Passion, cooperation and JavaScript: This is what the industry is looking for in a recently graduated computer programmer

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Abstract

For institutions offering a degree in information technology (IT), knowledge about what the IT industry needs from their employees is valuable. In this study we talk to people interested in hiring computer programming graduates. Through semi-structured interviews with representatives from 10 companies we investigate what the companies are looking for in a recently graduated computer programmer.

Our findings suggest that an inner drive and interest in the computer programming field is the most important quality. If a person has a genuine interest in the field, the person will most likely learn what is needed to excel at their job. Further, the candidate should be a good match for the team, as well as the company culture.

Most interviewees do not focus on which exact languages or technologies the candidates know. If a candidate fit the other criteria they are assumed to be able to learn the required technologies quickly. However when asking directly, we find a clear trend: All companies want JavaScript competence.

This insight can guide educators in multiple ways. First of all we can always improve focus on team work and cooperation. Further, we may be able to to nurture the intrinsic motivation of our students. Lastly, the JavaScript ecosystem is ripe for a more prominent place on our curricula.

1 Introduction

Finding the right person for a job is a critical process for a growing business. One of our informants in a small start-up put it this way:

> *Company F:* In Norway, hiring the wrong person is one of the worst mistakes you can make. [...] It can ruin a company.

While businesses want to hire the right people, educational institutions want to provide those candidates. To aid in that task, we investigated which qualities are important for businesses when hiring graduates for computer programming (hereafter, *programming*). To illuminate this broad question, we spoke to the people who actually hire programmers in a series of semi-structured interviews. When describing the profession we are interested in, we decided to use the word *programming*, rather than *development, information technology (IT)* or *computer science (CS)*. While this description is not concise, it is mostly understood in the same way. The other mentioned terms are quite broad, which could lead to confusing answers.

The primary intention of this work is guiding development and maintenance of programmes educating programming professionals. While education should be based on updated research, a clear understanding of what the graduates need to succeed in their careers improves the relevance and quality of the studies. We do however not limit our results to qualities and competences that can be improved by higher education. To make such a distinction would require deciding exactly what institutions of higher education can and cannot teach its students. This is outside the scope of the work. Thus we have included both concrete technical competences as well as desired personal characteristics. Further, the results of this study might benefit others who help young people find their way in the IT industry as well as the students themselves.

2 Background

The IT industry changes fast, and so does what it wants from its employees. Thus, previous work on the topic might be quickly outdated in its specifics, even though some general themes might be valid for a longer period. In this section we look at previous work on the topic of this paper, focusing on recent work.

A review of research between 1995 and 2013 [8] focuses on *skill gaps*, defined as 'Any skill, ability, or knowledge of concept which a recently graduated student lacks based on the expectations of industry or academia.' Interestingly, they find that the most common identified gap is communication skill, both written and oral. Further, they identify project management and *software tools* that is, using industry relevant tools, as often identified gaps. The only purely technical skill among the top five gaps is software testing.

The review was followed up by an empirical study [9] similar to ours. The authors interviewed managers and hiring personnel from different software companies in the United States and Europe. As opposed to asking what these companies look for in a candidate, they asked for areas where graduates struggled when they started working. The research suggested that graduates struggle with using configuration management systems, communication skills and writing unit tests. The empirical study therefore seems to strengthen the results of earlier research described in the literature review performed the year before.

The same study also investigated employability. Which specific missing qualifications could prevent a candidate from being hired? Lack of project experience and problem solving abilities were the most cited issues preventing the candidate from landing that important first job.

McGrath [5] provides a thorough description of the term *employability*. He refers to different definitions of the term where the most comprehensive model

for employability is found to be in McQuaid et al. [6]. McQuaid et al. uses three main categories in their employability framework: *Individual factors*, *personal circumstances* and *external factors*. To us, *individual factors* is the most relevant category. Within this category, McQuaid et al. use the subcategories *employability skills and attributes*, *demographic characteristics*, *health and well-being*, *job seeking* and *adaptability and mobility*.

More recently, a study in New Zealand [11] looked at *soft skills* and how this concept compares to technical skills. Using a focus group and interviews they find that, for many employers, technical skills, while important, do not need to be excellent, only *sufficient*. As long as graduates are at this level, further distinction should be based on *soft skills*. Employers expect to train technical skill on the job, but there is a widespread belief that soft skills are inherent and not teachable. Again, the authors highlight communication skills as critical. Thus, while these results are interesting, the questions asked are somewhat biased, and seem to anticipate the conclusion. In our study we will attempt to avoid such biases.

In the Chicago area, researchers used semi-structured interviews to investigate a similar question [10]. They ask open-ended questions, but introduce themes to the respondents. Again communication is highlighted as the most important missing skill. Respondents noted that many IT professionals regularly interact with customers, thus such skills are critical.

3 Method

Our research question is fairly broad, and we did not expect clear-cut answers. Consequently, we decided to follow a qualitative approach. Because we wanted first hand accounts from people in the industry and did not have a clear idea of what we would find, we chose to do a survey based on semi-structured interviews [7, Chapter 13].

Recruiting participants

To find participants, we attended a career fair at *Westerdals — Oslo ACT* on the 17th of January 2017 and asked the participants if they were interested in hiring programmers and talk to us about it. Among those who were interested in this proposal, we scheduled interviews with 10 different companies during the rest of January and February 2017.

Conducting the interviews

When we arranged the interviews, we asked to talk to those who hired programmers. The companies interpreted this differently, and sent from one to five people to the interviews. After we arrived in a meeting room provided by the informants, we introduced the purpose of the interview and asked that one participant in each interview signed a consent form on behalf of the company. The form explained that we would keep companies and people involved anonymous. It further described the purpose of the research project and how data from the interview would be stored and later deleted. Then we started an audio recording of the interview. Because the interviews were semi-structured we had only planned a few questions in advance including a common first question for all interviews:

> When you are hiring, what do you look for in a recently graduated computer programmer?

The opening question deliberately did not suggest technical or non-technical skills or personal qualifications. The focus of attention was the *recent graduates* in computer programming, as these are the people we as educators are releasing to the industry. This allowed us to follow up interesting threads, while we had a small list of topics we made sure to touch upon. The average length of an interview was 33 minutes, with a range from 24-52 minutes. After the interviews we transcribed the conversation and sent transcripts to the informants for verification and comments.

Analysing the data

We began the analysis [7, Chapter 18] by filtering out parts of the transcripts we found irrelevant. Some of this was saved for future analysis focusing on other topics. Next, we employed an inductive approach to identify themes in the data. When we were satisfied we had identified the most relevant themes, we sorted all text in segments according to each theme. This allowed us to see how prevalent each theme was, as well as getting a more clear idea about what the dataset as a whole implied about each theme.

Limitations

While this method allowed us to answer an open-ended question, it does have some limitations. First of all, the number of companies interviewed is limited. It allowed identifying major themes and important topics, but might not catch all details. Also, because we did not ask detailed questions, a topic not mentioned by the interviewee cannot be excluded as irrelevant, we can only conclude that it was not mentioned. Furthermore, all companies were selected from the same pool - companies attending a career fair at our own campus. They represent a good cross-section of those who hire from our institution, but we may have missed some potential types of employers by this approach. Lastly, the qualitative approach in general makes it hard to weigh the importance of each theme we identify.

4   Findings

The results are split in two categories. While it was tempting to group by *technical* versus *soft* skills, these categories are very difficult to define. Thus we made one section for programming languages and one section for everything else. Although all participants are anonymous, for context we need to reveal some fundamental facts about the companies. To avoid including identifiable information this is necessarily broad.

The companies

To give an indication of size, we use the EU definition of *Micro, Small and Medium Sized Enterprises (SME)* [1, Article 2]. We use the staff head count only and do not include the *financial ceiling* part of their definition. The definition uses 3 categories: *Micro*, from 0 to 9 employees, *small* from 10 to 49, *medium* from 50 to 249. In our study, we label companies with more than 249 employees *large*. We also find it reasonable to say something about the current level of competency regarding

Letter	Size	Business	Programmer ratio	Participants
A	Large	IT Consulting	High	1
B	Medium	Digital agency	Medium	2
C	Large	FinTech	Medium	1
D	Small	Software development	High	3
E	Small	Media agency	Low	1
F	Micro	Design software	High	2
G	Large	IT Consulting	High	5
I	Medium	User experience	High	1
J	Small	Digital agency	Medium	1

Table 1: Overview of the companies.

computer programming. Some of the companies have a large proportion of computer programmers in their workforce. A few of the companies have recently started to see the value of recruiting computer programmers. We call this category *Programmer ratio*, as in the ratio of computer programmers already in the company, and we label the levels *low*, *medium* and *high*. Note that this categorisation is somewhat subjective. The name of the business these companies belong to is based on their own description. *Participants* refer to the number of participants in the interview (in addition to the interviewers). The companies are summarised in table 1. We decided to exclude company H after the interview because they revealed that they themselves did not hire programmers. They did facilitate hiring candidates for multiple start-ups, but we considered this second-hand information and omitted the interview from the data material.

Common themes

The first theme we noticed in the interviews was what we have labelled *enthusiasm and curiosity*. Most companies talked about how they want to hire people who are highly enthusiastic, eager and passionate about technology. Another concept that fit within the same theme is curiosity; employers want people who are interested in learning new skills. Because each technology has a short life-span, and the companies expect to replace these technologies often, they consider it more important that the candidates are good at learning new technologies than that they are good at a particular existing one. In the words of one of our participants:

> *Company G:* You can learn any technology, as long as you have the right personal qualities. You need a genuine interest in technology, you're curious, you're dedicated to the field.

Our informants look for this eagerness particularly in what students do besides their normal coursework. They look for participation in online communities, open source projects and personal projects. One put it rather bluntly:

> *Company A:* If you don't have a side-project, you are probably not among the best.

Somewhat related to curiosity is versatility. Most employers want the people they hire to have a broad set of competencies. They prefer people who know many different programming languages and tools to those who are specialised in a specific

one. For web development, they look for *potential future full-stack developers*, people who can work with both front-end and back-end systems. Beyond the technical, employers also look for other skills relevant in their organisation. Many want their programmers to have an eye for design or understand usability issues. One informant was very ambitious in this respect:

> *Company C:* Not just front-end, but ideally full-stack. Not just development, but design, UX[User eXperience], service design. Experience in *design thinking*. Some competence in different techniques such as lean start-up, agile and dev-ops.

Another theme in many interviews is the ability to work well in a team. Currently, most, if not all, programming happens in teams. Working with other programmers is critical, but it is also important to be able to cooperate with other professions. Employers are not only looking for teamwork skills in general, many also want their candidates to fit well into a particular team.

> *Company F:* I would rather hire someone who fits into the team, and is able to quickly learn our technology, than someone who is very good at the technologies we are using, but doesn't fit into the team.

> *Company J:* It is important for us to make the teams work well together. This is alpha and omega. Collaboration and understanding of other professions than one's own profession. I think that is an important element, which is sometimes forgotten in specialist educations. There is a big focus on subjects for the developer, and not so much focus on what is required of a person in a mix of people with other professions. When creating software, you rely on many different types of skills. To get a team to work well together, that is alpha and omega.

In addition to teamwork skills, many of our participants also look for a more general cultural fit between the company and potential employees. They not only want people who can cooperate in a team, but people who contribute to the feeling of community in the company. What is the candidate interested in outside work? Can they contribute to the right topics around the lunch-table? These questions are even more important for young companies still building their culture.

> *Company F:* We're a small team. We have to all get along. Coming to work should be fun. We need a positive mood and you should feel that you meet friends and are on the same page regarding humour and social preferences. I think this is as important to us as everything else.

Another common topic is the need to understand business requirements. That means that the companies want their programmers to understand the purpose of the product rather than simply fulfilling requirements. Some say this explicitly:

> *Company D:* We want the ability to understand business logic; the ability to see business requirements as much as technical requirements.

Among our informants, many also mention communication skills as a separate topic. Most focus on oral communication. They want people who can both explain technology to non-experts and understand others who describe products and requirement without technical vocabulary. On this, one informant said:

> *Company E:* You need to communicate well and be a translator between technology and marketing.

Because of the wording of our first question, it was clear that we were asking about candidates who had completed a degree with passing grades. While none of our informants claimed formal academic qualifications beyond this as the most important factor, some mentioned it as a relevant criterion early in a hiring process. Some look for master's degrees, others are interested in grades from the bachelor's degree. Even if it is not considered important, it is a criterion that may be checked easily. One large company put a particular emphasis on grades:

> *Company C:* We believe grades indicate total capacity: The combination of intellect and talent with effort. Good grades indicate that both are quite good.

Other informants said nothing about grades and formal resumes, or went as far as describing it as nearly irrelevant.

> *Company F:* I have never displayed a CV in the places I have worked — ever. And I have never cared about a CV if I were to hire someone either. It is completely unimportant to me. I had skimmed through it, but if it says ABC there, it is not what we are looking at.

The last theme we identified in the interviews was professionalism and responsibility. Some companies mentioned it, but it was always secondary to enthusiasm. These informants recognise that you cannot be highly enthusiastic about anything for years in a row, hence it is important to have the ability to go to work and get the job done in a professional manner. And in smaller companies and smaller teams, they need everyone to step up and get the job done, and also inform if something is not right.

> *Company D:* We are a small team - responsibility is crucial. If someone does their job, but doesn't think outside of that scope... We cannot control everything, we cannot have a manager for every developer. We depend on a person being responsible; if he sees something going out of control or not working out we need him to let us know that the result will be bad. If he ignores the problem and does his job he will miss the whole point. The team will have failed.

To give a quick overview of these concepts, and who considered them relevant, we have summarised them in table 2. This shows which companies discussed each concept, and also includes quick mentions.

Some companies also had more unique requirements, which we deem less relevant. All companies talked about programming languages and APIs, at least if we reminded them to say something about technology in addition to personal qualifications.

Tools, programming languages and APIs

These are the skills that are unambiguously technical. Each company has its own set of technologies for the software development work, and naturally they prefer people who know those technologies. But, as we have mentioned before, it was more

Concept	A	B	C	D	E	F	G	I	K
Professionalism				✓		✓	✓		
Cultural fit	·	✓			✓	✓	✓	✓	
Communication skills		✓		✓	✓	✓	·		
Teamwork	·	·		✓	✓	✓	✓		✓
Understanding business requirements			✓	·	✓	✓		✓	✓
Enthusiasm and curiosity	✓	✓		✓	✓	✓	✓	✓	
Versatility, broad competencies		✓	✓	✓		✓	✓		✓
Formal academic qualifications	✓		✓	✓			·		

Table 2: Summary of which concepts were discussed. A check-mark (✓) represents a concept that was thoroughly discussed during the interview, while a dot (·) represents an in-passing mention of the concept.

important that they can convey an interest in learning new skills and technologies. In many interviews we had to ask directly about technical skills.

Every company we talked to at least mentioned *JavaScript* and its ever expanding ecosystem. For many it is a core technology, but for others it is an interesting area of expansion. *Node.js*, *React*, *Angular* were all mentioned repeatedly. Other web technologies such as HTML and PHP are also popular among our respondents. There seems to be a general opinion among our informants that recent graduates from Norwegian IT education do not know much JavaScript.

> *Company I:* In general, they lack a lot on the JavaScript part. They often have quite a broad education. That is at least the impression. They have done a little in C, and a little in Python, and have experienced things like databases. So maybe JavaScript was just an elective at best. Maybe not even that. (...) We understand that not the entire education can be about web development, but we get a little scared when we see that they have worked with 10 year old technology. Then it might be better not to have worked with it at all. (...) But I find that they do not know what we need, in a way. In that case, we must invest in them.

> *Company B:* Of skills, JavaScript is the most important thing now, absolutely. The term "full stack developer" has moved from describing those who mastered the entire LAMP stack, to become pure JavaScript developer. Now you can do both front-end and back-end in JavaScript.

However, all companies involved in our research have moved completely to the web. Traditional programming languages such as Java and C# are still relevant, though only a few of our participants mentioned them.

5 Discussion

Our findings have some unique features, such as the location. We have not found any previous studies from Norway. However, these results are comparable to previous work. We have investigated how our results fit into employability models, and compared the findings to previous work.

Employability

In McQuids employability model [6], all our findings fall within the category *individual factors*. We discuss what a company interested in recruiting is looking for in a candidate searching for a job. And therefore *external factors* and *personal circumstances* are not relevant. Within *individual factors*, we find a clear overlap between the employability framework and our findings, especially within the subcategory *employability skills and attributes*. Social skills, proactivity, communication skills, team working skills and academic qualifications are just some examples of overlap within this category. Factors not covered by our informants are related to work experience and current employment status, a natural consequence of our explicit focus on recently graduated candidates.

Job seeking factors are also present in some of our interviews. Although only mentioned by a few of our informants, some recruiters emphasise interview skills, and how the candidates represent themselves in the interview situation. A more common theme among our informants was *effective use of informal social networks*, another factor within *job seeking*. They like to see digital footprints of relevant candidate activity, such as code in GitHub. We did also get some data on how they are evaluating the candidates and where they find them, but this is outside the scope of this paper.

There were individual factors within the framework not mentioned by our informants: *Demographic characteristics*, *Health and well-being* and *adaptability and mobility*. The latter factor may be explained by the fact that all interviews took place in Oslo, the capital of Norway, with the by far largest population and job marked. The only demographic factor mentioned was one company hoping to recruit more women.

Comparison with earlier studies

The literature review by Radermacher [8] defined *Written communication*, *Oral Communication*, *Project Management*, *Software Tools* and *Testing* as the most identified knowledge deficiencies. Communication skills are important for the companies we talked to also, both internally and externally. They do not specify written or oral communication explicitly, although we have the impression they favour oral communication. They emphasise ability to communicate with other people, not necessarily with the same background as themselves.

> *Company G:* Everything we do is about properly understand other people's needs and problems and translate this into code.

An example from Radermacher is Hagan [2] who found that employers who had recently hired ICT graduates in Australia mentioned *ability to communicate with clients, and written communication skills* as areas where there were room for improvement. And within oral communication, Tesch et al. [12] ranked the ability to listen even higher than written communication skills for employers hiring recent graduates. However, these candidates were within the field of IS, not Programming.

Project management skills, which were prominent in the literature review, were not mentioned in our interviews. This could be explained by the fact that the literature review had a broader scope with CS, IS and IT candidates. Although programmers might end up with project management, the recruiters we talked to did not have this in mind for graduates.

When comparing our results to Radermacher's literature review, we should keep in mind a major difference. In our study, we ask what the industry is looking for. Radermacher is looking for the most identified knowledge deficiencies. Hence, something might be very important for an employer, but as long as the candidates fulfil the specific requirement, there is no deficiency. So when we, in the review, find *personal skills* rated no higher than the 10th most identified knowledge deficiency, it could still be critical and in sync with our findings. If we look further into the papers within the review and look for examples, we find that Lee, et al. [3] describe personal skills, such as motivation, as something considered more important for recruiters than (IS) students. McGill [4] investigated expectation gaps between the industry and game development curriculum at post-secondary institutions in USA and Canada. She found that industry emphasised *attitude/disposition* significantly more than what is emphasised in the curriculum. But again, both these examples look for some kind of discrepancy. We only describe what the industry is looking for.

Team skills is one of the *soft skills* that is often described as an industry need in existing research, and also in our results. We have not found the same clear description of the ability to fit into a company culture. One possibility is that this is a result of the size of the companies involved. In our study we have a wide range of company sizes, and we find that *fitting in* is of major importance for smaller companies. It could be that our inclusion of micro companies introduces another type of result. Another possible interpretation is that Norwegian workplace culture is different from the cultures studied in previous work. Existing research is mainly from USA and Australia as well as a few countries in Europe. As one of our informants explicitly described: Terminating a work contract in Norway is difficult compared to other countries. So, if a micro company wants to get rid of an employee who did not fit in, it might be very difficult.

6   Conclusion

Despite a limited dataset, some clear conclusions emerged from this work partly because some similarities in the answers were quite striking. Most importantly, all participants valued non-technical skills highly. Between *enthusiasm and curiosity* and the two somewhat overlapping categories *teamwork* and *cultural fit* we find what seemed most important to all the companies.

Some differences also emerge. Larger companies are more likely to focus on academic achievements beyond a bachelor's degree. From the data this seems to be mostly about efficiency in the hiring process. Academic qualifications are relatively quick to verify, and can thus speed up the task of working through a large stack of applications. However, when the stack is cut down to a reasonable size it seems even the large companies look to other qualities when making their final decision. Small companies on the other hand start out more casually, and use a more informal interview process to find out if the candidate is socially suitable for the existing team. Only later do they go into details regarding technical skills and knowledge.

We can also make a distinction regarding the proportion of programmers already working in the company. For companies with very little current competence in programming, priorities are different. Companies who only recently realised that they need programmers are looking for people who can work directly with other professions, and thus value the ability of programmers to understand business

requirements.

Regarding technical skills, it seems more important that the candidates know one or a few programming languages well, than that they know the exact ones used in the company hiring. However, when pressed about particular technologies they are interested in, all answered that they were interested in JavaScript and its ecosystem.

The original incentive to conduct this study was our jobs as educators. Knowing what employers are looking for is good, however what we found do not lend itself trivially to teaching. So what can educators do? First of all, enthusiasm may not be teachable, but it is contagious. If educators show enthusiasm, students might catch some. Further, we should encourage students to look for their own motivation. Some are motivated by common assignments, others might need to look further to find their motivation. And some students might benefit from a variety of course deliveries focusing on different forms of active learning.

Culture is in a similar position; by working to build culture and community among our students, we prepare them for a future where they rely upon such skills. Somewhat counter-intuitively, both culture and enthusiasm could be improved by widening focus, from a narrow focus on technical deliverables to allowing more exploration and play.

Teamwork is somewhere between a technical and a soft skill. There are many techniques which can be taught, but there are also aspects that are more personal. Both can probably be improved by practice. All institutions of higher education require that their students work in teams to some degree, but we should always ask if we can do it more, or better.

Deeply intertwined with the question of *who* companies are looking for is *how* they are looking. That is, how are they searching for potential employees as well as how are they identifying the qualities they are looking for in a potential employee. In the course of this research, we have indications companies are experimenting with alternatives to both the traditional job advertisement as well as the traditional interview. Following up this lead might lead to further insights.

In the future, we would also like to address some of the limitations of this work. The themes and categories identified in the interviews map well to a questionnaire rating these qualities in terms of importance. By inviting a larger number of companies to answer, we may generate quantitative data and identify which qualities are most important. This will also allow us to include a broader selection of companies.

Furthermore, we could follow up with a similar approach targeted at a different pool of companies. We could for example ask the same questions of high tech manufacturing companies or public institutions, which were not included in this research. Inviting companies targeting an educational institution with a very different profile might generate new insights.

Lastly, it would be interesting to know more about what educators actually teach, and compare and contrast that with our findings. This would allow us to answer questions about how updated and *in touch* educators are with industry.

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