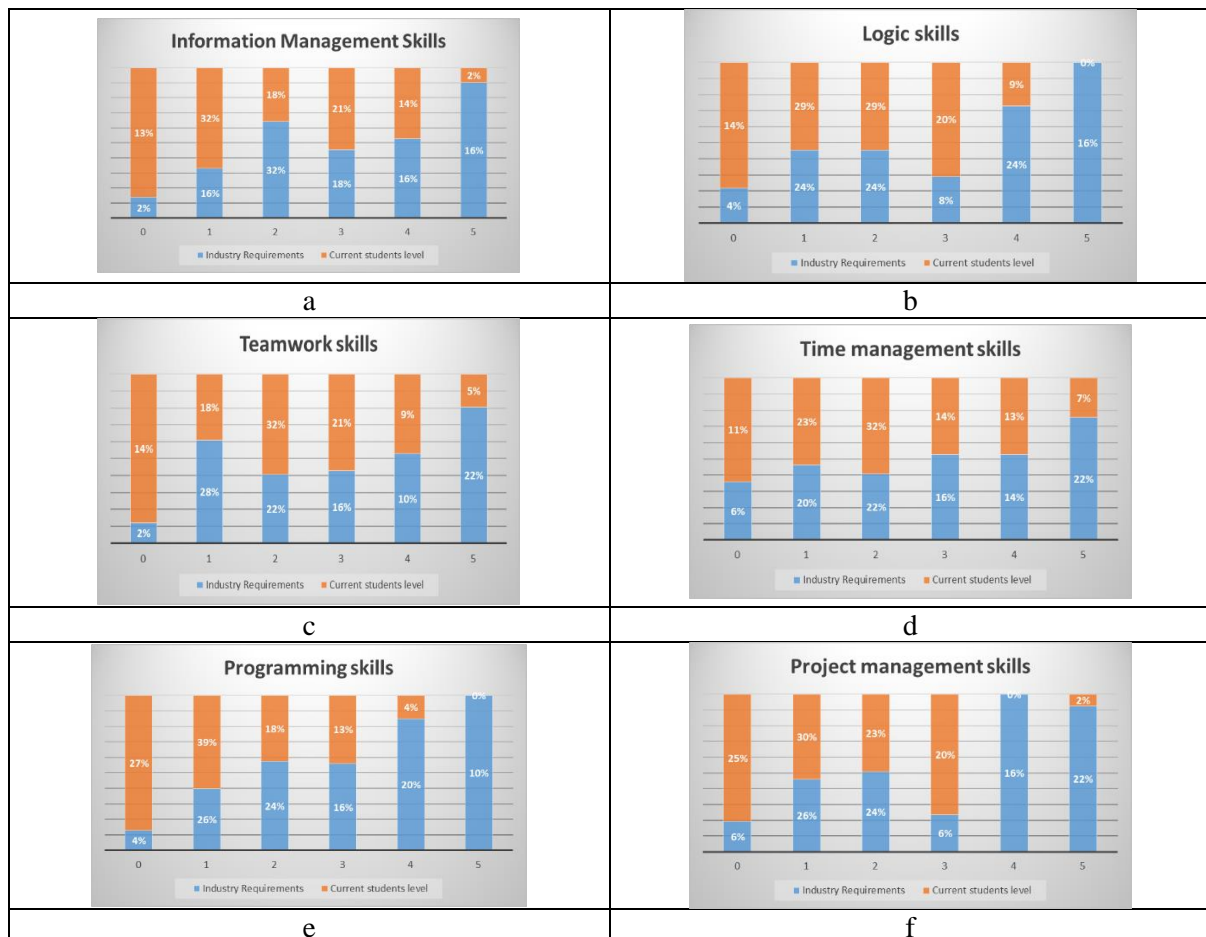
5.2. Industry skills

As stated before, skills mean the ability to use knowledge. From Figure (3), it can be concluded that commonly student level is also less than the industry expectation, which requires improve the current curriculums to overcome these gaps.

It can be seen that the current situation of time management, teamwork, documentation, and self-motivation skills, current civil engineering students are meeting the industry opportunities. The main

reason beyond that is the way of engineering currently studying that required from them to manage their time and work with groups to perform some task such as lab experiments.

The situation of the other skills different where the student currently is not good enough to perform industry necessities such as Information management, logic, project management, and self-directed learning, hand on, communication, and creativity skills. Despite project management is currently part of academic study, the students' level of understanding still not mature enough which require to improve the practical implication of PM knowledge and implemented as apart of study. The way of teaching and evaluating students currently in Iraqi universities prevent skills to be developed such as logic, creativity, and self-directed learning by not giving students any chance to create new ideas or change the way of giving the information. In addition, even with students have been taught programming and information management skills practically in the academic period however they still beyond industry potentials. The main reason for this gap may occur because of unqualified lecturers that are teaching these skills are not a specialist in programming or them just civil engineers, which prevent any advance development in these skills. Communication and hands-on skills are facing the same situation, which really they need to be addressed, or at least introduced to students through their academic study.



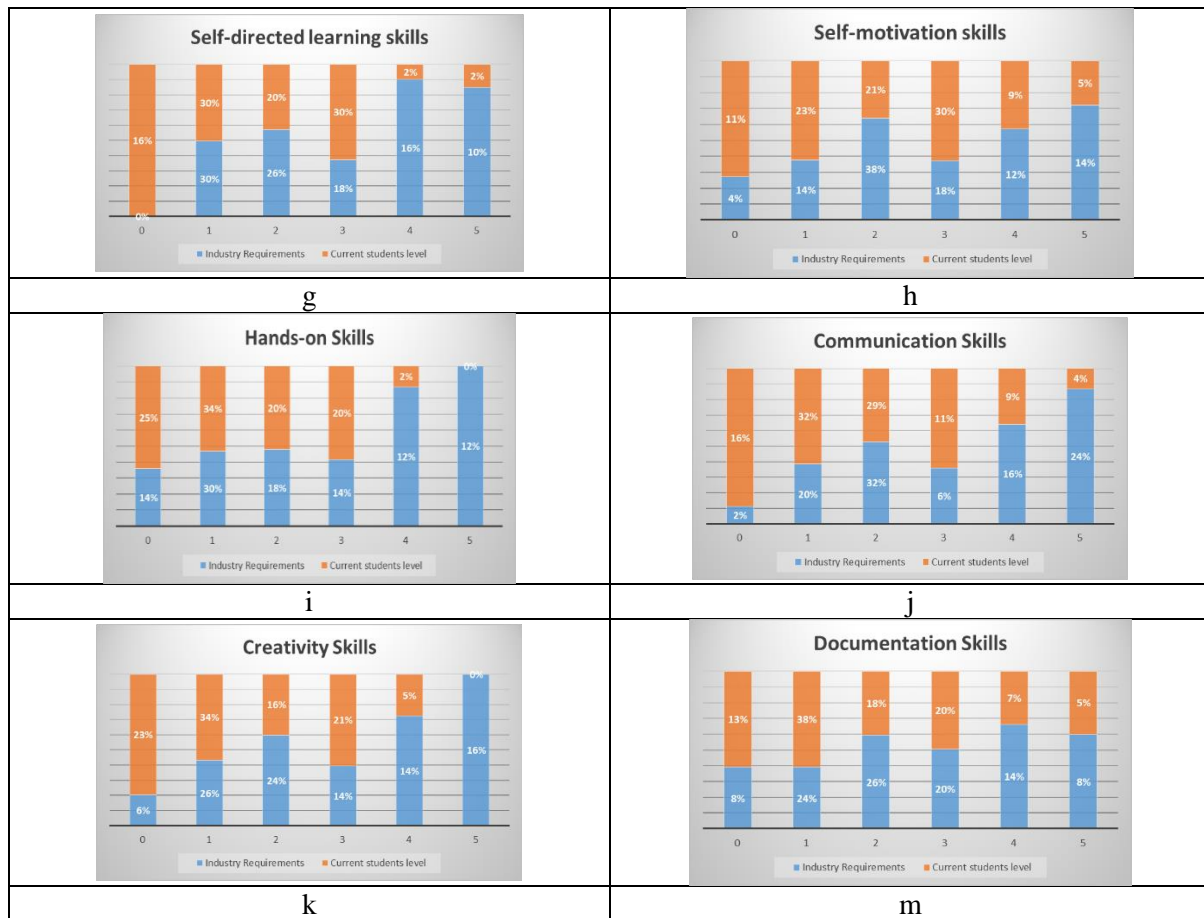


Figure 3. The comparison between student level and required level by professional regarding different areas of skills.

5.3. Academic Knowledge skills

The situation is completely different in academic knowledge and skills, where student level of understating is much more advanced that is really required by industry. This means that there are huge efforts put in place to improve student knowledge in a certain area where they may need it or will never use it in their career life.

For example, it can be seen from Figures 4 and 5 that students are at present more advance in hydraulics, math, soil, and traffic management while the industry state that medium level of knowledge will be sufficient. This means that the time and effort have been used for these areas can be used to improve other gaps identified in industry sections.

The other area has quite a stability between academic and industry, which can be considered as an achievement for Iraqi universities. This may result from lecturers' expertise in the construction industry field as consultants, which qualify them to amend their study material to match the industry anticipations.

The only areas of academic knowledge that show different manner are concrete and construction material. Where the student is facing a lack of advance understanding. The main reason is the huge development in construction material and the ways to improve concrete properties by additives. These improvements accelerate much faster than the enhancements in the curriculums, which produce a growing gap that can only be addressed by keeping such topic alive and can be improved regularly.

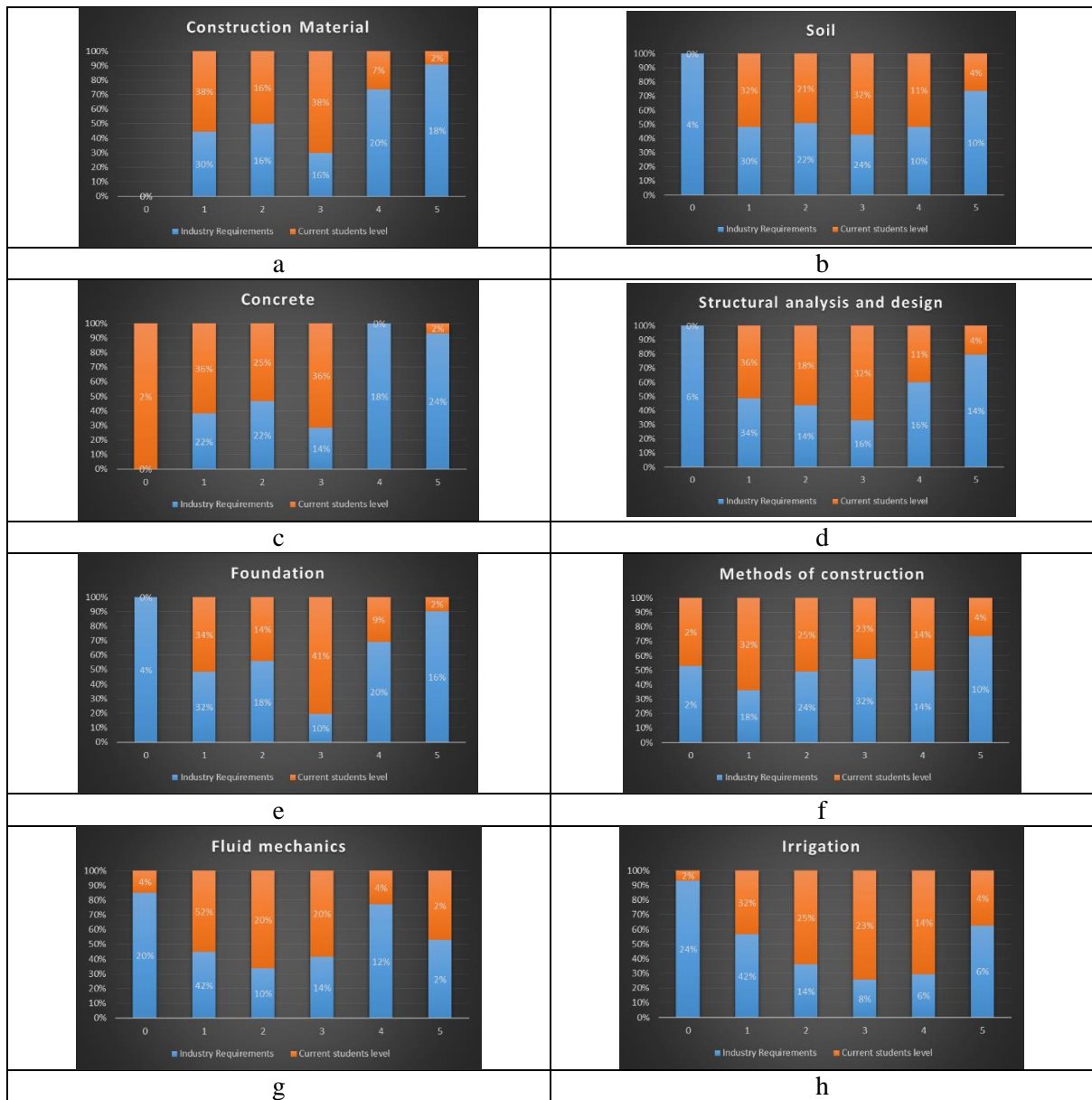


Figure (4): The comparison between student level and required level by professional regarding different areas of academic knowledge.

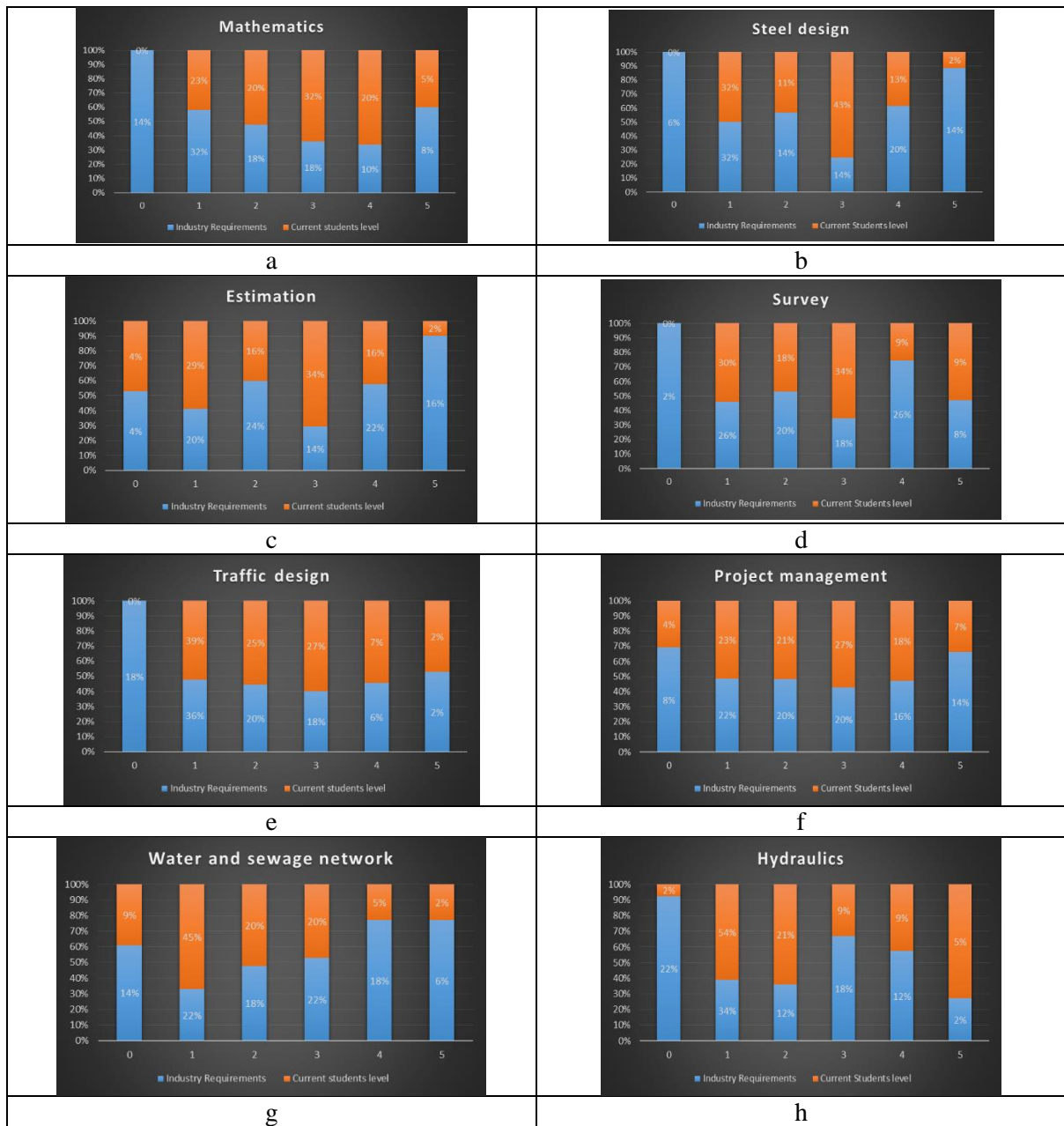


Figure 5. The comparison between student level and required level by professional regarding different areas of academic knowledge.

6. Conclusion

To conclude, it can be seen that there are huge efforts have been deployed to improve student knowledge in certain academic areas where they may not need it in their industry career as professional stated in their answers. This will lead that the universities and the ministry of Higher Education need to put in place such a framework to evaluate current engineering curriculums and make sure that they will help fresh engineering to secure their place in the highly competitive industry.

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