

AI Driven Competency Development at the Threshold of Working Life

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Abstract

In information technology and communication (ITC) industry the technology advances are unexpected and moving mysterious ways causing significant mismatch between demand and supply in labour market. To some extent the mismatch is due to emergence of new technologies replacing the old ones. But on other hand, it is also due to lack of capability and capacity of educational system to provide up to date and spot on graduates.

This paper presents AI driven competency development service that provides students or persons already in labour market a way to match one's competencies against existing or future competency requirements, and thus being valid employee or applicant. On the other hand, the service discussed in the paper is also a tool for giving input for forecasting future labour needs. Further, the service also serves as mid- and long-range planning apparatus for education provider when making decisions on what academic modules best serve the needs of society and individuals. The paper presents data collected in pilots spring 2020 where the university students were given the opportunity to test the AI service tool. According to the results, the service discussed in this paper could help the users to identify better their skills, creating an overall picture of competence as well as mapping out future opportunities.

Keywords

labour market mismatch, learning analytics, artificial intelligence

1. Introduction

Extensive use of educational technology, especially digital learning environments, digital curricula, and digital managerial systems have brought about need for analytics to monitor the use of the learning environments, the learning itself, and most important the individual competency development. Technology that is more sophisticated is provided by edtech industry to better serve teachers, individual as end users and industry as primary customer. There are four main trends in enhancing teaching and learning practices. On micro level (learning event), analytics is for assessment of achieving certain goals. On meso level (subject level), i.e. implementing the curricula analytics are for achievements, adaptivity and general assessment. On macro level analytics is for promoting management by knowledge, risk assessment and measuring KPI's on different levels. The fourth trend is compliance, privacy, and security issues on the level mentioned and can be considered as the primary prerequisite for utilizing learning analytics. (Okkonen et al. 2020a.) This paper contributes practical work in competency development


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micro-level and macro-level.

In the economy the technology advances are unexpected and moving mysterious ways causing significant mismatch between demand and supply in labour market. To some extent the mismatch is due to emergence of new technologies replacing the old ones. On the other hand, it is also due to lack of capability and capacity of educational system to provide up to date and spot on graduates. Educational systems are skewed by many things as financing and teaching staff. According to the report of National Audit Office of Finland (2011) (Valtiontalouden tarkastusvirasto), decisions on the allocation of training are based too much on existing structures, such as human resources and interest of young persons. The composition of the teaching staff and the application of students also have a strong guiding effect on the kind of education that educational institutions provide in practice. In this paper presented service offers an opportunity for developing competencies from a perspective of business needs. As stated in Brammer and Goodrich (2014) the solution is competency-based education, i.e. instead of degrees future employers are seeking for skills to put into action.

There are several attempts to bridge the gap between supply and demand, yet both public and private sector had at least partially failed in the task. Universities are on the edge of education paradigm shift as labour market is not interested graduates with 3-year bachelor or 5-year master degrees, but they are actively seeking competencies to meet changing needs. Moreover, the shift from studies and labor is made more flexible and therefore also employees are actively seeking updates for their skillsets. However, companies utilize skills data in various ways. Some companies have woken up to the situation that future skills needs have also to be clarified. A survey for companies shows that two out of three respondents represent the company's identified future skills needs well. Skills data is collected and stored by 40 % of companies, especially service and industrial companies as well as large companies. More than half of companies participated in the survey, actively or occasionally collaborates with educational institutions. (Sitra 2021). So there is an clear interest in educational cooperation but the relevant form of cooperation is not necessarily acknowledged.

Competence modeling can be started using competence ontologies. At European Union work has been done on skills and skills mismatch. The basis for the work has begun with ESCO (European Skills, Competences, Qualifications and Occupations) which is multilingual classification of Skills, Competences and Occupations. It can be exploited as a dictionary, describing, identifying and classifying professional occupations and skills relevant for the EU labour market as well as education and training. (European Commission 2019). Instead, European Economic and Social Committee (2018) divides the different causes of mismatches, like slow adaptability of the education systems and poor labour mobility. The European Parliament has also carried out a study distinguishing between qualitative and quantitative labour market shortages (Reymen et al. 2015). All these theoretical references focus on creating a theoretical basis for the competencies but not actually provide tools on how competence could be maintained with existing technological solutions. As Davenport (2018) states AI driven services open more vistas than analyzing existing and predesignated data.

Finnish Government (2020) states in its publication of Strategy for Lifelong Guidance 2020–2023 that digital services that support guidance are being developed from each other detached although in Finland there is comprehensive technological infrastructure and equipment for digital services related to career planning and guidance. Cooperation between different stakehold-

ers is therefore needed. Microcompetencies enables this by bringing companies closer to the university and thus cooperation is easier for both companies and students.

The gaps in training supply also causes unexpected problems. Competence development is challenged by the fact that there are gaps in training supply, especially in the case of shorter training options that meet the needs of working life, and the current supply is not properly targeted. This will lead, among other things, to the use of free degree education as continuing learning. (Toni & Ylikännö 2021). This will also cause a notch in the university budget if degree programs are used for continuous learning and other alternatives must be invented. Microcompetencies aims to provide both for already in working life persons and for graduate students possibilities to develop their professional competencies. Thus, it also seeks to save the university budget.

The need for service such as Microcompetencies has already been identified (Okkonen et al. 2020b). Ministry of Employment and the Economy (2019) (Työ- ja elinkeinoministeriö) states in its press release that at the same time Finland is known as a leading country in artificial intelligence, one of the biggest bottlenecks arises from the fact that employees and job vacancies do not meet. This aim of this paper is present a novel AI driven modus operandi that provides students or persons already in labor market a way to match one's competencies against existing or future competency requirements, and thus being valid employee or applicant (Ketamo et al 2019). The paper presents the concept of technology and functionalities as well as roadmap for developing and implementing the service. The presented concept is heuristically proofed in expert evaluation and tested in with student pilot process. Moreover, the heart of the service has been technically and functionally tested in several cases. We propose the data and results of the pilot process. At the conclusion the paper presents the benefits of the service.

On the other hand, the service discussed in the paper is also tool for giving input for forecasting future labor needs. And the third, the service also serves as mid- and long-range planning apparatus for education provider when making decisions on what academic modules best serve the needs of society and individuals.

The paper also raises discussion on extensive curricula based schemes on developing strategic knowledge. The validation of the service is issue of several questions. The first one is that is a (simple) market test sufficient way to validate the concept? As brought about, the technical issues are solved and now the implementation is more about integration and setting the operational limits. This tends to suggest that concept is already validated by a market test and assessment should go further.

2. The service

Microcompetencies uses open skills data collected from various public online services and archives like job advertisements and companies web sites. After the user has added educational or/and working information (like CV), the service models a word list of user's skills and competencies utilizing artificial intelligence. The service can also recommend courses to its users based on these skills word lists. Thus, the service can contribute to the development and employment of its users. The service has different features and serves various stakeholders like companies, students and education providers. It can be used only for recognizing own skills

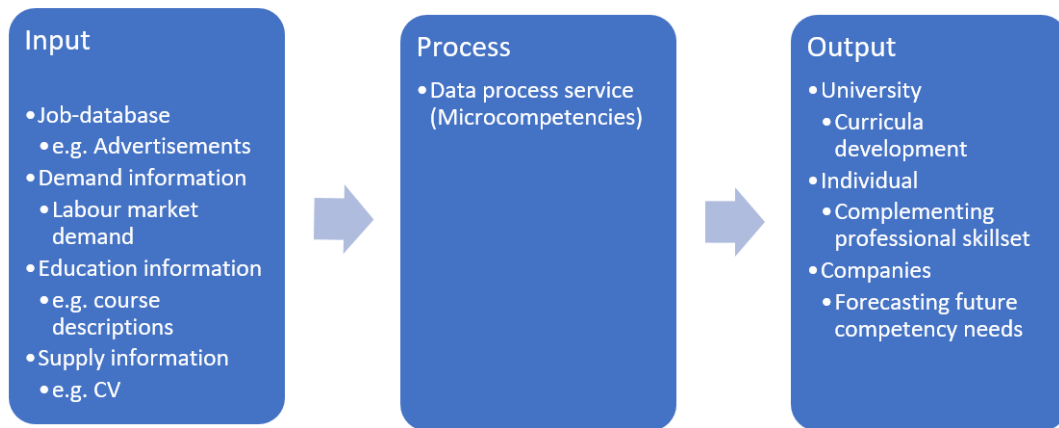


Figure 1: Outline of the service

and competencies or broader for recommending courses which could contribute to achieve the needed skills. The service utilizes analytical information and artificial intelligence driven market analysis for producing skill maps and course recommendations. The service consists of three parts. The first part is input including all the data which have been mined or added by the user, like job-database or education information. The second layer is process. the actual service utilizing its analytical capacity and seeking for personal development scheme. The third part comprises output layer including all the stakeholders benefiting the service. University can develop its curricula for more competence point of view. At the individual stage the student can complement professional skillset. In turn, companies get better and more systematic forecasting future competency needs Figure 1 summarises the key functionalities and relations.

The service utilizes machine learning and semantic calculation for creating a skills map of the user. Most of the natural language processing is currently done with machine learning algorithms focusing on multidimensional classification and/or grouping. That makes such applications narrow, dependent on training sets, and so makes cognitive reasoning, predictive analytics and explainable decision making very challenging. Furthermore, the privacy/security concerns related to black boxes are enormous.

Digital Twins are digital replicas on e.g. objects, entities or knowledge. Idea of Digital Twins raises from industry, but they have been applied in multiple contexts outside industry. Digital Twins serves as prepared and cleaned data layer that enables cognitive, predictive and explainable operations for next layer algorithms. In this study, the strengths of unsupervised learning and reinforcement learning is brought together in order to build language based digital twins on knowledge domains. Digital Twins serves as prepared and cleaned data layer that enables cognitive, predictive and explainable operations for next layer algorithms.

There are at least two major issue to be contemplated. The first issue is the ethical considerations about using the service, and the second one is the validation of the service. The ethical considerations are issue on the perspective of individuals, and on the other hand on the perspective of the labor policy. The individual perspective is about privacy and security

as well as maintaining control on individual. The privacy is quite easily tackled if there is responsible service provider and sufficient guidelines to use the services. The security is issue as it is with any data repository containing personal information. The control issue is the most complex one, since using the service individual surrenders control, at least to some extent. The control on self-regulation and decision power on own career is in flux. Moreover, the revealed competency gaps are efficiently recognized and communicated also to employer. The labor policy perspective is not straightforward either. By using service to analyze the trends and setting development agendas it makes decision making easier, yet it might make long range planning more difficult as it might attract to offer academic modules that serve short-term needs. However, this is the issue of sound judgement and therefore beyond the scope of the development and research endeavour.

3. The data

The data of this research was collected in spring 2020. The purpose was to organize data collection in physical piloting but due to the Corona, it was organized completely remotely as three virtual meetings. 17 students from three different disciplines participated in this study. All the three different disciplines had own virtual meetings. The majority of participants (59 %) had completed at least 50% of the studies but had not yet graduated. Among the participants, most students had at least somewhat working experience either 1-4 years (35 %) or 4-8 years (41 %).

The aim of the virtual meetings was to co-development and get ideas and comments to support further development. The students tested the tool and the testing was incorporated into part of the career guidance process aimed at finding out two main points. Firstly, does the tool help they to better identify their own skills. And secondly, is the tool bringing added value to students' career planning and help them to find potential job opportunities.

The pilot process was developed and facilitated by three guidance and counselling professionals and two continuous learning professionals. During the pilot the students made knowledge-based CV, first before and then after testing Microcompetencies. The students were able to try out, for example, words lists of their competence that artificial intelligence produced after adding educational information and CV. Feedback was collected from students in writing (SurveyTool) and verbally (notes) during each of the three virtual meetings.

4. Results

Next, both qualitative and quantitative results of the study will be presented. This allows us to ask the data whether the qualitative results obtained may be explained by background variables, such as the stage of the student's studies. All the results are collected from surveys that students completed at different stages of the pilot.

The students were asked in advance, do they believe that the Microcompetencies tool is useful for identifying one's own skills and mapping out future job opportunities. All the students considered the tool could be useful at least to some extent.

The major of students felt that word lists of skills made by Microcompetencies were useful, at least to the extent that it helps to create knowledge-based CV. It gave the basis on which to start creating CV. Some students also benefited to the extent that it also broadened their thinking about potential employers. Although some of students felt the words were already familiar to themselves, it could however create an overall picture of their own competence, as evidenced by the following feedback from one student: *“However, it was nice to see them all in one list, from which it was perhaps easier to see your own expertise as a whole and thus combine different things.”*

Students experienced that Microcompetencies can help to write to words their competence. It can also open their eyes to new areas or employers. The service is capable for creating an overall picture of competence.

The students were asked if creating the knowledge-based CV was easy or difficult. There were no students completely disagreed or completely agreed that but there was a lot of variation among the students. The same phenomenon was repeated when asked whether the competence list made by Microcompetence helped them to create the knowledge-based CV.

5. Summary of results

According to the results of this pilot, it is reasonable to describe that Microcompetencies is a helpful tool to identify skills, see a big picture and even realize new potential sectors and employers. The simplified process graph is illustrated in the following figure.

Double-headed arrows describe relationships of the findings to each other, so all the three key findings are connected to each other. For instance, when a student can identify own skills better with the application, he or she can more easily create an overall picture of competence and thus also makes mapping out future opportunities easier. All the benefits of the service are mutually supportive.

6. Discussion

The results presented above implicate that students experienced the benefits of Microcompetencies. At this point, the most benefits concerned on precisely that the service made it easier to perceive larger entities. In some cases, certain skills may also be taken for granted even if they are significant skills. So the service can also be useful in identifying such skills and through it helps to develop own competence development. Background variables, such as working experience or stage of studies, did not appear to be affect application utility so it can be recommended to anyone.

Microcompetencies may also help students to open up their own thoughts a little more broadly. They can identify new fields or potential employers. Particularly in the areas of broader entities, the perspective of potential employers can be too narrow. The service can help expand these views. Perception of larger entities is an important skill in today's working life as employees are increasingly expected different skills. The students felt that it was difficult to comprehend their competence, but Microcompetencies can be helpful in creating the overall picture of competence.

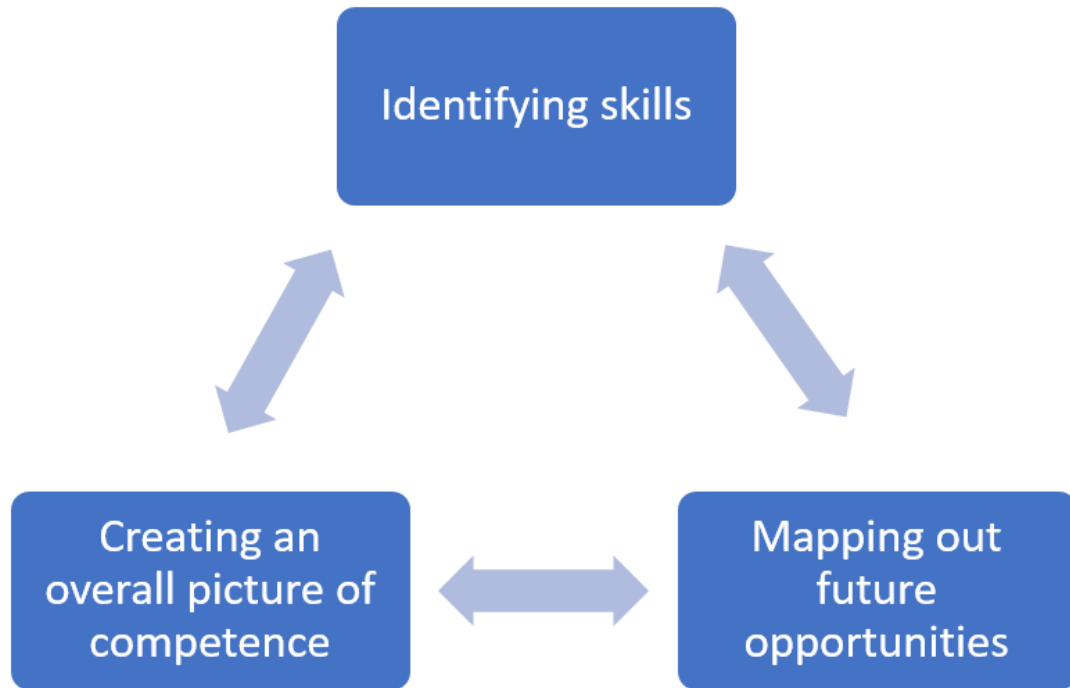


Figure 2: Simplified process graph

Some students experienced more benefits than others so there may be differences in different field of studies as only three different field of studies were presented on this pilot. Traditionally perhaps in technical fields it can be easier to identify one's own skills than even in the social sciences.

7. Conclusions

When assessing the results one should take into account that the results are context sensitive as presenting only a part of field of studies in a Finnish University. As is well known, there are also differences in different field of studies. However, based on consensus among the participants the service per se has value. As stated previously the student at the threshold of working life have numerous options available, yet limited experience and capability to weight those. As the service is about to help correspondence to labour market demand AI driven service does the work.

It is also important to notice that the purpose of the piloting was not to evaluate the functionalities of the application but study the idea of the service. The goal was neither to carry out research but co-create and generate input for further development. Originally it was intended to carry out face-to-face piloting, but due to the pandemic it had to organize online and this might have affected on results. The next phase is put the service under more through examination and both utility as well as user experience should be investigated.

The service produces the skill map based on the skill needs by companies. However, it is good to remember that those skill needs may be inconsistent with the university's curricula. In that case, a solution should be found that benefits all the stakeholders. It is also good to note that all the skills can't be achieved in one course either. As the organizer of the education, the university must assess how the user could achieve the missing skill or at least be closer to achieving the skill.

The data wasn't collected for research purpose so the data contained only a small number of students. Thus, the results can only provide an indication of the use of the service and its usefulness.

We present that the service like Microcompetencies can be a useful tool for those entering the labor market as well as for those who already have a longer career. Self-development and continuous learning have been trendy for a long time, so the service is the exact instrument for this need. It brings the competence development closer the user and makes it concrete when proposing suitable study modules. By choosing the recommended study modules, the student can promote his or her competence towards the requirements of working life. The service provides critical insight for decision making regarding choices during the studies. As future employment is goal for the graduates it makes the path at least somewhat more visible.

Further research is needed among the employed persons who are willing to develop their own skills as well as their employee for to see evident competency gaps within the organization. The results would differ somewhat from the students who participated in this pilot.

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